ABSTRACT

Title of dissertation: **CONTAMINANTS IN THE ATMOSPHERE OF THE DELMARVA PENINSULA: IMPACT OF LOCAL ACTIVITIES AND ATMOSPHERIC TRANSPORT**

Anubha Goel, Doctor of Philosophy, 2007

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Upper Delmarva Peninsula (within the Chesapeake Bay watershed), where the land use is predominantly agricultural, may be a significant source of pesticides (contributors in the declining water quality and bio-diversity of associated wetlands of the Chesapeake Bay) to the region. Although the Peninsula is predicted to be receiving significant inputs of herbicides through atmospheric deposition, the extent of local or regional atmospheric transport and deposition of pesticides to this area is poorly understood. The goal of this research was to determine the atmospheric levels and estimate deposition flux of pesticides in the Upper Delmarva Peninsula. This was accomplished by collecting weekly air samples (n=271) and event based rain samples (n=489) from three locations in the region (Dover and Lewes, DE; Cambridge, MD) for the period 2000-2003. The samples were analyzed for the presence of 34 pesticides (19 current use (CUPs), 15 historical (HUPs)) and 4 congeners of penta-BDE (PBDEs) using gas chromatograph-mass spectrometry (GC-MS). Statistically analyzed data was used to evaluate factors impacting phase distribution and the contribution of wet deposition to the levels in Chesapeake Bay. The more persistent insecticides and fungicides occur ubiquitously while application on corn influences herbicide occurrence and levels. Atmospheric CUP levels are driven by regional agricultural activity. CUPs do not exist in equilibrium and local meteorological conditions (like high relative humidity) influence phase distribution. The wet deposition flux of insecticide and fungicide is dependent on the total rainfall amount during the sampling period while timing and frequency relative to application on corn impacts herbicide flux. Levels in rainwater of some pesticides (endosulfans, chlorothalonil, diazinon etc.) were high enough to be of concern for the biota associated with the region's water bodies and associated wetlands and reveals that atmospheric deposition arising out of short range atmospheric transport can result in significant pesticide input to non-target areas. HUP atmospheric levels are lower than in the Great Lakes and are decreasing at a faster rate. This study reveals that spray irrigation of treated wastewater is an unknown source of toxic PBDEs to the atmosphere and can result in elevated levels at locations downwind of the irrigation field.

CONTAMINANTS IN THE ATMOSPHERE OF THE DELMARVA PENINSULA: IMPACT OF LOCAL ACTIVITIES AND ATMOSPHERIC TRANSPORT

By

Anubha Goel

Dissertation submitted to the Faculty of the Graduate School of the
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of the requirements for the degree of
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Advisory Committee:

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PREFACE

Two roads diverged in a yellow wood,
And sorry I could not travel both
And be one traveler, long I stood
And looked down one as far as I could
To where it bent in the undergrowth;

Then took the other, as just as fair,
And having perhaps the better claim,
Because it was grassy and wanted wear;
Though as for that the passing there
Had worn them really about the same,

And both that morning equally lay
In leaves no step had trodden black.
Oh, I kept the first for another day!
Yet knowing how way leads on to way,
I doubted if I should ever come back.

I shall be telling this with a sigh
Somewhere ages and ages hence:
Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference.

DEDICATION

Ma – this is for you

You were my strength when I was weak
You were my eyes when I couldn’t see
You gave me faith cause you believed
I am everything I am because you loved me.

ACKNOWLEDGEMENTS

As with all research programs, mine has been a roller coaster ride with the regular ups and downs. The ride would not have ended well and in time if it had not been supported and directed well. First, I want to thank my advisors Alba Torrents at UMD and Laura McConnell at USDA who came up with the idea for this research and have seen it through. Alba got me interested in the project and was always present to guide me, share my frustrations, both academic and personal, and give me the strength to keep moving on. Laura taught me the analytical aspect of work, right from how to handle the GC-MS and other instruments, managing the sample collection efforts and how to get things done in time and done well. Her door was always open and I could barge in any time to discuss the interesting findings and why-is-this-the-way-it-is. They have been there through the good and tough times.

I thank my research committee members George Helz, Allen Davis and Kay Brubaker for taking the time to read and comment on my work. Their comments helped me review and take a closer look at some interesting aspects of my research.

I acknowledge the monetary support from Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) for conducting this study for monitoring pesticides in the air of the Delmarva Peninsula. Partial funding for this project also came from the Maryland Water Resources Research Center.

The research worked well through the co-operation and help of the people at different educational and government agencies. I thank Donald Merritt, Joseph Scudlark and Robert Scarborough for hosting sample collection stations at Horn Point Laboratory, Lewes and Dover, Delaware, respectively. I express my gratitude to the site operators Stephanie Tobash, Marie Freeman, Jennifer Clark, Doug Dinkle, and Mike Mensinger for their conscientious sampling efforts. I am grateful to Gabriella Morato and James Skagge for their help in sample extraction. Interesting conversations with them while working made the time go by fast. I am thankful to Staci Simonich (Oregon State University) for agreeing to test some of our samples for the occurrence of some PBDEs and to Toby

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Special thanks with love and respect to my family. My parents have always supported me and given me the freedom to choose my own path. Through the toughest time in my life, when a car accident completely shattered me and made me start life again from square one. Their love, support and belief in me gave me the strength to accept challenges and start life anew. There is a long list of friends and family I can't thank enough for support but a few people stand out. Aunt Niti and Uncle Sanjay are role models for their take on life – they have taught me that taking care of the present takes care of the future. Brother Abhinav's realism teaches me to move ahead with strength and focus on the future and to let the past rest in peace. Also special thanks, in this respect, to my advisors Alba and Laura for believing in my capabilities more than I did. The list of friends is long and endless and they made my life enjoyable. They are An-ni, Avanti, Brinda, Mey, Mridula, Soumya, Sonam, Jorge, Tanay, Milind, Nitin, Ankush………to name just a few. Those who have not been named here I acknowledge your support which enabled me to restore my life and faith in myself and I could realize my dream.

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LIST OF FREQUENT ABBREVIATIONS

BARC	Beltsville Agricultural Research Center
BDL	below detection limits
BF	Back Filter
CBOS	Chesapeake Bay Observation System
CC	Clausius-Clapeyron equation
CEAT	Deisopropylatrazine
CHTHNL	chlorothalonil
CIAT	Desethylatrazine
CICEET	Cooperative Institute for Coastal and Estuarine Environmental Technology
CLRPS	chlorpyrifos
CUP	current use pesticide
DCM	Dichloromethane
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DV	Dover, Delaware
FF	Front Filter
FID	Flame ionization detector
GC	Gas chromatograph
GFF	Glass fiber filter
HCH	Hexachlorocyclohexane
HEPT	Heptachlor
HEPTX	Heptachlor epoxide
HP	Horn Point Lab, Cambridge, Maryland
HUP	historical use pesticide
IADN	Integrated atmospheric deposition network
J-P	Junge-Pankow
LD	Lewes, Delaware
LOQ	Limit of Quantitation
LRT	Long-range transport
MDL	Method detection limit
MS	Mass spectrometer
MWRRC	Maryland Water Resources Research Center

NERR	National Estuarine Research Reserves
OC	Organochlorine
OH	hydroxyl radical
OP	organophosphate
PAH	Polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	Polychlorinated biphenyl
PUF	Polyurethane Foam
RH	Relative humidity
SAS	Statistical Analysis Software
SVOC	Semi-volatile organic compound
TP	transformation product
TSP	Total suspended particles
U.S.	United States of America
USDA	United States Department of Agriculture
USEPA / EPA	United States Environmental Protection Agency
V/P	Vapor/Particle
WD	wind direction
WR	washout ratio
WS	wind speed

CHAPTER 1 - INTRODUCTION

1.1 SOURCES OF TOXIC CHEMICALS IN AGRICULTURAL ENVIRONMENTS

Chemicals used in agriculture to destroy insects, fungi, bacteria, pests, weeds (such as pesticides, herbicides, fungicides), and to regulate plant growth (such as fertilizers) are collectively referred to as agrochemicals and are among the most widely used organic chemicals throughout the world. The three main methods of pest control (commonly referred to as pesticides, the biggest group of agrochemicals) are herbicides, insecticides and fungicides. In U.S. alone, a little more than 900 million pounds of active pesticide ingredients are purchased annually for agricultural use (Donaldson et al. 2002). Those pesticides that are currently in use are referred to as current use pesticides (CUPs), while those whose use has been discontinued as referred to as historical use pesticides (HUPs).

The chief source of occurrence of pesticides in the environment is their usage in agricultural areas. Pesticides are applied at the soil (pre-emergence) and crop (post-emergence) surfaces using various application methods. Pesticides can be injected into the soil for use as a fumigant or sprayed onto the soil surface, possibly followed by its incorporation into the soil top layer. After application, the pesticide can be released to the atmosphere, degraded in the soil, leached to the ground water or removed in runoff (Figure 1-1).

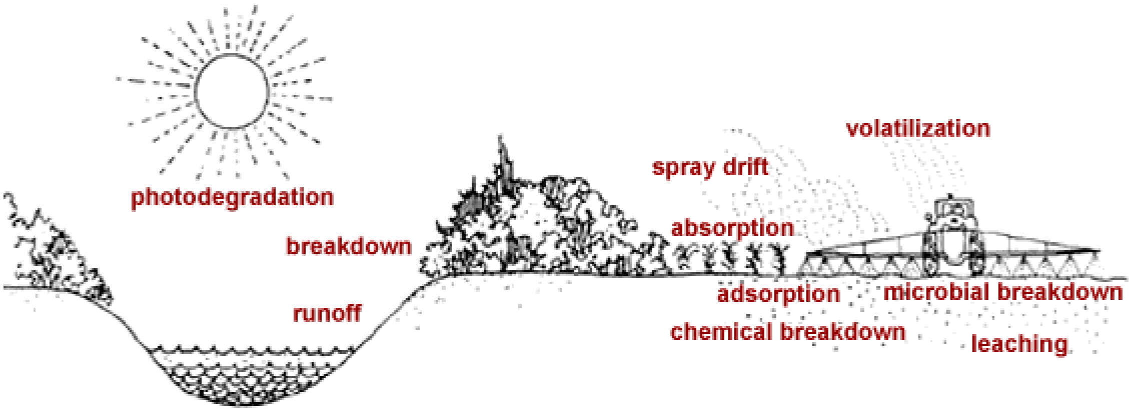

FIGURE 1-1 Post application behavior of pesticides

While a significant number of studies have been conducted to assess the environmental fate of pesticides in the soil environment and their potential for leakage into groundwater, less is know with respect to their fate in the atmosphere.

Atmospheric fate of pesticides and their possible effects in ecosystems beyond the immediate surrounding of the application site are not actively considered in currently used regulatory risk assessment schemes. Concern with respect to atmospheric transport and subsequent deposition of pesticides in non-target areas is however growing.

Agricultural pesticides are released to the atmosphere by spray drift (during application), post application volatilization and wind erosion of soil (Majewski and Capel 1995; Bidleman 1999). The rate and extent of emission during application depends primarily on the application method, the formulation and environmental conditions, whereas the emission after application depends primarily on the properties of the pesticide, soils, crops and environmental conditions (Van Den Berg et al. 1999). Most of the pesticide volatilization takes place shortly after application. For example, 95% of the cumulative metolachlor flux has been reported to have occurred during the first 12 h after application (Prueger et al. 1999). The volatilization losses of triazines have been reported as much smaller than disappearance by chemical degradation (Glotfelty et al. 1989). Most pesticides (along with PAHs and polychlorinated biphenyls or PCBs) are semi-volatile organic compounds (SVOCs) (Bidleman 1988; Cotham and Bidleman 1992; Simcik et al. 2000). Their intermediate volatilities (vapor pressures in the range of 10^{-1}-10^{-6} Pa, Cotham and Bidleman, 1992) allow them to be present in both the gas and the particulate phase. The phase in which these compounds are present in the atmosphere will affect their deposition, chemical reactions, long-range transport (LRT), and human and ecosystem health effects. Greenberg et al. (1993) concluded that most of the mutagenic activity of extracts of airborne particulate matter is associated with neutral organic substances more polar than PAHs and nitro-PAHs (a category, which could include pesticides). Hence, it is important to better understand the phase distribution of pesticides and the influence of different environmental conditions on it to predict the environmental fate of these compounds.

Once toxic chemicals enter the atmosphere (through volatilization etc.) they undergo several processes, advection, diffusion, partitioning onto surfaces (Figure 1-1, transformation etc. The gaseous and particle phase pesticides are removed from the atmosphere by dry and wet deposition and by (photo) chemical degradation. Once deposited to the soil or vegetation, the pesticide distributes over the gas, water and organic matter or lipid phases in the soil and vegetation. In water, the pesticide may also adsorb to suspended material and deposit to the sediment. They may also undergo degradation/transformation in the water column. Dependent on the gas concentrations of the various compartments the pesticide may revolatilize again and be transported further via the atmosphere.

Pesticides are effectively scavenged from the atmosphere by rainfall (Simcik et al. 2000; Karlsson 2000). Pesticides have frequently been detected in precipitation (including snow and fog) throughout the world (Glotfelty et al. 1987; Polkowska et al. 2000; Karlsson et al. 2000; Chernyak et al. 1996; Bidleman 1999; Goolsby et al. 1997; Hoff et al. 1994). The U.S. Geological Survey (Majewski 1995) has gathered the results from 132 studies of pesticide findings in air and in precipitation in the United States during 30 years in a summary report. The studies show that most of the pesticides studied have been detected in rain or air, but many that are used have never been studied. Pesticides have been detected in the atmosphere in all areas of the nation sampled and the concentrations in air and rain are most affected by use and resistance to environmental degradation. The highest atmospheric concentrations of pesticides occur seasonally in high-use areas when applications are greatest. Low levels of long-lived pesticides are present in the atmosphere throughout the year. Insecticides have been most commonly detected in air whereas triazine and acetanilide herbicides have dominated the detections in rainfall (Figure 1-2). Concentrations in precipitation depend not only upon the amount of pesticides present in the atmosphere, but also on the amount, intensity, and timing of rainfall. The highest concentrations are observed during light rainfall events, especially after extended dry periods (Van Dijk and Guicherit 1999). Precipitation events tend to scavenge most of the pesticides from the atmosphere, especially those associated with particulate material and gaseous pesticides with high water solubility.

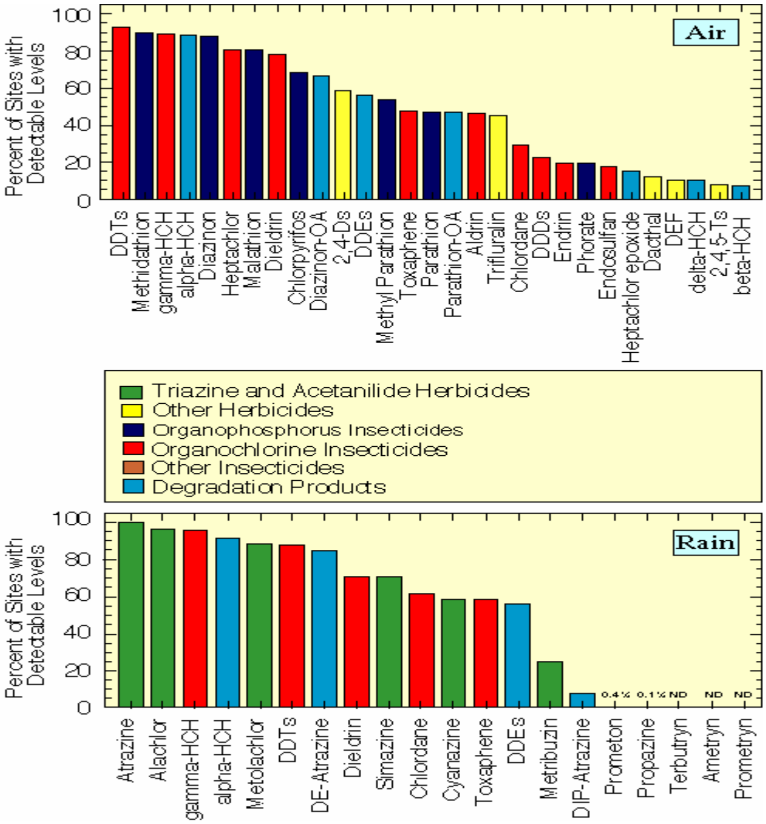

FIGURE 1-2 **Pesticides in the atmosphere of United States (courtesy USGS)**

Another increased concern in agricultural areas, is the use of wastewater effluents. As water demand increased. Agricultural areas are being sprayed irrigated with sewage effluents, as an important alternative to advanced wastewater treatment. It is an effective way to reduce the nutrients load to water bodies (which were traditionally used for the disposal of wastewater effluent) and their declining water qualities now require the elimination of external nutrient loads. For instance, in Delaware, total maximum daily loads (TMDLs) for the Inland Bays require that all point sources of nutrient loading (which includes wastewater discharge) to these water bodies must be systematically eliminated. With this alternative come several benefits, such as purifying the wastewater through soil and crops and reuse and recycling of the water and nutrients. Treatment mechanisms such as soil filtration of solids and microorganisms, soil adsorption of trace elements and crop uptake of nutrients remove pollutants from wastewater prior to entering the groundwater system. Spray irrigation systems can be installed in wooded areas, open fields or farmland. Together with the benefits there are new concerns that need to be addressed. Besides nutrients, wastewater effluents may contain small concentration of organic pollutants that have been determined to be highly toxic and potentially endocrine disruptors. Their fate upon irrigation is also a concern with respect to the introduction of toxic chemicals in agricultural environments and their transport to sensitive ecosystems. One of such chemicals is the presence of PBDEs. PBDEs have been detected in all environmental compartments, including herring gull eggs from the Great Lakes and even in human milk and blood, and believed to undergo LTR. PBDEs are receiving much attention in recent years, while concentrations in Europe are on the decline, in the US one study has reported that PBDE levels have doubled every 4-6 yr (Hites 2004).

1.2 PROCESSES CONTROLLING RELEASE TO ATMOSPHERE

Field volatilization is by far the most important source of pesticides to the atmosphere and is controlled by simultaneous interactions between chemical properties, soil properties, and weather conditions. Volatilization of the applied chemical is usually a first order process (Majewski 1999) and is primarily dependent on the chemical's effective vapor pressure at the surface and environmental conditions that control the rate of movement away from the surface. The application method and formulation type, temperature, and moisture content, as well as surface interactions such as sorption, can all affect the effective vapor pressure of the compound. Solar energy, atmospheric turbulence, and surface roughness can affect the movement of chemical away from the surface and thus the overall volatilization. Environmental factors such as high temperature, low relative humidity, and large air movement tend to increase volatilization.

Tillage practices, compound hydrophobicity, soil moisture content, and meteorological factors such as wind speed can all impact volatilization. Water content of soil also impacts volatilization. Volatilization rates of non-polar pesticides are very rapid from moist soil. Losses from dry soil are much slower and are controlled by the supply of moisture to the dry surface layer (Glotfelty et al. 1989). Precipitation occurring near the application period can result in not only elevated rates of volatilization losses, but in extended periods of the loss depending on the rate of surface drying) (Prueger et al. 2005. Impact of wind erosion on transport has also been reported (Bidleman 1999).

Once they are airborne, pesticides can also undergo reactions in the atmosphere. Reactions with hydroxyl radicals are the most important degradation mechanism for many gas phase organic compounds including pesticides. Atmospheric lifetimes are dependent on OH radical concentrations and temperature. Thus, as chemicals travel from temperate to polar regions, their atmospheric lifetimes will increase due to lower temperatures and fewer OH radicals (Bidleman 1999). Therefore, for pesticides whose introduction into the environment has ceased (such as DDT, chlordanes etc.), concentration in the atmosphere is a function of temperature and is also a function of time (Cortes et al. 1998). For such pesticides, water bodies are thought to be the major sources to the atmosphere through re-volatilization (Buehler et al. 2001). For the pesticides currently in use, the concentrations in the atmosphere will depend not only upon the temperature, but also upon the cycle of application and time (Cortes et al. 1999).

Reactions of pesticides in the atmosphere can lead to the formation of products that are themselves of concern because of their toxicity. Photoproducts of many OC pesticides are known, e.g., for heptachlor, dieldrin and mirex (Bidleman 1999). Photo heptachlor has a relatively high toxicity compared to the parent compound, and has been found in ringed seal blubber and human plasma in the Arctic (Zhu et al. 1995).

1.3 PROMINENT PROCESS INFLUENCING OCCURRENCE IN ATMOSPHERE

Most studies reporting concentrations of semi volatile compounds in the atmosphere show a great spatial and temporal variability. The largest source of variability has been attributed to atmospheric temperature (Cortes et al. 1998; Hillery et al. 1997; Hornbuckle and Eisenreich 1996). Gas phase partial pressures increase as temperature increases and the functional relationship between these two parameters is given by the Clausius-Clapeyron (CC) equation:

$$\ln P = \frac{-\Delta H}{RT} + constant \qquad (1.3\text{-}1)$$

Where, P is the atmospheric partial pressure of the compound (atm), ΔH is the characteristic phase-transition energy of the compound (kJ/mol), R is the gas constant and T is the atmospheric temperature (K). The CC equation has been used by several researchers to explain the concentrations of various SVOCs (mainly PCBs and OCs) in the atmosphere (Hillery et al. 1997; Hoff et al. 1998; Simcik et al. 1999; Cortes et al. 1998). Relative humidity (Hornbuckle and Eisenreich, 1996) and also wind speed and wind direction (Sofuoglu et al. 2001) have been found to influence aerial concentrations and been included in the CC equation.

The plots are often nonlinear and there is considerable scatter in some cases (Hoff et al. 1998; Cortes et al. 1999; Wania et al. 1998; Simcik et al. 1999) and has been attributed to the combination of exchange and transport processes that affect the air concentration at a remote site (Wania et al. 1998; Hoff et al. 1998). The former depends on local air temperature whereas the transport component is related to climatic and application conditions in the source region, which maybe distant from where air samples are collected (Bidleman 1999). Agricultural usage influences variations in concentrations of CUPs (Hoff et al. 1992a; Cortes et al. 1999) and for areas close to regions of current pesticide use non-linearity and scatter in the CC plot is much greater (Cortes et al. 1999).

1.4 FACTORS AFFECTING PHASE DISTRIBUTION IN THE ATMOSPHERE

Since the atmospheric fate of pesticides is strongly dependent on the phase in which they exist, knowledge of vapor/particle (V/P) partitioning is critical to understanding the fate of these toxic compounds in the environment. Among other factors, partitioning of SVOCs is dependent on temperature (Yamasaki et al. 1982; Pankow, 1991), relative humidity (Pankow et al. 1993; Goss1992), surface area of aerosols in case of adsorption (Yamasaki et al. 1982; Pankow, 1991), and organic content of the particulates in case of absorption (Pankow, 1987, 1994).

The theory of vapor/particle (V/P) partitioning is well developed (Junge 1977; Pankow 1987, 1991, 1994; Pankow et al. 1993 etc.). The J-P model, which is the most common model (Junge 1977; Pankow 1987) is essentially a Langmuir isotherm which relates the fraction of the compound adsorbed to particles (Φ) to the sub cooled liquid-phase vapor pressure of the pure compound (p_L^0) and the particle surface area per unit volume (θ cm^2 aerosol/cm^3 air) by the equation:

$$\Phi = \frac{c\theta}{p_L^0 + c\theta} \qquad (1.4\text{-}1)$$

Where, parameter c is related to the excess heat of desorption from the particle surface, the moles of adsorption sites on the aerosol (Ns, mol/cm^2) and temperature. The value of c is usually taken as 17.2 Pa.cm (Junge 1977). Typical values of θ are 1.1×10^{-5} (urban air), 3.5×10^{-6} (rural air) and 4.2×10^{-7} (rural air with some urban influence) (Whitby 1978). Limitations of the model include uncertainties in the parameters c and θ. Adsorption/desorption kinetics and relative humidity influence the adsorption of compounds onto aerosols and the model does not take these factors into account. Relative humidity has been shown to have an exponential influence on vapor-particle partitioning of certain organic compounds (Goss1992) and it is not included in the model. Researchers have considered the effects of aerosol properties, organic carbon, temperature, etc. on partitioning. Again, the attention has been focused on the PAHs and PCBs and even for the few studies in which the partitioning of organochlorine (OC) pesticides has been studied, it has been found that theory does not adequately explain the field data (Bidleman 1999). A conclusion in review papers

(Bidleman 1988; Bidleman et al. 1999) is that improvements in modeling vapor/particle distributions need to be made by taking into account differences in sorption, aerosol types and humidity effects. In particular, the effects of changes in relative humidity on partitioning is not well understood (Bidleman 1999) and may play an important role in coastal regions where the relative humidity is high throughout the year and the currently used pesticides (such as metolachlor and atrazine) are more polar than the compounds normally studied.

1.5 CHESAPEAKE BAY - THE SENSITIVE ESTUARY AND PESTICIDES IN THE REGION

Chesapeake Bay is the largest estuary in the United States, supporting an abundant and diverse wildlife population; more than 3,600 species of plants, fish and animals. Intensive agriculture and continued development in the region have degraded the water quality of the Bay, threatening its value as an economic and recreational resource. *Crassostrea virginica*, also known as the Eastern, American or Atlantic oyster is one of the species whose population in the Bay has declined sharply in recent years and today stands at about one percent of its historic level. This is of grave concern since these oyster populations historically served as a natural water-cleansing system.

The Chesapeake 2000 agreement commits to achieve a tenfold increase in native oysters in the Bay by 2010 (Chesapeake Bay Program). Some CUPs, such as, chlorpyrifos, endosulfans, trifluralin and diazinon have been detected in the oysters from Choptank and

Patuxent rivers (Lehotay et al. 1998) and believe to contribute to their decline. DeLorenzo et al. (1999) found that exposure to agricultural pesticides alters both functional and structural aspects of the estuarine microbial food web that could have serious implications for the higher trophic levels. In view of the toxicity of these compounds, there is concern that pesticides and other toxic chemicals are affecting the life cycles of aquatic organisms in the Bay. Accordingly, one of the objectives of the Bay agreement is also to reduce the potential risk of pesticides to the Bay.

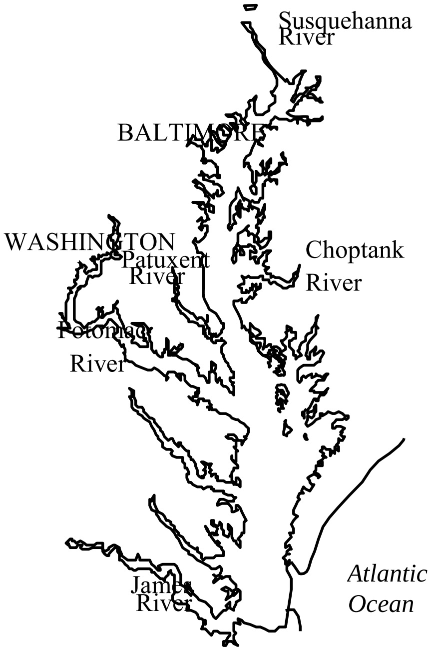

FIGURE 1-3 Tributaries of the Chesapeake Bay

The threat of exposure to pesticides is of imminent concern due to the agricultural activity in the watershed. More than 166,000 km^2 of land drain into the Chesapeake Bay and of this about 23% was under agriculture in 2000. The Chesapeake Bay estuarine drainage area receives the highest pesticide application of any coastal area in the US (Harman-Fetcho et al. 1999). Pesticides have been detected in all environmental compartments of the Chesapeake Bay region including tributaries, air, fog and rain.

Susquehanna, James and Potomac rivers are the main sources of freshwater into the Bay (Figure 1-3) and are expected to be the major sources of pesticides to Bay. Several studies have been conducted on the Susquehanna River (Godfrey et al. 1995; Foster and Lippa 1996; Foster et al. 2000; Liu et al. 2002), which provides 90% of the freshwater flow to the upper half of the Bay and 50% overall (Liu et al. 2002). Studies have also been conducted on the Choptank, Patuxent (Lehotay et al.; 1998) and Wye River (Glotfelty et al. 1984) as well. Levels of CUPs in Susquehanna are quite high and it is the biggest contributor. Input of currently used pesticides has been found to be governed by the agricultural practices in the watershed, the timing of storm events after major application periods, pesticide properties (e.g., soil half life) and intensity of rain events throughout the year (Glotfelty et al. 1984; Foster et al. 2000).

While atmospheric deposition is not expected to represent a major contributor on the overall budget of pesticide to the bay, its capability to reach remote ecosystems raised its concern. The Chesapeake Bay area is not very well characterized with respect to concentrations of pesticides in the atmosphere and most studies have focused on CUPs (Wu, 1982; Glotfelty et al. 1987; Harman-Fetcho et al. 2000; McConnell et al. 1997). Atrazine, metolachlor, chlorpyrifos, have been the most frequently detected in air and rain. Atrazine concentrations detected in rainwater samples collected from Wye River (Wu 1982) during cooler months were frequently higher than in summer months, which were attributed to long-range transport. The detections of atrazine and alachlor during the winter months at sites far from the corn belt in Midwest in mid 90s corroborate the potential for long-range transport (Goolsby et al. 1997). Atmospheric input (mainly through air water gas exchange) has been shown to be an important source of chlorpyrifos to the Bay between June and September when riverine inputs decrease and air concentrations increase (McConnell et al. 1997).

Although river runoff contribution is the most likely source to the region, atmospheric inputs (wet and dry deposition, air-water exchange) can be quite significant sources as well. Major pathway for organic contaminant loading to water bodies (Van Jaarsveld and Van Pul 1999), can also be significant. Aerial fluxes are believed to contribute 4-5 times as much total organic carbon to the Chesapeake Bay as does the river inputs (Bidleman 1988) and on an annual basis, the atmosphere is a net source of volatile PAHs to the Bay (Nelson et al, 1998). Atmospheric deposition can occur as both dry deposition (gas exchange across air-water surface or particle deposition) as well as wet deposition (particle and gaseous scavenging by precipitation). McConnell et al. (1997) have established that during mid to late summer, atmospheric loadings become an important contributor to the Bay chlorpyrifos budget. Long range transport is also an important factor. The studies mentioned above suggest that wet deposition can be an important source of pesticides to the water bodies in the region, especially during times farther from the application time (e.g., after October, when there is no more pesticide application). Further, it can be the only source of pesticides to regions farther from the point of application where there are no major water bodies (and hence air-water exchange is not a possibility) and the washout of pesticides from the atmosphere is the only source. Since air levels can be the deciding factors on water levels and will control the loading through wet deposition, it is important to know the sources and trends in air concentrations of pesticides in atmosphere.

1.6 DELMARVA PENINSULA - THE CLOSEST SOURCE FOR PESTICIDES IN THE ATMOSPHERE OF THE CHESAPEAKE BAY

Delmarva Peninsula is part of the Chesapeake Bay air shed and a major portion of it is part of the Bay's watershed as well. It is comprised of Delaware (New Castle, Sussex and Kent counties), Maryland counties on the Eastern Shore (Caroline, Cecil, Kent, Queen Anne's, Talbot, Dorchester, Somerset, Wicomico and Worcester) and Virginia counties on the Eastern Shore (Accomack and Northampton). Parts of Delaware (the eastern most edge of the Peninsula) drain into the Delaware Bay. Geographically, the Peninsula is divided into the Upper Delmarva Peninsula (Delaware and Maryland counties of Cecil, Caroline, Kent, Queen Anne's, Talbot and Dorchester) (Figure 1-4) and the Lower Delmarva Peninsula. The Peninsula has a total land area of about 15,500 km^2 and a population of 1.23 million (2000 Census). Of this the Upper Peninsula has 63% of the total land area and 76% of the total population. Agriculture is the main industry in the Peninsula. About 44% of the total land area in the Peninsula is under farms. Of the total farmland in the Peninsula, about 85% was in the Upper Delmarva Peninsula in 2000 (Maryland Agricultural Statistics, 2001 and Delaware Agricultural Facts). About 6.41 x 10^3 tons of pesticides were used in the Maryland counties on the eastern shore alone in 2000 (Maryland Pesticide Statistics).

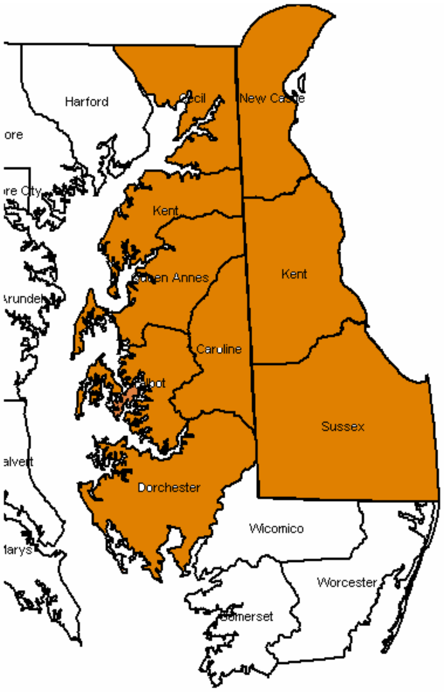

FIGURE 1-4 Upper Delmarva Peninsula

1.7 SCOPE AND OBJECTIVES OF THIS STUDY

An examination of literature reveals that most studies on the presence of pollutants in the atmosphere have focused on PCBs, PAHs, PCDDs/Fs, (hydrophobic) less frequently on organochlorine (OC) pesticides and hardly at all for modern (more polar) insecticides and herbicides. The same is true for investigations on vapor/particle partitioning. Even for the few studies in which the organochlorine (OC) pesticides have been studied, it has been found that theory does not adequately explain the field data (Bidleman 1999). Some currently used pesticides (like atrazine) are more polar than most of the compounds commonly studied and will differ in their environmental behavior from PAHs, PCBs etc. Greater research on the vapor/particle partitioning of pesticides and its dependence on various factors is warranted.

Also most of the research has been carried out in the region around the Great Lakes via the Integrated Atmospheric deposition Network (IADN) by Hites and co-workers (Buehler et al. 2001; Cortes et al. 1998, 1999, 2000) and also by other researchers (Simcik et al. 1998; Hoff et al. 1992). Measurements have also been taken in remote locations as diverse as the Artic region (Hung et al. 2002), Indian Ocean, Antarctic and the Pacific Ocean (Iwata et al. 1993, ref. Hoff et al. 1992). With the exception of a few studies the intensely agricultural region of the Delmarva Peninsula has largely gone unnoticed. Even the few studies that have been conducted in this region have focused either on the pesticide presence in rainfall or water bodies (Goolsby et al. 1997; Harman-Fetcho et al. 2000; Liu et al. 2002) or on the air-water exchange (Harman-Fetcho et al. 2000). As a consequence, the Delmarva Peninsula is poorly characterized with respect to the presence of pesticides in its atmosphere. This has hindered our ability to assess the importance of atmospheric loadings to the concentrations of these compounds in the Chesapeake Bay.

A single high temporal and spatial resolution data set for pesticides in the atmosphere of this region does not exist. The high usage in the Peninsula, combined with the potential aquatic toxicity of most pesticides, points to the need for characterizing the presence of these compounds in the atmospheric compartments of the Peninsula. Long-term studies are needed to determine the affect of various factors (such as temperature, application cycle, and local usage vs. long range transport) on the presence of these compounds in the atmosphere, deposition and their phase distributions. Greater research on the vapor/particle partitioning of pesticides and its dependence on various factors is warranted.

The goal of this research is to better understand and characterize the Upper Delmarva Peninsula with respect to the presence of pesticides in its atmosphere. This knowledge, in combination with better understanding of the vapor/particle partitioning mechanisms for polar pesticides, will be helpful in predicting the fate of these compounds. To accomplish our goal, the objectives of this research were:

1. Ascertain what pesticides occur in the atmosphere of Delmarva Peninsula and determine their levels in air and precipitation

2. In order to accomplish this objective automated collection and in-line extraction method for the determination of currently used pesticides in rain and air has been validated. We collected air and precipitation samples at three different locations on two sides of the Peninsula and determined pesticide concentrations using chromatographic techniques (details in Chapter 2 and 3).

3. Assess what processes control the levels of HUPs in the region

   This objective was accomplished by examining the influence of temperature and meteorological parameters on levels in gas phase by using the CC equation (Chapter 3).

4. Assess if local agricultural activity of the region influences levels of CUPs

   This was accomplished by regressing gas phase concentrations of CUPs against agricultural cycle and meteorological parameters (WS, WD). Modified CC equations were used and details are given in Chapter 4.

5. Examine if the weather conditions of the Peninsula influence the phase distribution in the atmosphere

This objective has been accomplished by examining the influence of relative humidity and wind speed on the fraction that occurs on the filter. The efficacy of the J-P model in predicting the portioning of CUPs in rural areas and the efficacy of current sampling methods in determining correct levels in the gas and particulate phases were also examined. Details are given in Chapter 5.

6. To determine the vapor pressure-temperature relationships for some commonly used pesticides and selected transformation products.

This objective was accomplished by determining the gas chromatographic retention times for selected pesticides and some transformation products to determine the sub-cooled liquid vapor pressures (Chapter 6).

7. Assess the contribution of wet deposition to the pesticide load to the Bay

This objective has been accomplished by calculating yearly wet fluxes of pesticides to the Bay and comparing them with the known annual loadings to the Bay (Chapter 8). Factors affecting pesticide gas washout have also been examined in Chapter 7.

8. Determine if spray irrigation activities in the region are impacting air levels of PBDEs

This objective has been accomplished by determining PBDE levels in the atmosphere at the 3 sites and determining 24-h back trajectories of air over the sampling duration and determining if the air crossed over any spray irrigation facility when the levels were high (Chapter 9) .

The completion of this research is hoped to better elucidate the role of the atmosphere as a source of pesticides to the Chesapeake Bay and to address current limitations in our basic understanding on the basic processes controlling their fate our capability to model it.

CHAPTER 2 - SAMPLING AND ANALYTICAL DETAILS

2.1 AGRICULTURAL PROFILE OF THE DELMARVA PENINSULA

Corn, soybeans, wheat, barley and vegetables are the major crops in the region. Field corn planting usually begins mid-April and soybean planting begins in May. Herbicides, insecticides and fungicides are the three main classes of pesticides used in agriculture. Herbicides are usually applied pre-emergence to the soil to control broad-leafed weeds and grasses. In some cases, post-emergence application of herbicides is also done. In this region, the application of herbicides typically occurs between April and July (Figure. 2-1). Insecticide application tends to be more variable from year-to-year compared with herbicides, as the timing and location of insect infestation can vary both spatially and temporally. Fungicides are typically applied during the summer months to control blight, leaf spot, and mold in some fruit and vegetable crops (Pait et al. 1992). As of 2000, chromate copper arsenate (8.8×10^6 lbs), cuprous oxide (1.8×10^6 lbs a.i.) and glyphosate (9.5×10^5

lbs a.i.) were the 3 most used pesticides in Maryland. On the basis of agrochemical type, herbicide use was dominated by glyphosate followed by atrazine (6.2 x 10^5 lbs) and metolachlor (5.8 x 10^5 lbs a.i.). Chlorothalonil (1.1 x 10^5 lbs a.i.) was the most used fungicide while chlorpyrifos (1.4 x 10^5 lbs a.i.) was the 3rd most used insecticide in the state (Maryland Pesticide Statistics for 2000).

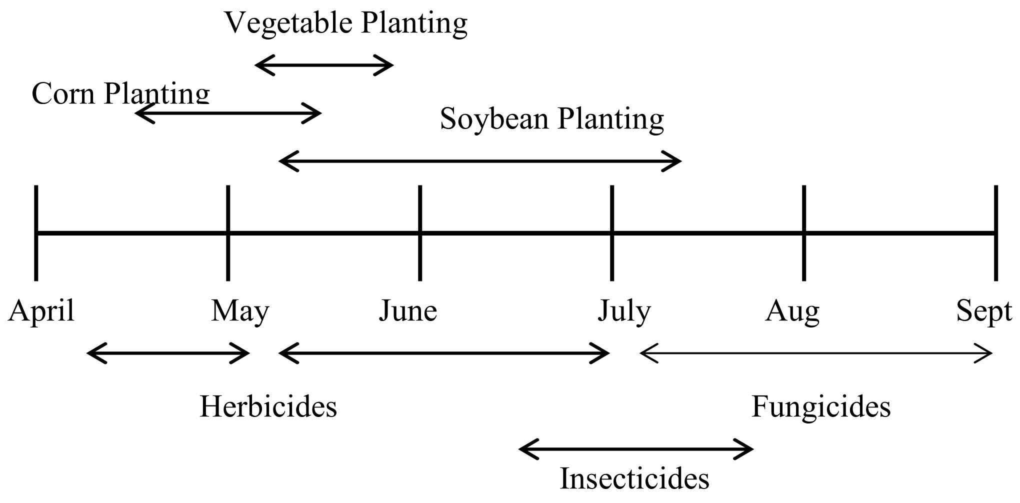

FIGURE 2-1 Regional Agricultural Activity

Generally, herbicides atrazine and metolachlor are applied together at the time of corn planting. Alachlor, a pre-emergence herbicide for corn and soybeans, is applied between April and July whereas atrazine application (on corn) is between April and June. Insecticide applications typically occur between March and August. Chlorpyrifos is typically applied between April and June. The herbicides metolachlor and/or alachlor/acetochlor are applied during soybean planting. Other herbicides such as pendimethalin and trifluralin can also be applied on corn. Insecticides (e.g., endosulfan, diazinon, malathion, chlorpyrifos etc.) and fungicides (mainly chlorothalonil) may be used for vegetables during summer or early fall depending on weather conditions and pest disease pressures (Appendix A lists the crops that some pesticides are used on in the Peninsula). In 1997, about 40% of all soybeans grown in the Peninsula were RoundUp ready (i.e., using glyphosate as the herbicide). This number has gone up to at least 80% in 2002 (Lewis, J., personal communication). About 10% of the corn grown in the region is Bt corn. The use of glyphosate tripled from 1997 to 2000 ($3.7 – 9.5 \times 10^5$ lbs a.i.) in Maryland alone while the use of traditional soybeans herbicide, metolachlor, fell ($8.9 – 5.8 \times 10^5$ lbs a.i.) . Other than metolachlor, the use of the other soybean herbicides, alachlor and acetochlor, is expected to have decreased. The use of most pesticides has remained more or less stationary. The application rate of the new corn herbicide, fipronil, varied from 1.78×10^5 lbs/ac in 2000 to $2.7\ 10^4$ lbs/ac in 2003 (NASS) for the entire U.S. as a whole. The usage of endosulfan has also gone down since the 1990s for most crops.

2.2 TARGET COMPOUNDS

In total, 35 pesticides (including transformation product, TP) and 4 Penta-BDEs were monitored in precipitation and air during the course of this study. Appendix B provides the full list of compounds analyzed for in this study.

The pesticides included 16 current use pesticides (CUPs) and 19 historical pesticides (HUPs). These include both the groups- more persistent and hydrophobic (OCs, OPs) as well as less persistent and more polar (triazines). The CUPs (herbicides, insecticides and fungicides) include those typically used on corn, soybeans, and vegetables which are the main crops in the region. Fipronil is the most recently introduced insecticide. Some of our analytes (chlorpyrifos, lindane, and endosulfans) are included in the Toxics of Concern List for the Chesapeake Bay.

The transformation products of pesticides that remain in soil can also volatilize and be detected in the atmosphere. Common pesticide transformation products (CIAT, CEAT, chlorpyrifos oxon, endosulfan sulfate) were also included. Hydrolysis of atrazine in soils leads to the formation of hydroxyatrazine whereas biological activity results in the formation of deisopropylatrazine (CEAT), and deethylatrazine (CIAT). Chlorpyrifos undergoes hydrolysis to form 2,5,6-trichloro-2-pyridinol. Endosulfans forms endosulfan sulfate under aerobic, anaerobic and flooded conditions.

The HUPs include the persistent insecticides that were extensively used till the mid 80s (mostly), and while banned, they are still detected in the environment. Cyanazine (voluntarily phased out by the manufactures by 1999) is the only herbicide in the group. The transformation products of some are also included. p,p'-DDT converts rapidly to p,p-DDD under anaerobic conditions and to p,p-DDE under aerobic conditions. Chlordanes degrade to oxychlordane, heptachlor etc. Heptachlor is microbialy oxidized to form heptachlor epoxide (Montgomery, 1993). Dieldrin, an insecticide, is also a transformation product of aldrin. Appendix C provides their physical and chemical properties. Little data is available on the atmospheric half-lives of pesticides and their acute and toxic effects to organisms, but there is a general consensus that they represent a risk to sensitive ecosystems.

In recent years, concerns have been raised with respect to the prevalence of PBDEs in the environment. We embraced the opportunity that this study provided to analyze PBDEs in our study area. The constituents of penta-BDE most commonly reported in the environment (BDE-47, -99, -100, -154) (Palm et al. 2002; Hites 2004) have been selected for this study.

2.3 SAMPLING SITE LOCATIONS

Air and precipitation samples were collected at three sites on the two ends of the Upper Delmarva Peninsula (Figure 2-2) for the period 2000-2003 (data for 2000 is available from Kuang 2001).The project began in 2000 with one site on the campus of the University of Maryland, Horn Point Environmental Laboratory, close to the mouth of the Choptank River in Cambridge, MD (38^{o} 36′ 04″ N, 76^{o} 07′ 47″ W). The second site on the campus of the University of Delaware, Lewes, DE (38^{o} 46′ 26″ N, 75^{o} 08′ 20″ W) started in 2001. The third site at the St. Jones Reserve in Dover, DE (39^{o} 09′ 29″ N, 75^{o} 31′ 26″ W) was added in 2002. The sites are abbreviated to HP (Cambridge), LD (Lewes) and DV (Dover).

The sites were carefully chosen on the basis of their geographical location and the ease of data collection. Among the three sampling locations one is the closest to rural areas and likely to be most greatly impacted by agricultural activity (Lewes) one is semi rural (Horn Point) and one most remotely located but is closest to urban influences (Dover).

Cambridge is the seat of the Dorchester County in Maryland which is located at the mid-point of the Chesapeake. The county has over 122,000 acres (or 494 km^2) of wetlands, which is about 40% of the entire state's wetlands. It is a semi-rural region near the mouth of the Choptank River with no major industrial activity in the vicinity. The Washington, D.C./Baltimore metropolitan area is approximately 90 km to the west-northwest.

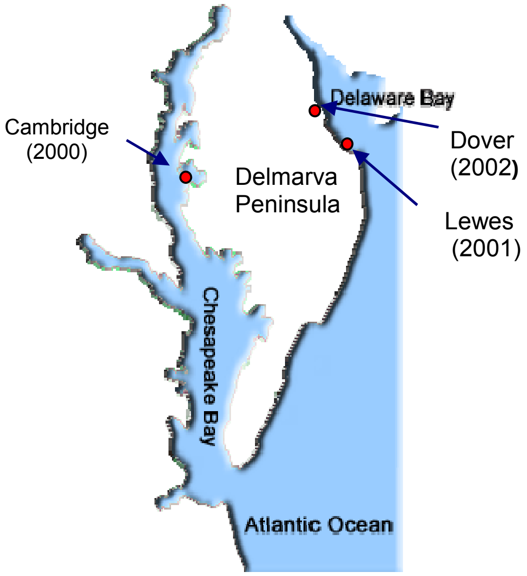

FIGURE 2-2 Sampling sites on the Delmarva Peninsula

The site at Cambridge (HP) is located close to the wetlands and although it has no agricultural activity in the immediate proximity (at least 800 m), it is susceptible to aerial deposition from the agricultural activity in the region. Lewes, the seat of the Sussex County in Delaware, is located at the intersection of the Delaware Bay and Atlantic Ocean. The land use in southern Delaware is primarily rural-agriculture. The sampling site also does not have any agricultural production in the immediate vicinity. However, there are large corn fields to the west of the site. Dover, in the Kent County, is the capital city of Delaware. The site at Dover is on the premises of the St. Jones River Component of the National Estuarine Research Reserve (NERR). The reserve has a total area of 910 acre and is spread along the St. Jones river along the Atlantic coast. The site is located about 0.8 miles south-east of the Dover Air Force Base (and 34 miles north of LD). The measurements at this site are expected to be influence by long/short range transport and reflect the background levels for the Peninsula. It would also reflect the atmospheric loadings which the wetlands would receive.

Given the difference in the geographical location and the agrochemical usage in the vicinity of the three sites, we expect the trends to be different at three sites. Lewes being surrounded by agricultural field agrochemical are expected to be detected most frequently, have higher levels of CUPs and show the greatest variation with time. Horn Point is expected to have lower levels of CUPs and be impacted by direction of wind motion. Dover, being the most remote site, is expected to have the lowest levels of CUPs and represent the background levels of HUPs in the Peninsula. Furthermore, it being situated closest to urban centers could also reflect the influence of urban usage on atmospheric levels.

2.4 SAMPLE AND METEOROLOGICAL DATA COLLECTION

Samples of air and precipitation (and meteorological data for that time) were collected from the three sites. Some soil samples were collected from an experimental agricultural field. Overall we collected 4 years at HP (2000-2003), 3 years at LD (2001-2003) and 2 years at DV (2002-2003). Sampling was concentrated on the agricultural season (April-Sept), however, some samples were also collected in other months (mainly in 2002) to observe the levels in off-season. To ensure that there was no bias in results due to possible contamination of the samplers, once every month field blanks for both air and precipitation samplers at the three sites were also collected and used to adjust data if required (see section 2.7 for details).

2.4.1 Air sample collection

The air samples were collected for a 24 h period once every week using a high-volume sampler (Figure 2-3, Model GPNY 1123, Grasby General Metal Works, Village of Cleves, OH). To obtain concurrent samples at all the sites, the sampling was done from 10 a.m. on Tuesday morning to 10 a.m. the following day (Wednesday).

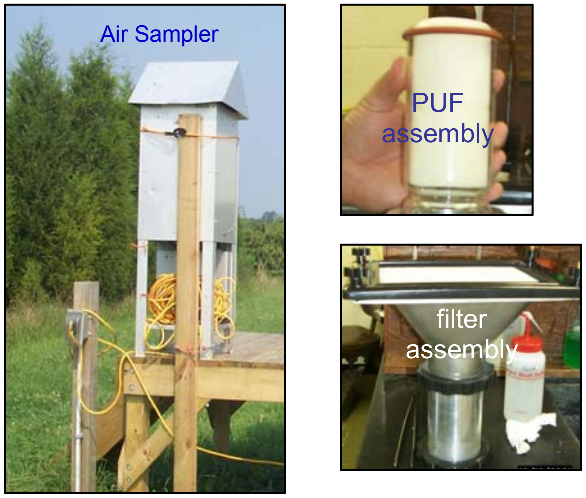

FIGURE 2-3 Air sampler and PUF and filter assembly

The sampling assembly consisted of a filter (for particulates) and a sorbent for the gaseous fraction. Polyurethane foam (PUF) plugs have been shown an efficient absorbent for organic compounds and have been used in a variety of environments (McConnell et al. 1997; Fetcho et al. 2000; Hillery et al. 1998 and Nelson et al. 1998) and were used in this study. Air was pulled at a flow rate ranging from 0.29 to 0.64 m^3/min through a 20.3 × 25.4 cm rectangular glass fiber filter (Gelman A/E) followed by two 7.6 × 7.6 cm PUF held within a glass sleeve. Prior to start of sampling every year, flow rates were calibrated by using an orifice calibration device (General Metal Works) to relate the pressure drop across the sampling train to the flow rate (m^3/min). Beginning 2002, two filters were used in place of one to examine the possibility of air sorption to filter material.

The efficiency of the PUFs in collecting the air samples was evaluated by determine the percentage of the chemical breaking through to the back PUF (break volume = BF/(FF+BF). For most compounds it occurred in <20% samples collected from 2001-2003. Trifluralin, chlorothalonil, and the HCHs were the only compounds for which break through occurred in more than 50% of the samples (details in Appendix D). At the end of each sampling period, the filter was folded face inward and placed back into the original clean foil pocket and PUF plugs were returned to the original jars. The PUF plugs and filters were kept frozen (-20 ^{o}C) until extraction.

PUF plugs were precleaned using tap water, distilled water, followed by Soxhlet extraction with pesticide grade acetone for 12 hours and then ethyl acetate (Burdick and Jackson, high purity solvent) for another 12 hours. The PUF plugs were dried within a vacuum desiccator and kept in individual, pre-cleaned glass jars with Teflon lined lids. The glass jars were cleaned using tap water, distilled water and acetone before they were baked at 400 ^{o}C. The Teflon lined lids were solvent rinsed. Filters were wrapped individually in aluminum foil pocket and baked 400^{o} C as described by McConnell et al. (1997).

2.4.2 Precipitation sample collection

The precipitation sample collection method developed by Kuang (2001) was used. Rain samples were collected on an event basis using a modified commercially available MIC-B (Meteorological Instrument Center, Ontario, Canada, Figure 2-4). Each event was any rain that fell during a 24-hr period from 10 a.m. to10 a.m. (± 1 hour) the following day.

Samples of <50 ml (0.025 cm precipitation) were not analyzed and cartridges and filters were discarded by the site operator. The sampler was equipped with a 0.2 m^2 stainless steel funnel that was covered with a lid until the rain sensor activated the lid to open. A Teflon column (12 cm length × 40 mm diameter), which was attached to the bottom of the funnel, was connected to a Teflon filter head containing a 45-mm diameter glass fiber filter (Whatman GF/F, 0.75 μm nominal pore size). The filter head was designed to trap particle-phase pesticide residues in the rainwater. Attached to the filter holder was a solid phase extraction (SPE) cartridge containing 200 mg of a hyper cross-linked styrene-divinylbenzene copolymer (Jones Chromatograph, IST Isolute ENV+, 6 ml reservoir). A peristaltic pump (Model 7518-00, Cole -Parmer) was connected to the cartridge to pull rainwater through the filter cartridge assembly at a flow rate of 20 - 50 ml/min and the extracted water was collected in a 20- liter bottle for volume measurement. The pump was activated while the funnel was open. Extraction efficiencies with these flow rates have been demonstrated to be > 80% for most compounds (Kuang 2001).

After a rain event, the site operator removed the cartridge and filter. The cartridge was stored in the refrigerator and the filter was wrapped in tin foil and stored in the freezer. Once every week the rain samples were shipped on ice packs in small Styrofoam coolers via overnight mail to Environmental Quality Laboratory (EQL), US. Department of Agriculture, Beltsville, MD for analysis.

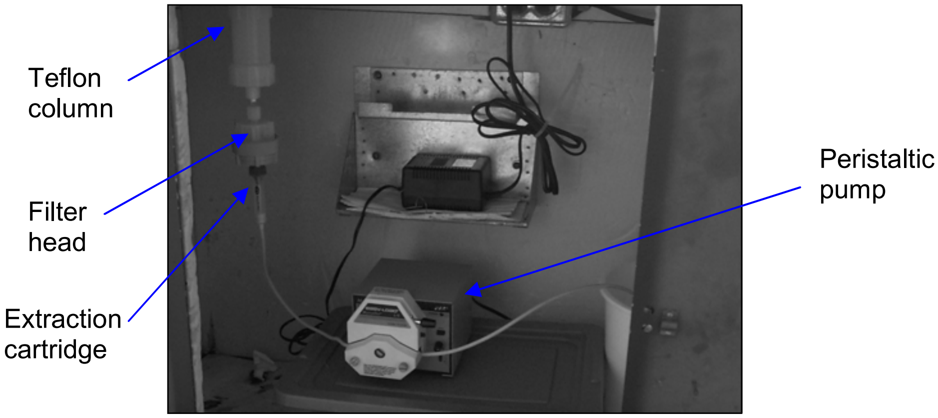

FIGURE 2-4 Rain sampler assembly

2.4.3 Soil sample collection

As a means to estimate the potential magnitude of pesticide which may be present on airborne particles due to residues from the prior year's application, surface soil samples were collected from an experimental corn field on the premises of the USDA-ARS Beltsville Agricultural Research Center (BARC) in Beltsville, MD which has received the same rate of atrazine and metolachlor applications each year since 1999. In total, 20 soil samples were collected from the field in June, 2004; 10 months after the herbicides were applied and before the fields were tilled for the next application. Data for the concentration of atrazine and metolachlor on soil for 5 days after application is available (personal communication, Tim Gish). Although the geographical location for the soil sampling is not the same as that of air sampling (the soil sampling site is located on the other side of the Chesapeake Bay,), the sandy loam soils present at the experimental site are not uncommon in certain regions of the

Delmarva Peninsula, and the detailed dataset available from the soil sampling site makes it suitable for estimation purposes.

2.4.4 Meteorological data collection

The primary meteorological data for Horn Point was obtained from a 10-m tower located next to our sampling station. Data for Lewes was obtained from the meteorological center on the premises of the University of Delaware campus at Georgetown, located 15 km southwest from Lewes. Data for Dover was obtained from the meteorological tower on the premises of the St. Jones Reserve, close to our sampling station. For the three sites, temperature, wind direction, and wind speed were averaged over each 24-h sampling period. Average wind direction was determined using vector averaging.

The meteorological conditions varied greatly during the sampling period. For the site at Lewes, samples were collected over a temperature range of -8 to 29 °C, 4-29 °C at Horn Point and 6-28 °C at Dover. The lower temperature range at Lewes reflects the extra samples collected during the winter months. The precipitation also varied over the years. In general, 2000 was an average year, 2002 was a dry year while 2001 and 2003 had above average precipitation.

2.5 SAMPLE EXTRACTION PROCEDURE

2.5.1 Air sample extraction

Air PUF plugs were extracted separately in batches of 15-20 using a Soxhlet extraction apparatus with ethylic acetate for 12 h. Diazinin-d_{10} was spiked on samples while extracting as the extraction efficiency surrogate. Extracts were reduced to 5-10 ml using a rotary evaporator and further reduced to 1 ml using a gentle stream of chromatographic grade (99.9%) N_2 gas. The air filter extracts were concentrated by rotary evaporation to approximately 5mL. The extracts were quantitatively transferred to a graduated centrifuge tube and concentrated to 1ml using gentle stream of high purity nitrogen, then exchanged into hexane (2000) or ethyl acetate (2001-2003). The procedure was identical for air filters except that chromatographic grade methylene chloride (Burdick and Jackson, high purity solvent) was used in place of N_2 gas for extraction. A laboratory blank and a spike were also extracted along with each batch of samples to observe any matrix interference or contamination and to determine extraction efficiency, respectively (Section 2.7 for details).

2.5.2 Precipitation sample extraction

The SPE cartridge was dried upon receipt using clean nitrogen gas. Absorbed analytes were eluted from the cartridge with 6mL dichloromethane (DCM) followed by 9 ml 3:1 acetone: acetonitrile (MeCN) solvent mixture. The resulting extract was concentrated to a volume of about 1.0 ml under a gentle stream of high purity (99.9%) nitrogen gas. Then another 2 ml MeCN was added and the solution was blown down to 1.0 ml, which was quantitatively transferred to an amber auto sampler vial. The rain filters from 2000 did not contain appreciable amount of analytes (Kuang2001) and were not analyzed for subsequent years.

2.5.3 Soil sample extraction

The soil sample was thawed and 200 g weighed out into a jar. 100 mL of 4:1 methanol/water was added to the jar and shook for 15 minutes. The jar was then sonicated for 15 minutes. The mixture was filtered through a glass micro fiber filter using a Buchner funnel. Soil/filter was rinsed with methanol. The filtrate was roto-evaporated to less than 20 mL (water baths at 50º C) and then diluted by adding 40 mL of water. The mixture was then extracted using a C-18 Sep-Pack cartridge which had been previously rinsed (2 mL ethyl acetate, 2 mL methanol and 10 mL water). The mixture was first loaded on the cartridge and then eluded with 4.5 mL ethyl acetate. 100µl of internal standard (trifluralin) solution was also added. Sodium sulfate ($NaSO_4$) was added in the extract and mix well to absorb any water. The extract was then transferred to GC vials for chromatographic analysis. A spike sample (100g soil + 1 ml of 5ppm standard) was included with the samples to determine spike recovery.

2.6 SAMPLE ANALYSIS DETAILS

Analytes concentrations in all samples were determined using gas chromatography (GC) mass spectrometry (MS) analysis. Sample quantization was performed using the method of internal standards with a five-point calibration curve. Details of analysis for samples from 2000 are available in Kuang et al. *2003*. Beginning 2001, 25 μL atrazine-d_5 (53.6 ppm) and 25 μL PCB-204 were used as internal standards for analysis. Different instrumental setups were utilized for air and rain samples for 2001-2003. Appendix E lists the ions monitored (m/z) for chromatographic analysis.

2.6.1 Precipitation samples

Rain extracts (2001-2003) were analyzed using a Hewlett-Packard (HP) (Palo Alto, CA) 5890 gas chromatograph coupled to an HP 5989A mass spectrometer (GC-MS) in selected-ion monitoring mode using electron impact (EI) and negative chemical ionization (NCI) mass spectrometry. The chromatographic conditions were as follows: in EI mode, injection volume, 1 μL; column, J&W DB-1MS, 30 m, 0.25 mm i.d., 0.25-*μ*m thickness; flow rate through the column, 1 mL/min; temperature program, 90 °C, raised at 5 °C/min to 150 °C, then at 2 °C/min to 166°C, and finally at 5 °C/min to 280 °C for 2 min; interface, 300 °C; quadruple, 100 °C; source, 200 °C; injector, 270 °C. For the analysis of samples from 2003, a DB-17MS column (J&W) was used as it was observed that it gave a better separation for 6-amino-2-chloro-4-ethylamino-*s*-triazine (CEAT) and 6-amino-2-chloro-4-isopropylamino*s*-triazine (CIAT). In NCI mode, the injection volume was 2 *μ*L. The chromatographic conditions were as follows: column, J&W DB-17MS, 30 m, 0.25 mm i.d., 0.25-*í*m thickness; flow rate through the column, 1.4 mL/min; temperature program, 130 °C, raised at 6 °C/min to 205°C for 4.5 min and then at 6 °C/min to 300 °C for 5.5 min; interface, 300 °C; quadrupole, 150 °C; source, 200 °C; injector, 290 °C. The soil samples were also analyzed using the same chromatographic setup.

2.6.2 **Air samples**

Air PUF and filter extracts (2001-2003) were also analyzed in selected-ion-monitoring mode using both NCI and EI mass spectrometry. NCI analysis was conducted using an Agilent (Palo Alto, CA) 6890N gas chromatograph coupled to an Agilent 5973 mass spectrometer (GC-MS) The chromatographic conditions were as follows: column, J&W DB-17MS, 30-m, 0.25 mm i.d., 0.25 μm thickness. Flow rate through the column was 0.9 mL/min; temperature program, 130 ºC, raised at 6 ºC/min to 205 ºC for 4.5 min and then at 6 ºC/min to 300 ºC for 6.2 min; interface, 300 ºC; quadrupole, 150 ºC; source, 150 ºC; injector, 230 ºC. The ionization gas was ultra high purity methane supplied at 60 kPa. PCB-204 (80 ng) was added to all extracts just before analysis and used as an internal standard. For the EI analysis, the instrumental and analysis used were the same as that for precipitation samples (see section 2.6.1). The analyte mass on the back and front PUFs were combined to calculate the gas–phase concentrations.

2.7 QUALITY ASSURANCE (QA) / QUALITY CONTROL (QC)

To ensure the quality and stability of the data generated, several QA/QC procedures were strictly adhered to throughout the period of the study. These included procedures for the collection of samples (field blanks) as well as in the laboratory (spikes, blanks, extraction surrogate) and analytical (method detection limit) processes.

2.7.1 Method Detection Limits (MDL)

The method detection limit (MDL) for dissolved-phase rainwater, gaseous and particulate phase air samples were determined by spiking 5–50 ng of each compound (the equivalent to the lowest point of the GC-MS calibration curve) into 4-L distilled water, which was poured into the funnel of the sampler, was extracted through the filter-SPE cartridge assembly, and was processed in the same manner as the samples. For the gaseous and particulate phase air samples the MDLs were determined by spiking 5–50 ng of each compound (the equivalent to the lowest point of the GC-MS calibration curve) onto pre-cleaned PUFs or filters (8 replicates) and extracting and processing them in the same manner as samples. Standard deviations of measured replicate concentrations from these low-level spike experiments were used to calculate the MDL for each compound according to the U.S. EPA standard methods (U.S. EPA, 1986). A sample volume of 720 m^3 (total volume sampled with a flow rate of 0.5 m^3/s assumed for MDL calculation. For the more hydrophobic pesticides (OCs, OPs) the MDLs were ~ 1 pg/m^3 in the gas phase and < 1 ng/L for dissolved phase of precipitation. PBDEs had MDLs of 3-9 pg/m^3 (gas phase) and 1-3 pg/m^3 (gas phase). The MDLs of more polar analytes (herbicides) varied more and were generally higher. In the gaseous phase they ranged from 9 – 16 pg/m^3 (gas phase), 5 -10 pg/m^3 (particulate phase) and <2 ng/L (dissolved precipitation). Values of MDL for each analyte in the different media (along with details on exceptions are given in Appendix E.

2.7.2 Sampling

Field blanks of PUF plug and filter were obtained monthly from each station by pulling air through the air sampler for ~ 1 min and processed in the same way as samples. Between rain events, the funnel, column and the filter holder assembly were well cleaned by wiping with lint-free paper and rinsing with 4-6 L of distilled water followed by approximately 0.5 L chromatographic grade acetone (Burdick & Jackson). The collection and extraction of field blanks involved pouring 4-L distilled water into the pre-cleaned rain sampler once a month and treating it in an identical fashion to field samples.

The pesticides were, in general, not detected in the field blanks. In a few cases when the levels were above the MDL, the MDL was modified accordingly (see Appendix E). At HP it was in the air samples (metolachlor, α-,β-endosulfan, chlorothalonil, chlorpyrifos, γ-chlordane) and not for rain samples. At LD, it was for air (metolachlor) and rain (γ-HCH, chlorpyrifos) while at DV, it was only in precipitation for two CUPs (fipronil, trifluralin). In 2001 and 2002, which were relatively drier years, metolachlor was detected at higher levels in almost all filter field blanks from HP and LD and thus higher MDLs for 2001-2002 were used for these two sites. Except for BDE-47 in some PUF blanks from LD, PBDEs did not occur above MDLs in air samples from the sites.

2.7.3 Sample extraction

One clean PUF plug (or filter) was extracted along with samples for each batch to observe any matrix interference or any contamination from laboratory procedures. Another clean foam plug (or filter) in each batch was spiked with a mixture of target analytes to determine analyte recovery. All samples were spiked with 25 μL of diazinin-d_{10} (concentration 41.4 μg/ml for samples from 2000 and concentration of 50.8 μg/ml for years beginning 2001) as an extraction efficiency surrogate.

Other than a couple of exceptions, laboratory spike recoveries were >70 % for PUFs, >80% for filters and >75% for precipitation cartridges (see Appendix F for details). Samples were not corrected for spike recoveries. Surrogate recoveries were > 50% for all air samples (see Appendix G for details).

CHAPTER 3 - OCCURENCE OF PESTICIDES IN THE ATMOSPHERE OF THE DELMARVA PENINSULA

3.1 DATA COLLECTION AND DETERMINATION OF WEATHER CONDITIONS

Sampling was focused on the main agricultural season (April – September). In some years additional samples were collected in March or from October and November to determine levels in the colder months and outside the main agricultural season (Table 3-1). For the year 2003, sampling was terminated on 15th September due to Hurricane Isabelle. A total of 271 air samples were collected during the sampling period (including 31 collected from HP in 2000). The rain samples collected totaled 489 (including the 68 samples from 2000) (Table 3-1).

Pesticide concentrations in air (gaseous, particulate) and rainfall (dissolved) along with meteorological characteristics are listed in Appendix Y-AG. Previous studies in our group, (Kuang 2001) showed that at the precipitation volumes collected, pesticides were not present in particle-phase above the limit of quantitation. Hence, in this study, filters from precipitation samples were not extracted and the data presented in this study is for dissolved-phase pesticide concentrations only.

TABLE 3-1 Sampling durations and number of air and precipitation samples collected at the 3 sites in Delmarva Peninsula

Air

	2000	**2001**	**2002**	**2003**	**# samples**
HP	31	27	39	32	129
	(4/18-12/19)	(5/9-11/13)	(3/5-11/26)	(3/31-9/26)	
LD		29	42	24	95
		(4/11-11/28)	(3/6-12/20)	(4/14-9/16)	
DV			22	25	47
			(4/2-11/26)	(3/27-9/16)	
Total	31	56	103	81	**271**

Precipitation

	2000	**2001**	**2002**	**2003**	**# samples**
HP	68	40	72	62	242
	(4/3-11/25)	(4/1-10/16)	(3/2-11/31)	(4/6-9/16)	
LD		45	73	58	176
		(4/9-11/25)	(3/1-12/1)	(4/14-9/16)	
DV			31	40	71
			(4/9-11/12)	(4/25-9/16)	
Total	68	85	145	120	**489**

4 PBDEs, 1 CUP (Fipronil) and 8 HUPs (cis-nonachlor, oxychlordane, aldrin, dieldrin, heptachlor, heptachlor epoxide, metribuzin and mirex) were included in the analysis of air and precipitation samples beginning 2001. Summary of concentrations for the three sites are listed in Appendix H-J (gas) and Appendix K-M (precipitation). Appendices N-O list the summary of concentrations in the three phases at each site, Appendix P summarizes the overall detections, median, and maximum concentrations in the three phases.

The average air sample volume was 702-826 m^3. The maximum precipitation sample volumes were 19.95 L at HP (7/24/02), 21.85 L at LD (9/1/02) and 21.30 L at DV (9/1/02). Only 11 of precipitation samples (5 each from HP and DV and 1 from LD) had sample volumes exceeding 10 L. Beyond the 10 L limit, some pesticides are likely to exceed their breakthrough volumes (Kuang 2001). Hence, the measured pesticide concentrations from these high volume events are likely to be lower than the actual values. Since the biggest dataset is available for HP, most of the analysis has been performed for this site.

Weather conditions

The 24h average ambient temperature ranged around 293 K for the three sites during sample collection. The highest recorded temperature was 302 K. LD was the site where the air samples were collected at the lowest recorded temperature (266 K) followed by HP (274 k) and DV (279 K). The prevailing wind direction on the Delmarva Peninsula was from west-southwest in summer, while during winter and early spring, easterly surface winds frequently resulted in incursions of relatively “clean” oceanic air. The observed wind speeds were in general higher at HP (varied around 5.6 mph) followed by DV (3.6 mph) and LD (2.3 mph).

During the course of this study, a wide range of rainfall patterns were observed. The years 2000 and 2003 (as well as 2001 and 2002) were very similar in terms of the amount of rainfall received and the frequency of rain events. DV received larger amount in precipitation (median vol. 2.35 L) which was almost double that of HP (1.33 L) and LD (0.93 L). Table 3-1 lists the duration of the year when precipitation samples were collected and the total number of events observed. The conditions ranged from drought conditions in 2002 to above average rainfall in 2003 (according to MD statistics). However, fewest rain events were received in 2001 while maximum were reported in 2002 (HP and LD). The discrepancy in the reported and observed occurrences can be explained by the fact that 2002 was the only year when the samples were collected in March and October – November as well (Table 3-1). Also at HP, the median volumes of rainfall received in 2002 were the lowest (0.79 L) while it was the highest in 2003 (1.7 L).

3.2 DETECTION OF PESTICIDES IN THE ATMOSPHERE

The detection patterns in the atmosphere (air and precipitation) are summarized in Figure 3-1 (CUPs) and Figure 3-2 (HUPs). The target pesticides showed different detection patterns in air and precipitation which was quite expected given the difference in physical properties. More volatile HUPs were detected more frequently in air whereas the more soluble and polar CUPs occurred more frequently in precipitation.

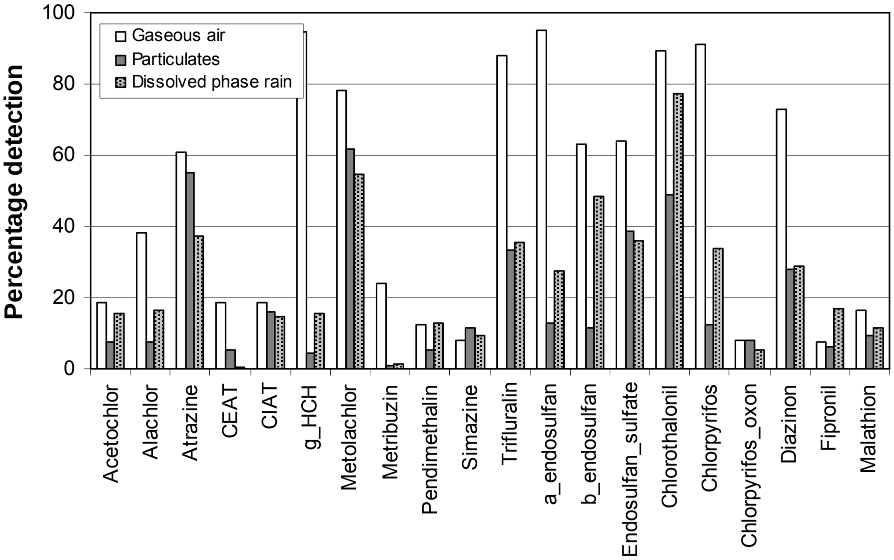

FIGURE 3-1 Percentage detection of CUPs in air and precipitation samples

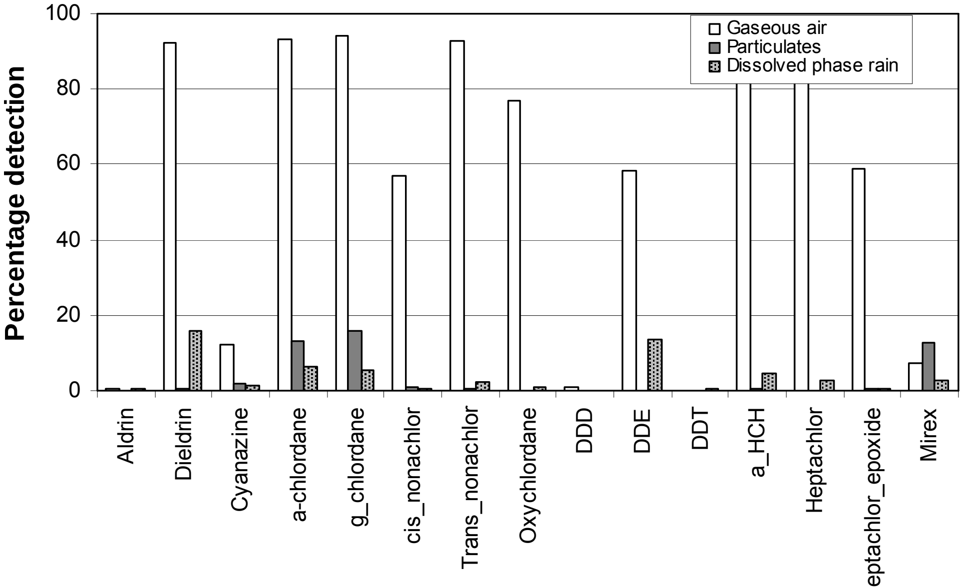

FIGURE 3-2 Percentage detection of HUPs in air and precipitation samples

Insecticides (OCs: γ-HCH, α-endosulfan and OPs: chlorpyrifos) dominated the detections of CUPs and were detected in more than 90% of the air samples. These were followed by chlorothalonil, trifluralin and metolachlor in >75% samples. Except metolachlor, trifluralin, alachlor (38%), and atrazine (61%), herbicides occurred in <25% air samples. Most HUPs occurred quite frequently in air - chlordanes, HCH and dieldrin occurred in >90% of the samples. p,p-DDT was the only HUP not detected in any air sample even though it's TP , p,p-DDE occurred in >50% samples. Aldrin was also detected in only 1 sample from HP. Even though HUPs are more hydrophobic than CUPs, they were detected less frequently in particle phase than CUPs. The detections in air also varied in terms of site location (Appendix Q). CUPs were detected more frequently at the rural (LD) and semi-rural (HP) sites as compared to the background site (DV). Detections at HP were dominated by herbicides (both chloroacetanilides and triazines) while insecticides (γ-HCH, chlorpyrifos, endosulfans) and fungicide occurred more frequently in samples from LD.

The detections in precipitation followed the pattern of the pesticide presence in air. Chlorothalonil (77%) and metolachlor (55%) where the two CUPs which occurred in more than 50% of precipitation samples and were followed by β-endosulfan and atrazine. Most other CUPs occurred in <10% of the samples. As compared to almost 100% detections of some HUPs in air the highest detection frequency in precipitation was 10% (dieldrin and DDE). Except dieldrin and p,p-DDE all HUPs occurred in <6% of precipitation samples. P,p-DDD was the only analyte not detected in precipitation.

PBDEs occurred more frequently in air (up to 70% samples) but were rarely detected in precipitation (maximum 6%).

3.3 CUPs IN ATMOSPHERE OF THE DELMARVA PENINSULA

CUPs occurred both in air and in precipitation in the region. Losses to the atmosphere occur during application and through volatilization from plant surfaces and soil after application. Volatilization losses depend on a variety of factors including physical-chemical properties of the pesticide (i.e., Henry's law constant, vapor pressure, octanol-air partition coefficient, and aqueous solubility), soil properties (i.e., moisture and organic carbon content), farming practices (i.e., tillage and application techniques) and meteorological factors (i.e., precipitation, temperature, humidity, and wind speed). The levels of CUPs observed and factors impacting the levels are discussed in the following sections.

3.3.1 CUPs in air

The levels and occurrence of CUPs showed influence of local agricultural activities and usage patterns. The location of site and meteorological conditions also impacted observed levels.

Compared to other agricultural areas in the U.S. (Table 3-2), levels of CUPs in the air of the Delmarva Peninsula are lower. The exceptions are metribuzin – levels are higher than in Iowa (part of Corn Belt) but lower than in Mississippi. The levels of endosulfans are higher than in the other rural areas in the mid-Atlantic.

TABLE 3-2 Levels of CUPs in the Peninsula air as compared to other rural areas in U.S.A

Concentrations in air samples in pg/m^3 (averages unless otherwise specified)

	Delmarva Peninsula						
CUP	**HP**	**LD**	**DV**	**Iowa**[a]	**Rural site in NJ**[b]	**Mississippi**[c]	**Mississippi**[d] **rural site**
	2000-03	2001-03	2002-03	2000-2002	Jan00-May 01	June, 1994	Apr-Sept, 1995
Acetochlor	43 ± 17	104 ± 85	97 ± 64	4,600 ± 3,000			
Alachlor	90 ± 35	26 ± 14	27 ± 14	1,100 ± 590		1,500 (8,800)	
Atrazine	255 ± 74	428 ± 477	318 ± 295	1,200 ± 720		1,100 (2,800)	(2,600)
CEAT	99 ± 54	72 ± 46	97 ± 62	1,200		(500)	
CIAT	28 ± 13	43 ± 31	61 ± 46	510 ± 300			
Metolachlor	718 ± 261	871 ± 994	889 ± 475	2,300 ± 1,200		1,200 (5,600)	
Metribuzin	385 ±144	66 ± 40	42 ± 29	<14		6,000 (6,600)	
Pendimethalin	41 ± 29	96 ± 97	722 ± 916	1,700 ± 1200		1,200 (3200)	
Simazine	36 ± 15	84 ± 87	68 ± 69	2,300 ± 1,600			
Trifluralin	32 ± 7	437 ± 263	788 ± 348	520 ± 230		2,400 (8,0000)	810 (5,500)
Chlorothalonil	1,351 ± 290	2110 ± 660	218 ± 118				
Chlorpyrifos	109 ± 29	156 ± 67	94 ± 42	1,000 ± 260		290 (1600)	(3,100)
≅-Endosulfan	118 ± 27	95 ± 31	230 ± 202		59		
≅-Endosulfan	19 ± 6.5	8.2 ± 2.8	29 ± 25		10		
Endo sulfate	14 ± 9.5	4.7 ± 0.8					
DiazInon	70 ± 17	158 ± 43		6,700 ± 8,600		80 (360)	(1,400)
Malathion	12 ± 6.6	45 ± 60	3.9 ± 1.8			230 (4,600)	
Cyanazine (HUP)	196 ± 58	50 ± 1.6	59 ± 2.6				(250)

[a] Peck and Hornbuckle 2005 (Avg ± 95% CI) (combined for for 3 sites - rural, urban and sub urban)

[b] Gioia et al. 2005

[c] Majewski et al. 1998. median(maximum). (along the river)

[d] Coupe et al. 2000

The CUPs concentrations in air followed the agricultural cycle closely. Generally, herbicides atrazine and metolachlor are applied together at the time of corn planting. Insecticide applications typically occur between March and August. The concentrations of most herbicides including atrazine metolachlor peaked at the time of corn and soybeans planting (April-May) and the concentrations gradually fell in other months (Figure 3-3). Insecticide concentrations were typically high during May-July and chlorothalonil concentrations peaked typically in August-September (Figure 3-4) in keeping with the application of these compounds on fruits and vegetables later in the year.

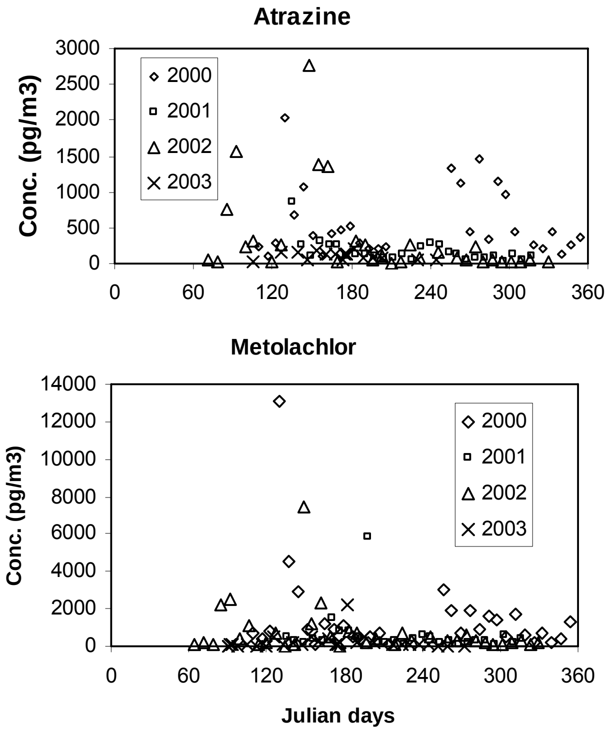

FIGURE 3-3 Concentration of herbicides in air at HP

In general, the concentrations of CUPs did vary with the site location. The levels in the air of some CUPs at the rural (LD) and semi rural (HP) were statistically higher (p<0.05). In particular, LD had the highest levels of the most highly used CUPs (atrazine, trifluralin, chlorothalonil, and diazinon) which was not surprising given the high corn planting in Delaware. HP had the highest levels of the insecticide (endosulfan) which ties in with the vegetable and fruit planting in the south of the site and the predominant wind direction. Trifluralin was detected more frequently at the sites in Delaware (91-100%) and the concentrations peaked later in June-July. The levels of trifluralin at DV were also higher than at the other two sites.

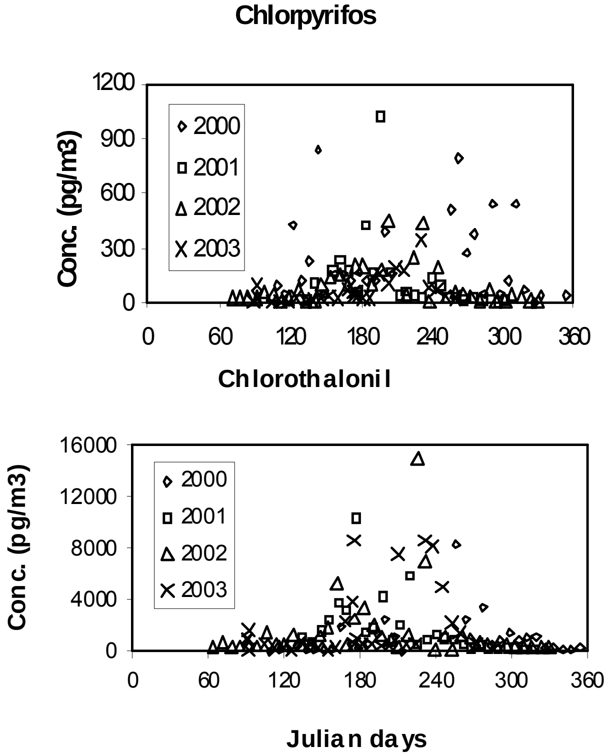

FIGURE 3-4. Concentrations of fungicide and insecticides in air at HP

Usage patterns over time impacted the occurrence (or detections) of CUPs in air (the data of pesticide usage in DE is not available and the data for MD has been used). The usage of acetochlor almost doubled while that of chlorpyrifos rose by an order of magnitude (making it the most used insecticide in MD) during the course of this study (Table 3-3). Increase in usage was clearly reflected by the steady increase in detections over the years (Figure 3-5). The detections of diazinon also went up from <50% (2000) to >75% (2003). The usage in MD did not increase significantly. However, the fact that the observed levels were higher at LD than at the HP suggests that usage in DE went up during this time. The use of glyphosate (RoundUp) and s-metolachlor increase sharply during this time making them the top most used herbicides. Consequently, the usage of atrazine and metolachlor (traditionally the top use herbicides on corn and soybeans) has dropped sharply (70-80% reduction in MD). The detections in air samples also dropped with time. Decreasing trends in detections for simazine and metribuzin were in keeping with their reduced usage. Occurrence in air of cyanazine, which was voluntarily phased out in 1999, also decreased over the years. The detections of other CUPs did not vary appreciably.

TABLE 3-3 Pesticide usage estimate for MD

	Pounds of active ingredients used			Ranking according to pounds used			
				overall	Class wise		
	2004	2000	1997		2004	2000	1997
Herbicides							
glyphosate	2,821,085	950,269	366,496	1	1	2	3
atrazine	1,109,475	617,627	487,837	3	2	3	2
s-metolachlor	872,768	109,566	NR	5	3	9	
metolachlor	246,509	1,000,656	695,586	7	4	1	1
simazine	72,883	301,427	172,911	19			
pendimethalin	51,682	533,715	339,845	22			
acetochlor	39,393	19,491	179,947	28			
trifluralin	36,019	34,509	9,657	32			
alachlor	34,906	16,931	124,261	33			
metribuzin	3,546	9,733	31,836	79			
malathiion	2,496	7,777	5,257	86			
Insecticides							
chlorpyrifos	2,375,008	136,670	72,289	8	1	3	3
diazinon	14,044	14,485	9,372	30			
endosulfan	12,205	4,359	2,092	32			
lindane (g-HCH)	24,011	343		42			
fipronil	15,696	78		49			
Fungicides							
chlorothalonil	1,529,493	113,510	48,331	2	1	1	1

NR : nor reported
references:
Maryland Pesticide Statistics for 2004
Maryland Pesticide Statistics for 2000

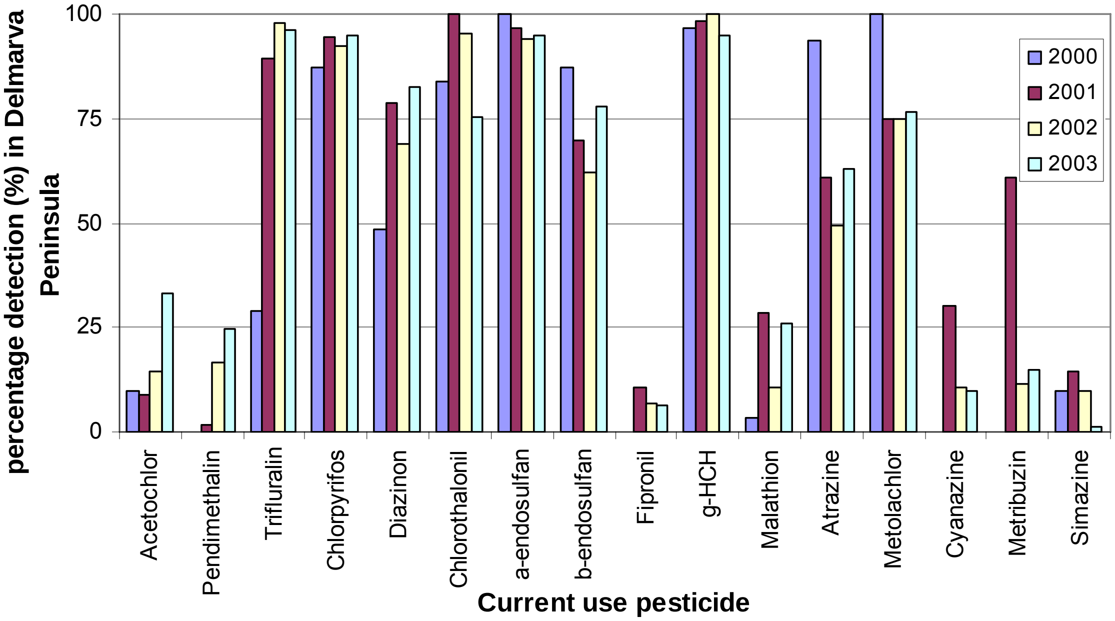

FIGURE 3-5 Detection of CUPs in air on a yearly basis

3.3.2 CUPs in precipitation

As was seen for their detections, herbicide concentrations were higher in samples collected around the corn and soybeans planting season and generally declined sharply after the end of June (Figure 3-6). The insecticides, in general, showed a greater variation in their detection and observed concentrations. Most insecticides as well as the fungicide, chlorothalonil, were detected in low concentrations throughout the year and concentrations typically peaked in July-August.

The concentrations of some pesticides in the precipitation are high enough to be a cause of concern. Among the most frequently detected CUPs, only two insecticides (endosulfan and chlorpyrifos) exceeded the marine water quality criteria in more than 2 samples (Table 3-4). Endosulfan, a restricted use pesticide (RUP) is among the most toxic

CUPs. The highest level in precipitation and exceedence of water quality criteria occurred at DV which is the site closest to sensitive wetlands. The high toxicity class of both endosulfan and chlorpyrifos makes their increased usage (Table 3-3) a cause of concern. Also, maximum observed concentrations of diazinon (0.2-1.3 μg/L) approach or exceed the 0.47 μμg/L level at which reduced fecundity has been reported for the sheep head minnow, a freshwater species in the region.

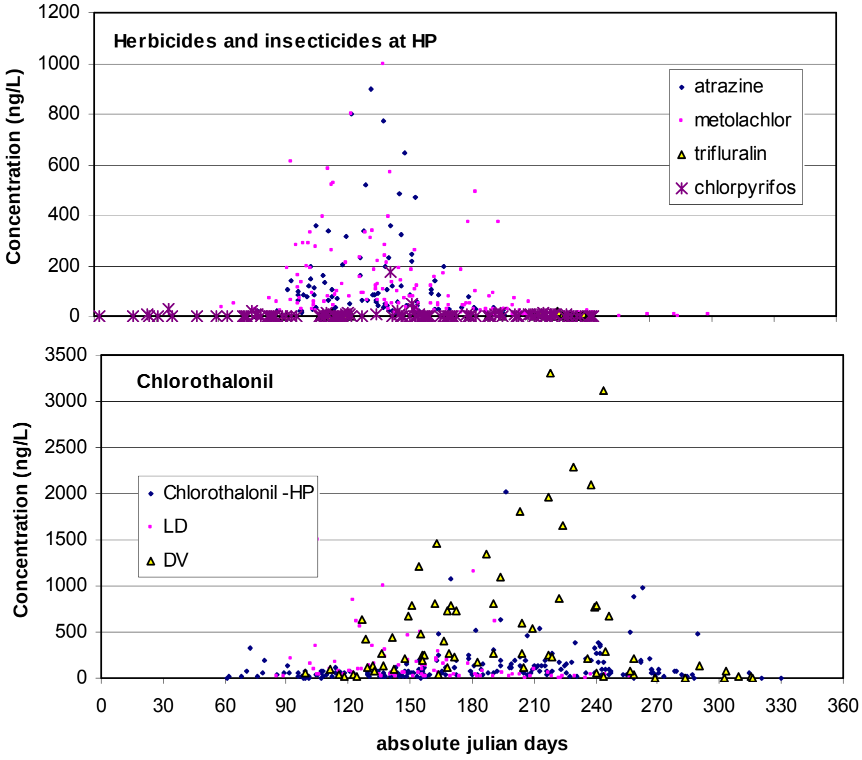

FIGURE 3-6 Temporal distribution patterns of CUPs in precipitation

TABLE 3-4 CUPs in precipitation and levels of concern

CUP	Type	Toxicity class *	Harmful water levels		Delmarva Peninsula					% of total samples (N=489)
			Criteria	level (ng/L)	max. observed conc. (ng/L)	detection in this study (%)	# samples harmful levels exceeded in harmful level			
							HP	LD	DV	
Chlorothalonil	F	II	96 h LC50 (atlantic oyester)	3200	2,000 - 5,600	86	0	1	1	0.4
metolachlor	H	III	96 h LC50 (daphnia magna)	25,000	1,000 - 1,500	55	0	0	0	0
Endosulfan	I	I	U.S. EPA marine water quality criteria	8.7	110 - 200	49	6	17	24	10
Chlorpyrifos	I	II	U.S. EPA marine water quality criteria	5.6	40 - 180	47	24	7	18	10
trifluralin	H	III	96 h LC50 (rainbow trout)	20	24 - 110	40	1	9	3	2.7
Atrazine	H	III	sublethal effects on phytoplanktonic algae	1000	860 - 900	37	0	0	0	0
Diazinon	I	II, III	reduced fecundity for sheepshead minnow	470	160 - 1,300	30	0	3	3	1.2
Malathion	I	III	U.S. EPA marine water quality criteria	100	50 - 360	12	1	0	1	0.4

EPA assigned. I: highly toxic; II: moderately toxic; III : slightly toxic

Observed atrazine seasonal maximum concentrations (Table 3-4) in this study approach the level at which sub lethal effects have been observed on phytoplankton algae. The highest level of trifluralin was at the rural site LD and the levels occurred above the safe limit for aquatic species more frequently than the other sites. The detection and average concentration of trifluralin in precipitation showed a steady rise at the three sites (Appendix S). This suggests that soluble herbicides are likely to be delivered to nearby wetlands in concentrations likely to be of concern during a rain event shortly after application. This raises concern for rivers and streams located close to the agricultural regions since the use of this herbicide seems to be on the rise. Chlorothalonil seasonal maximum concentrations (2,000-5,600 ng/L) approach the 96-h LC50 for Atlantic oyster (3200 ng/L), a critical component of the Chesapeake Bay ecosystem.

CUP wet deposition

Wet deposition flux (ng/m^2) of CUPs was calculated using the mass of pesticide deposited in an event in the sampler (C_r *V_r/ sampler lid area). The value for the different CUPs (excluding fipronil and metribuzin) at the different sites and years, during the main agricultural season (April-September) (Appendices S –U present the data). The combined pesticide fluxes varied across years and across sites (Table 3-5). The three sites differed in terms of the contribution of different pesticide classes to the overall flux. Of the three sites, DV had the maximum pesticide wet flux. The two sites near the Atlantic coast had a greater contribution from insecticides (LD:11-29% and DV:15-16%) as compared to HP (5-15%). The pattern of precipitation also influenced the contribution of pesticide class to total flux. Contribution by insecticides and fungicide was lowest at all three sites in the driest year 2002

(Table 3-5) while the contribution by the fungicide was greatest in the 2003 (above average rainfall year).

TABLE 3-5 Total depositional flux (ug/m^2) of CUPs during the main agricultural season (April – Sept)

	2000	2001	2002	2003
HP	166	93	89	150
H/I/F	47/ 5/ 49	48/ 7/ 45	60/ 6/ 34	44/ 15/ 41
LD		102	102	73
H/I/F		31/ 29/ 40	63/ 11/ 26	29/ 19/ 53
DV			166	635
H/I/F			55/ 15/ 30	17/ 16/ 67

notes:
the total reported flux here does not include fipronil and metribuzin
H/I/F : Percentage contribution to the total flux by herbicides/ insecticides/ fungicide

Total pesticide fluxes were highest in the month of May at HP, decreased during June, increasing again in July, and dropping steadily during August and September. Herbicides contributed most to the flux in April and May; whereas, the flux in September was almost exclusively contributed by insecticides and chlorothalonil. Chlorothalonil was the single biggest contributor to the overall flux (33-46%) followed by metolachlor (19-22%) and atrazine (10-16%). Owing to their more frequent application (e.g., every 7 to 14 days for potatoes and tomatoes) insecticides and the fungicide, chlorothalonil, were present in precipitation in all months sampled.

The fluxes were typically high in May and June also at LD. However, at DV, the highest flux was in May in 2002 and in July-August in 2003. This was owing to the high chlorothalonil flux at this time. Owing to the greater need for fungicide in the wet year, chlorothalonil flux increased 10-fold from 2002 to 2003 resulting in the shift in flux distribution pattern at DV in 2003.

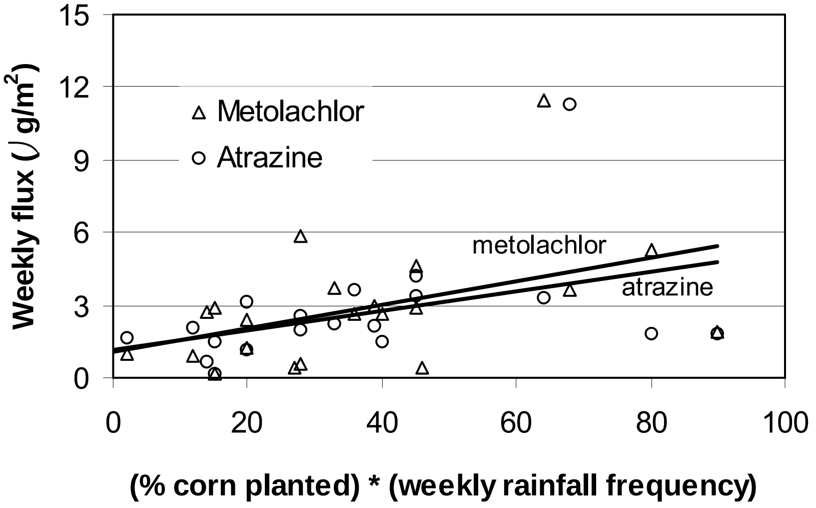

FIGURE 3-7 Impact of corn planting progress on wet flux of atrazine and metolachlor

The data from HP has been analyzed to investigate the influence of agricultural activity and intensity of rainfall on deposition fluxes. The details are presented later (Chapter 8). Briefly, the insecticides and fungicide fluxes appear to correlate with the total rainfall in the agricultural season and showed a statistically significant positive correlation with the amount of rainfall. Their high Henry's constant, lower solubility (as compared to the herbicides) and more frequent application explain the dependence of flux on total rainfall volume. In contrast, the herbicides, in general, have a lower Henry's constant and are washed out effectively even with a small amount of precipitation. Atrazine and metolachlor together contributed approximately two-thirds of the total herbicide flux at HP and their fluxes correlated well with the progress of corn planting (Figure 3-7). The weekly fluxes for atrazine and metolachlor for the duration of corn planting (combined data for four years) display a weak positive correlation (atrazine r = 0.41, metolachlor r = 0.45) with the frequency of rain events and percentage of corn planted in that week. A similar plot of metolachlor for soybeans did not show any positive correlation.

3.4 HUPs IN ATMOSPHERE OF THE DELMARVA PENINSULA

HUPs were detected in air the year round. The detections and levels were higher in the gas phase. In general, levels would start rising from April, peak around July-August and then subside (Figure 3-8). No HUPs occurred in the particulates at DV. Levels of those detected at LD (only 2 - dieldrin and mirex) and HP (HCH, chlordanes and heptachlor epoxide) were low (avg. < 1.5 p/m^3). The detections were mainly during the colder months (March, September). This was not surprising since the sampling was concentrated in the warmer part of the year when the volatility is higher and more occurs in the gas phase. As was expected, HUPs detection and concentrations in precipitation were very low. Except dieldrin, DDE (both 10%) and chlordanes (~6%) all other HUPs were detected in less than 2% precipitation samples. The low frequency of detection combined with low levels shows that wet deposition is not a significant source of HUPs to the region. The occurrence of HUPs in gas phase has been analyzed and factors impacting the levels investigated.

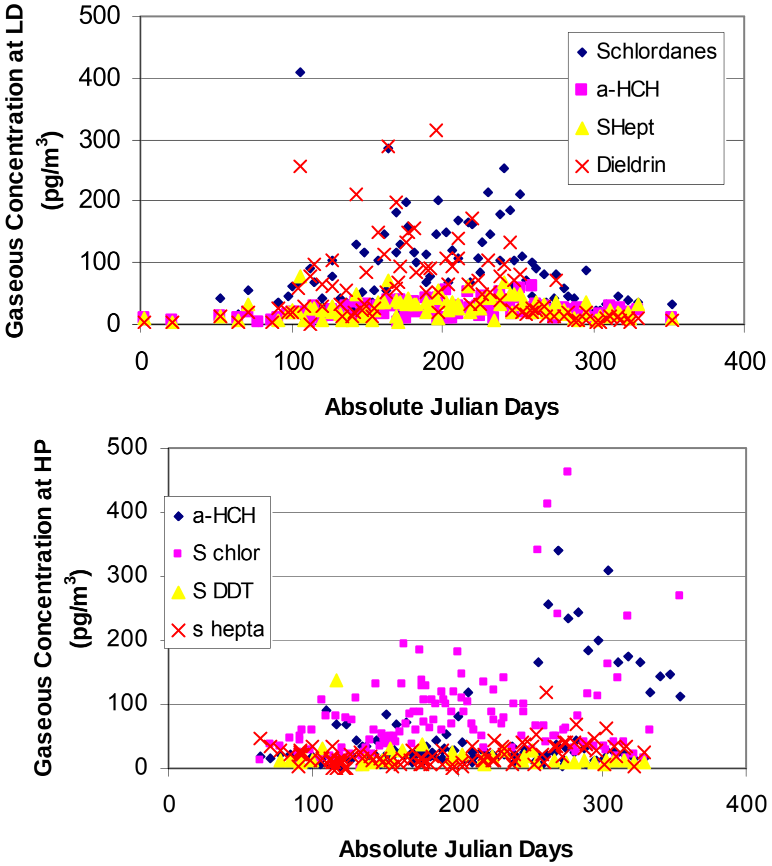

FIGURE 3-8 Levels of HUPs in air at LD (2001-2003) and HP (2000 – 2003)

3.4.1 HUPs in air

The levels of HUPs in general were low (Appendix N-O). Although they had similar levels for most HUPs, the sites did show some statistical difference in atmospheric levels for some. The background site DV had statistically higher levels ($p<0.05$) of DDTs and heptachlor epoxide (heptachlor TP). HP showed higher levels of two HUPs (dieldrin and α-HCH) and LD of cis-nonachlor. Higher levels for some HUPs were also seen in samples collected in colder months. These included chlordanes (LD: March 2002, HP: Oct-Nov 2000), α-HCH (HP: Oct-Nov 2001) and dieldrin (LD: March 2002). This suggests that levels in colder months might be higher than what has been detected from this study.

The levels of HUPs in Delmarva Peninsula follow the N-S descending pattern: are intermediate between the levels in the rural locations up north (Great Lake and Canada) and down south (Mississippi) (Table 3-6). Levels are higher than the rural areas in the south (Mississippi) and comparable to that in the Corn Belt. HCHs are lower than rural areas in the North. Chlordanes are comparable to Canada and higher than the G. Lakes rural sites. Except for DV, DDT levels are comparable to other areas. Levels of dieldrin are higher than all other reported values except Canada. Canada also has much higher levels of DDE.

TABLE 3-6 Levels of HUPs in the Peninsula (combined averages of all samples collected from 2000-2003) air as compared to other rural/remote locations in N. America

Geometric mean concentrations (pg/m^3) in gaseous phase at rural/remote regions in the US

	Upper Delmarva Peninsula				**Mid Atlantic**[a]			**Corn belt**[b]	**Great Lakes** [c]	**Canada** [d]	**Mississippi**[e]
	semi-rural	**rural**	background	overall	Coastal/marine sites		rural		4 remote sites	rural	rural sites
	HP	LD	DV	min - max	Delaware Bay	Sandy Hook	Pinelands				
	2000-03	2001-03	2002-03	2000-03	Jan 2000- May 2001	2000 - 2001		1996-1998	1996-98	Jul-Oct 2000	Apr-Sept, 1995
a-HCH	27	19	22	2 - 340	34	16	49			62	nd
g-HCH	30	28	24	1 - 400						40	nd
DDE	14	21	56	5 - 1,500				6.3		305	(1600)
Dieldrin	56	32	41	2 - 400	10	3	22	3.1	8.4 - 19	76	(640)
a-chlor	21	20	18	3 - 170				19		19	
g-chlor	21	22	19	2 - 180				16		16	
cis-non	0.9	2	2.1	1 - 10							
trans-non	16	15	13	2 - 120				16		15	
oxychlor	4.2	4.1	5.8	1 - 20							
Hepta	16	20	14	3 - 570	21	41	41	9.3			
Hepta Ox	3.8	4.9	8.8	1 - 30	9.3	1.5	16				
□ DDT	15	21	53	5 - 1,500	34	22	16		2.9 - 31		
□ chlordane	58	58	52		87	45	83		7.8 - 38	51	
□HCH	59	52	60						82 - 99	102	
□ Hept	18	22									

[a] Gioia et al. 2005
[b] Leone et al. 2001 (geometric mean)
[c] Buehler et al. 2001. these are averages
[d] Harner et al. 2004

3.4.2 Factors impacting the trends of HUPs in the atmosphere of the Delmarva Peninsula

The processes influencing the levels and temporal trends of HUPs in the region were investigated by determining the phase transition energy (ΔH, kJ/mol) and half life ($t_{1/2}$, in years) of HUPs. The observed concentration in gas phase (C_g pg/m^3) was converted to partial vapor pressure (P) using the ideal gas law. The commonly used Clausius Clapeyron (CC) equation was modified (Eq. 3.4-1) and used to perform a regression of ln(P) vs. 1/T and t, (modified) where T is the average ambient temperature (K) and t is the sample collection time (in Julian days relative to January 1, 2000). The coefficient a_1 is (-ΔH/R) and was used to determine ΔH (kJ/mol). The coefficient a_2, (in days^{-1}) expresses the rate of exponential increase ($a_2 > 0$) or decrease ($a_2 < 0$) of these partial pressures. Since HUPs are no longer in use, the levels are expected to be on the decline and a_2 is expected to be <0. Statistically significant ($p < 0.05$) rates were used to determine half-lives ($t_{1/2}$, in years) by using the formula $\ln(a_2)/365$ for each compound at each site.

$$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t \qquad (3.4\text{-}1)$$

The possible influence of local agricultural or urban areas on levels of HUPs in the region was investigated by including wind speed (WS mph) and wind direction (WD) in the Clausius Clapeyron equation as well (Eq. 3.4-2). Using the cosine and sine function of WD (degrees) enables a clearer determination of the impact of wind direction. According to trigonometric rules, $b_1 < 0$ (or $b_2 < 0$) means winds from east (or south) result in higher levels in air. The location of the sources can be identified with greater precision. If the values of the coefficients was significant ($p<0.05$), then $b_3 > 0$ would imply that increase in wind speed increased levels in air and shows that wind erosion from local fields is important. Use of natural logarithm of WS helps outlines variability with greater impact.

$$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS) \qquad (3.4\text{-}2)$$

This technique of multiple linear regressions to evaluate influence of different parameters (other than temperature) on atmospheric levels of contaminants has been refined by the IADN group working on the Great Lakes region. It has been found to improve predictions for PCBs in Great Lakes (Hillery et al. 1997) and OCs in Turkey (Sofuoglu et al. 2004).

The regressions were performed using the general linear model procedure in SAS (SAS Institute, Inc., Cary, NC). The results from the regressions (parameter values, ΔH and $t_{1/2}$) for the three sites are listed in Appendix V (HP), W (LD) and X (DV).

Results

HUPs responded well to the modified CC equation (Eq. 3.4-1). The regression results are highly significant ($p<0.0001$) for all compounds except DDE ($p=0.02$) at HP, LD ($p<0.001$ except heptachlor epoxide ($p = 0.01$)) and DV ($p<0.0006$ except oxychlordane $p=0.04$). Although the responses varied widely, up to 70% of the variation in HUP levels can be attributed to temperature and timing of sample collection (Table 3-7). Wind parameters influenced the levels of HUPs and including the wind parameters in the regression (Eq. 3.2) improved the regression (Table 3-8). Even though the co-relation (r^2) improved by 10 – 15 % in a few cases but the impact was not the same at all sites. The greatest number of compound were impacted at DV (6), lesser at LD (4) and least at HP (2). Half lives were not as much impacted as the heats of phase transition. Also it was WS which had a statistically significant impact at the rural and semi-rural sites while WD was the significant factor at the background location which is closest to urban locations.

Table 3-7 Heat of phase transition (ΔH, kJ/mol)for HUPs

HUP	Delmarva Peninsula									Great Lakes [1]	mid-Atlantic [2]
	Seni-rural (HP)			Rural (LD)			Background (DV)			7 sites	
	2000-2003			2001-2003			2002-2003			01/1996 - 12/2003	Jan 2000 - May 01
	r^2 range	Eq. 3-1	Eq. 3-2	r^2 range	Eq. 3-1	Eq. 3-2	r^2 range	Eq. 3-1	Eq. 3-2	range	range
ℵ-HCH	0.47 - 49	-9.8	-9.8	0.17-0.17	21 ± 5	19 ± 5	0.32- 0.36	14 ± 6	18 ± 7	21 - 30	19-38
DDE	0.24 - 0.34	26 ± 0.8	23 ± 8	0.37-0.41	52 ± 7.8	45 ± 7	0.61- 0.67	69 ± 10	76 ± 11	38 - 72	35 - 92
Dieldrin	0.51 - 0.52	69 ± 8	67 ± 8	0.41- 0.43	69 ± 9	65 ± 1	0.35- 0.42	67 ± 17	60 ± 21	61 - 92	49 - 116
ℵ-chlordane	0.38 - 0.39	37 ± 5.9	38 ± 6	0.48- 0.52	52 ± 6	49 ± 6	0.53- 0.62	52 ± 10	54 ± 10	33 - 57	44 - 65
ℵchlordane	0.38 - 0.39	35 ± 5.8	35 ± 6	0.51- 0.53	56 ± 6	53 ± 6	0.59- 0.66	52 ± 8	57 ± 9	27 - 57	41 - 60
cis-nonachlor	0.38 - 0.39	59 ± 7.4	63 ± 7	0.49- 0.53	38 ± 4.5	36 ± 5	ns				43 - 108
trans-nonachlor	0.38- 0.40	43 ± 6.6	43 ± 6	0.49- 0.52	55 ± 6	52 ± 6	0.59- 0.67	64 ± 10	69 ± 11	40 - 67	47 - 68
oxychlordane	0.38 - 0.60	43 ± 4.7	41 ± 5	0.35- 0.39	30 ± 5	26 ± 5	0.23- 0.39	ns	ns		44 - 82
Heptachlor	0.38 - 0.34	25 ± 7	21 ± 7	0.25- 0.27	27 ± 5	25 ± 5	ns				16 - 58
Heptachlor epoxide	0.38 - 0.37	58 ± 8.2	57 ± 9	0.16- 0.23	24 ± 8	21 ± 8	0.49- 0.50	33 ± 13	36 ± 16	28 -75	

Note:
Eq. 3-1 is the simple Clausius Clapeyron eq. with time attached
Eq. 3-2 is CC eq. with time and wind parameters
r^2 range: r^2 (Eq. 3-1)- r^2 (Eq. 3-2)
ns : (p<0.05)

ref : [1] Sun etal. 2006
[2] Gioia et al. 2005

TABLE 3-8 Half-life (yr) of HUPs in Delmarva Peninsula

	Delmarva Peninsula						**Great Lakes [1]**
	Seni-rural (HP, MD)		Rural (LD. MD)		Background (DV, DE)		7 sites
HUPs	Eq. 3-1	Eq. 3-2	Eq. 3-1	Eq. 3-2	Eq. 3-1	Eq. 3-2	Jan 1996 - Dec 2003
							min - max
□-HCH	1.2 ± 0.1	1.1 ± 0.1	ns	ns	(-1.9) ± 0.6	(-1.9) ± 0.6	3.1 - 4.2
DDE	3.7 ± 2.4	3.1 ± 1.7	ns	ns	ns	(-1.7) ± 0.8	5.9 - 7.0
Dieldrin	(-1.5) ± 0.3	(-1.5) ± 0.3	ns	ns	ns	ns	4.9 - 9.6
□-chlordane	2.2 ± 0.4	2.1 ± 0.4	ns	ns	(-1.3) ± 0.5	(-1.2) ± 0.4	8.8 - 13
□-chlordane	2.0 ± 0.3	2.0 ±0.3	ns	ns	(-1.3) ± 0.4	(-1.2) ± 0.3	6.1 - 11
cis-nonachlor	2.6 ± 0.8	2.2 ± 0.5	(-5.2) ± 2.5	ns			
trans-nonachlor	2.8 ± 0.6	2.8 ± 0.6	ns	ns	(-1.2) ± 0.4	(-1.1) ± 0.3	7.7 - 13
oxychlordane	3.5 ± 1.0	3.3 ± 0.9	ns	ns	ns	ns	
Heptachlor	1.7 ± 0.4	1.6 ± 0.4	ns	ns			
Heptachlor epoxide	1.5 ± 0.3	1.5 ± 0.3	ns	1.5 ± 0.3	(-0.8) ± 0.2	(-0.7) ± 0.2	(-2.5) - 7.7

[1] Sun etal. 2006

Eq. 3.1 is the simple Clausius Clapeyron eq. with time attached

Eq. 3-2 is CC eq. with time and wind parameters

ns : ($p<0.05$)

Processes impacting occurrence

The slope of the CC equation (ΔH) reflects the dominant phase transition process. As observed in most studies (Hoff et al. 1998), field ΔH values in this study (Table 3-7) are lower than enthalpies for physical partitioning (vaporization, octanol-air partitioning) suggesting that neither volatilization nor exchange with soil and vegetation is the process controlling the source and occurrence of these compounds to the atmosphere. The slopes are low and as suggested by Hoff et al. (1998) this indicates that long-range transport controls atmospheric concentrations of HUPs in the Delmarva Peninsula. The ΔH for the region are similar to what has been observed in the mid-Atlantic region and also the Great Lakes showing that in general, similar processes control the atmospheric transport and occurrence.

Even though long-range transport appears to be controlling, the levels of HUPs in this region (mainly the rural and semi-rural sites (HP and LD)), local sources also seem to be important as was observed by the response too the wind parameters. Most HUPs had slopes similar to the mid-Atlantic and concentrations are similar too. DDE and chlordanes (α-, γ-, trans-nonachlor) at the site closest to urban areas (DV) responded strongly to wind parameters, especially wind direction. The influence of WD was not significant at the other two sites. Winds coming from the south (where main agricultural region is) increased the atmospheric levels. DDE levels at DV were statistically higher. Although the level of trans-nonachlor at DV are not statistically higher, it's ΔH at DV are 10-20 kJ higher than at the other sites and is closer to ΔH_{vap}. Even though including wind parameters decreased the influence of temperature (i.e. lower ΔH) the case for DDE and chlordanes at DV was the opposite. The ΔH values increased by 2-5 kJ for chlordanes and by 7 kJ for DDE. The new value for DDE (76 kJ/mol) is very close to the ΔH_{vap} (86 kJ/mol). This shows that sources of these compounds are not far from the site at DV and can be urban in nature too. Chlordane's most common use in the U.S. was for termite control near homes, suggesting that urban areas could be emission sources at this point in time (USEPA PBT Chemical Program, 2002, Harner et al. 2004). Higher gas-phase chlordane concentrations at urban areas compared to rural sites has been reported for the mid-Atlantic region in New Jersey (Gioia et al. 2005). Thus, *both* historical local applications used to control termites *and* the influence of long-range transport from areas of high chlordane use could contribute to the relatively high chlordane concentrations at DV. Including wind parameters also improved prediction capability for DDE at LD and HP.

The impact of WS was seen on cis-nonachlor. Higher speeds decreased the levels at LD while increased them at HP. This combined with the fact the chlordane levels at DV are higher when the winds are from the south (direction of LD) suggests that fields close to LD are the local sources of chlordane in the region. Also influenced were heptachlor epoxide and α-chlordane at LD.

The half-lives of HUPs at HP (1-4 years) are 2 to 4 times lower than those in the Great Lakes region (Table 3-8). This is in keeping with the temperature and climate differences. Among the chlordanes, the shortest half life was of the g- isomer. This is the same as has been observed in the Great Lakes region and is in keeping with the greatest susceptibility of this isomer to degradation by microorganisms in soil (Kurt-Karakus et al. 2005; Beeman et al. 1981). Including wind parameters also resulted in decreased half lives of DDE (from 3.7 to 3.1 years), cis-nonachlor (2.6 -2.2 yrs) at HP. It also enabled the determination of half life of heptachlor epoxide (1.5 yrs) at LD which was not significant otherwise. The sampling duration and the number of samples from LD (95) and DV (47) were much smaller than those collected from HP (129). The smaller span and size of the dataset is the likely reason why the coefficient a_2 was either statistically insignificant or resulted in negative half lives for some of the HUPs at these sites.

3.5 WHAT THIS STUDY REVEALS ABOUT THE ATMOSPHERE OF THE DELMARVA PENINSULA

Both CUPs and HUPs occur in the atmosphere of the Delmarva Peninsula. Along with usage patterns, pesticide properties, weather and meteorological conditions, the occurrence of pesticides in the region also showed dependence on location of site. The levels of CUPs are markedly higher at the rural and semi-rural locations. The levels of HUPs were more consistent across sites.

HUPs occur more prominently in the air and are present throughout the year. HUP levels in the region are consistent with the N-S descending transect (occur in lower levels than in the region of Great Lakes). The intermediate levels of HUPs in Delmarva Peninsula atmosphere, as compared to other regions, suggest that presence of these compounds in atmosphere should not bring a greater risk to biota than in other regions. The aerial levels of one of the most toxic OC pesticide, DDT, have fallen below detection levels and the levels of other HUPs in the Delmarva Peninsula will fall below detection limits much faster than in the north. As expected, long-range transport is the main source of most HUPs in the region. However, levels in atmosphere of some HUPs respond to wind direction - presence of agricultural (or urban areas) where these compounds were used earlier, still influences the observed levels of some HUPs (chlordanes, DDE) in the region. Our results suggest that long range transport is not the sole source of these compounds to the Peninsula.

This study shows that the agricultural activity in the Upper Delmarva Peninsula is resulting in current use pesticides being present in substantial amounts in the atmosphere of the region. The atmospheric occurrence is dependent upon the usage patterns, pesticide chemistry and environmental conditions. The decrease in the use of the two major herbicides, atrazine and metolachlor (and increase in the use of trifluralin), is reflected in their reduced (or increased) occurrence and levels in the atmosphere. The voluntary ban of cyanazine has reduced atmospheric levels. The levels of CUPs in air and precipitation did respond to the changes in weather conditions.

The different classes of pesticides show markedly different behavior. Herbicides are present at high concentrations for a short time in the air. Due to their high solubility they are easily washed out and the concentrations are high in precipitation. Pre-emergence application on corn is the main source of herbicide wet flux in this region. Depending on pesticide properties, the deposition can be a function of timing of pesticide application, timing and amount of rainfall. Herbicide fluxes are dependent upon the timing of herbicide application as well as the frequency and distribution of rainfall events relative to application.

Insecticides and fungicide are present in air and precipitation at low concentrations throughout the year although the concentrations peak during the time of application. The insecticides are not very soluble and are not easily washed out in precipitation. Hence the wet deposition fluxes are correlated with the total amount of rainfall in the sampling period.

The concentrations of some pesticides in the precipitation are high enough to be a cause of concern. Levels of atrazine, endosulfan, diazinon and chlorothalonil did occur at levels that raise concern. The water bodies and associated wetlands are at risk from wet deposition of these pesticides arising from short range atmospheric transport. This information would be useful to applicators, regulators and producers in designing pesticide application programs to protect nearby wildlife areas. The highest pesticide flux occurred at Dover, which is closest to the wetlands and suggests that aquatic biota is likely to be at risk.

CHAPTER 4 - FACTORS INFLUENCING THE LEVELS OF CURRENT USE PESTICIDES IN THE ATMOSPHERE OF THE DELMARVA PENINSULA

4.1 INTRODUCTION

CUPs occur frequently in the atmosphere (gas as well as particulates) of the Delmarva Peninsula. Levels in air in this region are generally lower than in other agricultural regions. Both the levels and detection patterns in air largely follow the usage pattern (herbicides in the earlier part of the year, insecticides and fungicide in later months) and detection over four years responded to change in usage amounts (section 3.3.1). The levels and trends at the three sites were similar for most CUPs but levels of some did show variation. These observations are described in detail in section 3.3.1.

To assess the environmental fate of CUPs in Delmarva Peninsula it is important to determine the factors/processes that impact the occurrence and levels in the air. Considering that the land use in the Peninsula is predominantly agricultural, volatilization from fields where these pesticides are applied is likely an important source, making temperature an important factor. Temperature dependency can be affected by confounding factors such advection and meteorological conditions. When one correlates atmospheric levels with temperature applying the Clausius- Clapeyron (CC) equation (Eq. 1.5-1) (standard method to evaluate air concentrations), the values of slope (m) and coefficient of determination (r^2) help to infer the importance of temperature in controlling the gas-phase ambient concentrations of SVOCs and the relative importance of other factors (Lee et al. 2000). Generally steep slopes and high r^2 values indicate that temperature-controlled air–surface cycling and short-term transport influences the ambient gas-phase concentrations (Hoff et al. 1998; Wania et al. 1998). Relatively shallow slopes and low r^2 values suggest that other factors (i.e., advection, ongoing sources, wet and dry deposition, atmospheric reactions) and long-range transport influence concentrations (Lee et al. 2000).

Agricultural cycle has been shown to markedly influence air levels of CUPs (Cortes et al. 1999). Timing of the occurrence of temperature peak and pesticide usage peak has a big impact on the scatter of levels and response to the CC equation. Lag in the timing of peak results in large scatter in the air concentration data and the CC equation does not fit well with the spread of data. However, when both the cycles peak around the same time, the slope of the CC equation is uniform. This would result in temperature alone being considered the governing factor even though the timing of agricultural usage is equally important. Wind parameters (speed and direction) have also been found to impact air levels of CUPs (Sofuoglu et al. 2004). This chapter focuses on the occurrence of CUPs in gas phase. The occurrence in particle phase is discussed later in Chapter 5.

The objectives of this chapter are 1) to determine if factors other than temperature are important in controlling air concentrations in the Delmarva Peninsula and 2) to determine whether concentrations are influenced by site location and proximity to agricultural field. This involved evaluating if the local agricultural activity influences atmospheric levels of (CUPs) and investigating the influence of wind parameters (speed and direction) on observed concentrations. We expected that both wind parameters and agricultural activity (other than volatilization) will contribute to the observed levels of CUPs in the region. The temperature in the Peninsula is highest in June- Sept which is also the time when insecticide and fungicide application occurs (Figure 4-1). The prevailing wind direction on the Delmarva Peninsula was from west-southwest in summer, while during winter and early spring, easterly surface winds frequently resulted in incursions of relatively "clean" oceanic air. Both HP and DV, which lie downwind from the main agricultural region, are likely to be impacted by the direction of wind flow.

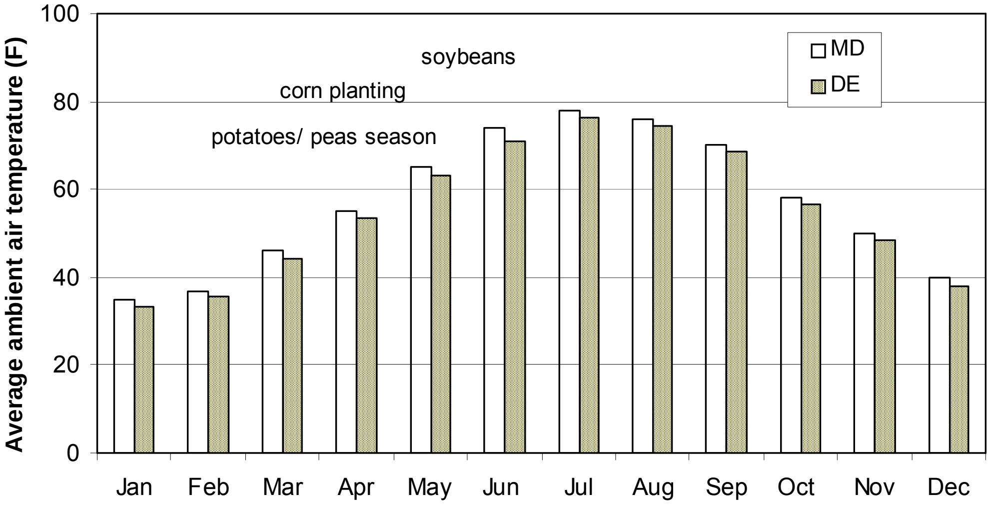

FIGURE 4-1 Average monthly temperature in Maryland (eastern shore counties) and Delaware (2000-2003)

4.2 DATA ANALYSIS

24 h air concentrations (on a weekly basis) of 19 CUPs (including TPs) during the main sampling period (April-Sept) over four years (2000-2003) at three sites (rural, semi-rural, background) in the Delmarva Peninsula were determined (Table 3.1). Details on air sample collection, extraction and analysis are given in sections 2.4.1, 2.5.1 and 2.6.2.

The processes influencing the levels and temporal trends of HUPs in the region were investigated by determining the phase transition energy (ΔH, kJ/mol) and half life ($t_{1/2,}$ in years) of CUPs. The observed concentration in gas phase (C_g pg/m^3) was converted to partial vapor pressure (P) using the ideal gas law. The dependence of concentrations on different factors was examined through linear regression of vapor pressures and the modified CC equations (Eq. 4.2-1, 4.1-2, 4.2-3) were used for linear regressions.

The modified CC equation (Equation 4.2-1) which includes the sample collection time (t, in Julian days relative to January 1, 2000) was used to examine the influence of temperature (T, K).

$$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t \tag{4.2-1}$$

The coefficient a_1 is ($-\Delta H/R$) and was used to determine ΔH (kJ/mol). The coefficient a_2 (in days^{-1}) expresses the rate of exponential increase ($a_2 > 0$) or decrease ($a_2 < 0$) of these partial pressures (or levels). To determine half-life ($t_{1/2}$, in years) the value of a_2 was substituted into the $\ln(a_2)/365$ for each compound at each site.

The effect of wind speed (WS, mph) and direction (WD) on gas-phase atmospheric concentrations of individual CUPs was investigated adding these parameters into Eq. 4.2-1 and using multiple linear regression analysis as in Eq. 4.2-2

$$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS) \tag{4.2-2}$$

The value of coefficient b_3 shows the importance of wind erosion. A positive value (i.e. $b_3 > 0$) would imply that increase in wind speed increased levels in air and shows that wind erosion from local fields is important. According to trigonometric rules, $b_1 < 0$ (or $b_2 < 0$) means winds from east (or south) result in higher levels in air. Hillery et al. (1997) are among the first authors to investigate the influence of wind parameters on aerial concentrations of pollutants (PCBs) in Great Lakes region. Sofuoglu et al. (2004) used a similar method for investigating air levels of OCs in Turkey.

The impact of local agricultural activity was investigated by incorporating the agricultural cycle in the regression (Eq. 4.2-3). Among the several functions available (Gaussian, sinusoidal, lorentzian), lorentzian function (with it's greater variable width) has been found to provide the best fit to highly scattered air concentration data of CUPs (Cortes et al. 1999). Since the concentrations of CUPs in the study were quite scattered, Lorentzian function for to simulate agricultural cycle has been used in this study.

$$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + \frac{a_3}{1+\left(\frac{t_a - a_5}{a_6}\right)} \qquad (4.2\text{-}3)$$

For the agricultural cycle a_3 is the amplitude of the function, t_a is sample collection time (absolute Julian days), a_5 is the center (in days) of the Lorentzian distribution; and a_6 is the width (in days) of the distribution at half-height. The maximum height of the function is at a5 and will represent the center the application cycle. Since the application of most herbicides in the region is more time specific (late March-April on corn, soybeans) the a_5 is expected to be ~120 d as compared to insecticides which are applied later and would have higher values of a_5 (~150 d). Similarly, the spread of the function (a_6) is expected to be greater for insecticides and fungicide keeping with their longer time of use.

The parameters in these equations were estimated using SAS (SAS Institute, Inc., Cary, NC). For Eq. 4.2-1 and 4.2-2 multiple linear regressions were performed by using general linear method procedure (glm) and parameter a_0 - a_2 and b_1-b_3 were estimated. The residual data from Eq. 4.2-1 was fitted the periodic function (Lorentzian) by using Excel Solver (Microsoft Corporation, Bellevue, WA) and the initial values of a_3-a_6 (for Eq. 4.2-3) were determined. The initial parameters were then optimized using the nonlinear regression procedure (NLIN) in SAS.

The resulting parameter estimates (including half lives, heats of phase transition) are listed in Appendix V (HP), Appendix W (LD) and Appendix X (DV). The results below the level of significance (i.e. $p>0.005$) were discarded and have been reported as non-significant (ns). Table 4-1and Table 4-2 list the heats of phase transition and half lives, respectively, calculated with the three equations for CUPs.

4.3 RESULTS

CUPs responded to the influence of temperature, wind parameters and agricultural cycle. Owing to the largest dataset, statistically significant responses were seen at HP and the least at DV (smallest dataset, n= 71 over two years). Discussion is hence, mainly focused on data from HP. The correlations are quite significant and the coefficient of determination (r^2) with Eq. 1 ranges up to 67%. This high response to temperature was quite expected and shows that volatilization is an important source of CUPs to the atmosphere. Co-relations improved slightly with the wind parameters (Eq. 4.2-2). Inclusion of agricultural cycle (Eq. 4.2-3) improved fit between data and predicted concentration sharply. The r^2 values increased sharply (up to 35%) and the highest r^2 value (75%) is with Eq. 4.2-3. The ΔH and $t_{1/2}$ from the three sites and by the three equations are summarized in Table 4-1 and Table 4-2. Low values of ΔH for most CUPs and the high response to agricultural cycle suggests that temperature (hence vaporization) is not the controlling factor and local agriculture activity also influences the levels of these compounds in the atmosphere of the region.

4.3.1 Impact of wind parameters on air concentrations

Both wind direction and wind speed impacted levels in air. WD impacted more CUPs (8) while WS influenced just two CUPs. Increase in WS raised levels of CIAT at HP (Appendix V). Increase in WS decreased the levels of chlorpyrifos at LD while decreased them at DV (Appendices W and X). Wind direction had a greater impact – the levels of 8 CUPs were influenced. Winds coming from the main agricultural region (mostly corn and soybeans fields) increased levels of the main herbicides (atrazine and metolachlor) at HP and levels of the insecticides (diazinon, α-endosulfan, and chlorpyrifos) at DV (Figure 4-2). Only one CUP (diazinon) was impacted by WD at LD, which was not surprising since it is the site closest to agricultural fields and the levels are normally higher than the non-rural sites (as is confirmed by the fact that the levels of atrazine, trifluralin, chlorothalonil, diazinon are statistically higher at LD). Our results strongly suggest that the impact of wind parameters shows that the location of a site with respect to proximity to an agricultural plot and wind direction influences the level of pesticides in air.

TABLE 4-1 Heats of phase transition (ΔH, kJ/mol) of CUPs in the Delmarva Peninsula

CUPs	Enthalpy of vaporization[1] ΔH_{vap} (kJ/mol)	Heat of phase transition ΔH (kJ/mol) of current use pesticides in the gas phase of the air in the Delmarva Peninsula								
		semi rural (HP)			rural (LD)			background (DV)		
		Eq. 4.1	Eq. 4.2 (wind para)	Eq. 4.3 (ag cycle)	Eq. 4.1	Eq. 4.2 (wind para)	Eq. 4.3 (ag cycle)	Eq. 4.1	Eq. 4.2 (wind para)	Eq. 4.3 (ag cycle)
Herbicides										
Alachlor		29 ± 10	23 ± 11	14 ± 12						
Atrazine		33 ± 10	29 ± 10	28 ± 10			ns			102 ± 28
CEAT		13 ± 19	11 ± 22	29 ± 19						
CIAT		24 ± 24	33 ± 25	66 ± 21						
Metolachlor		29 ± 9	21 ± 10				ns			
Metribuzin		ns	ns	ns	ns					
Trifluralin					57 ± 12	51 ± 13	ns	99 ± 16	102 ± 17	ns
Insecticides										
Chlorpyrifos		67 ± 9.0	70 ± 10	57 ± 10	82 ± 12	76 ± 12	ns	64 ± 20	77 ± 19	ns
α-Endosulfan	80	70 ± 7.0	68 ± 8.0	37 ± 13	103 ± 10	101 ± 11	36 ± 16	104 ± 22	114 ± 25	107 ± 17
β-Endosulfan	82	ns	ns	62 ± 15	65 ± 13	54 ± 16	ns	ns	ns	55 ± 22
Endo sulfate	85	(-23) ± 11	(-22) ± 20	41 ± 18	38 ± 6	38 ± 6	ns	ns		ns
Diazinon		26 ± 8.4	21 ± 9	46 ± 16	93 ± 13	88 ± 14	89 ± 19	37 ± 18	ns	
lindane (γ-HCH)		30 ± 6.4	26 ± 6.8	24 ± 7	51 ± 9	52 ± 9	33 ± 10			ns
Fungicides										
Chlorothalonil		61 ± 8.0	57 ± 9.0	45 ± 9.0	47 ± 9	50 ± 10	38 ± 10	ns		

[1] Hinkley et al. 1990

Noes :

blank cells for ΔH mean that the compound did not respond to the regression

ns : non significant ($p>0.05$)

TABLE 4-2 Half lives ($t_{1/2}$, yr) of CUPs at the semi-rural site in Delmarva Peninsula

	Half lives ($t_{1/2}$,yr) in Delmarva Peninsula air		
	semi rural (HP)		
CUPs	Eq. 4.1	Eq. 4.2 (wind para)	Eq. 4.3 (ag cycle)
Herbicides			
Alachlor	1.2 ± 0.2	1.1 ± 0.2	1.3 ± 0.3
Atrazine	1.0 ± 0.1	1.0 ± 0.1	1.0 ± 0.1
CEAT	(-0.5) ± 0.1	(-0.5) ± 0.1	(-0.5) ± 0.1
CIAT	1 ± 0.3	1.2 ± 0.4	1.3 ± 0.4
Metolachlor	0.9 ± 0.1	0.9 ± 0.1	
Metribuzin	0.6 ± 0.1	0.6 ± 0.1	0.7 ± 0.1
Trifluralin			
Insecticides			
Chlorpyrifos	13 ± 1.2	14 ± 1.2	ns
□-Endosulfan	1.6 ± 0.3	1.6 ± 0.3	1.6 ± 0.3
□-Endosulfan	1.6 ± 0.4	1.8 ± 0.5	1.5 ± 2.7
Endo sulfate	1.1 ± 0.2	1.3 ± 0.3	1.1 ± 0.2
Diazinon	15 ± 25	17 ± 31	ns
lindane (□-HCH)	1.5 ± 0.2	1.5 ± 2.1	1.5 ± 11
Fungicides			
Chlorothalonil	15 ± 25	13 ± 20	ns

Noes :

blank cells for □H mean that the compound did not respond to the regression

ns : non significant (p>0.05)

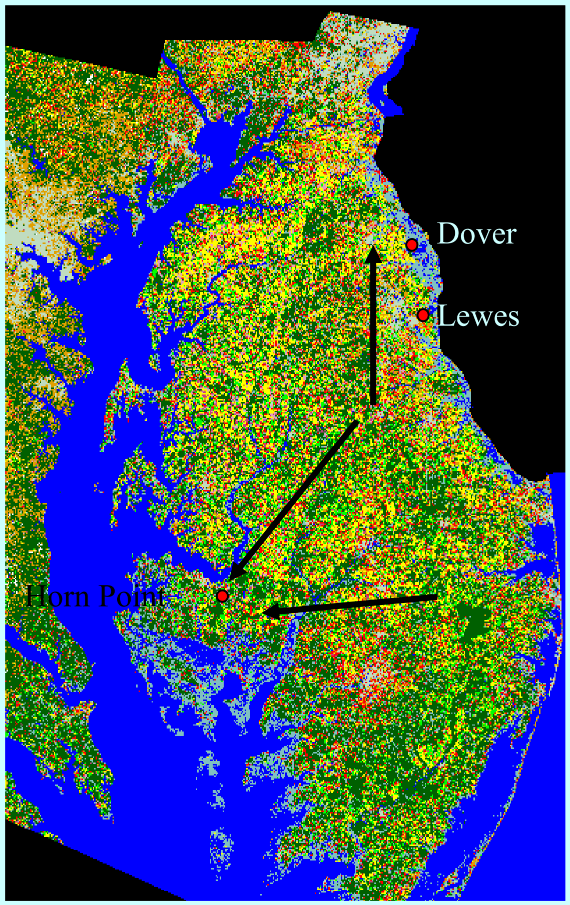

FIGURE 4-2 Impact of wind direction at sites downwind (HP, DV)

4.3.2 Impact of agricultural cycle in predicting the levels of CUPs

Agricultural activity in the region does strongly influence the levels in the atmosphere as is evident by the strong response to the agricultural cycle. The parameters determined from the regressions were used to predict levels of CUPs under given conditions and were compared to observed levels. At HP almost all CUPs responded and the agreement between predicted and observed values was quite significant. Figure 4-3 illustrates the predicted (solid line) and observed (dots) concentrations of the major compounds in each pesticide class (atrazine, α-endosulfan and chlorothalonil).

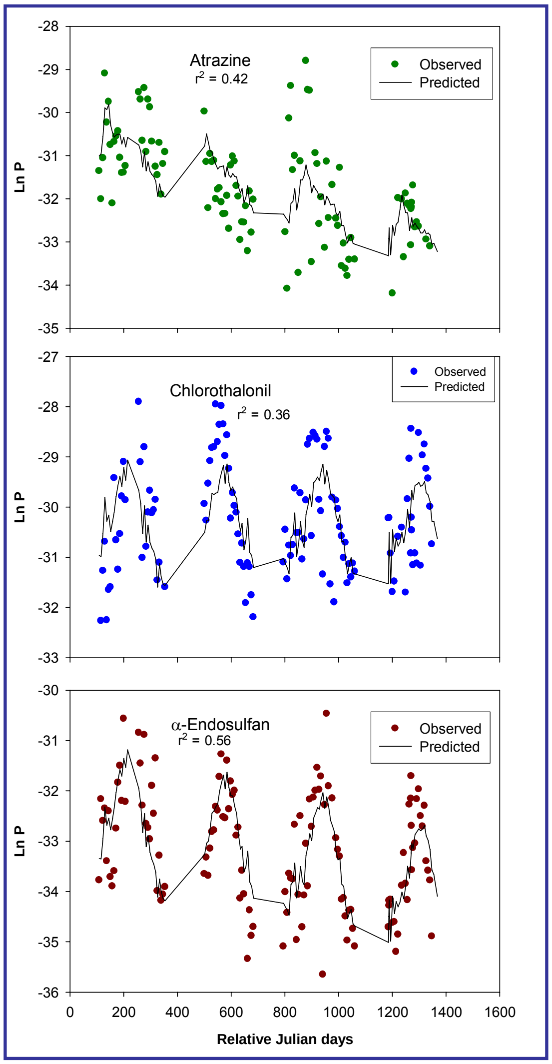

FIGURE 4-3 Agreement between the observed and predicted levels of CUPs (at HP)

The predicted function width at half height (a_5) and the amplitude (a_3) of the function (in terms of vertical spread of vapor pressure, Pa) compare quite well with actual field values. It is important to note that at LD, atrazine and metolachlor responded only to the agricultural cycle. The same was the case for lindane (γ-HCH) and atrazine at DV. The center of the agricultural cycle for the classes of compounds (Table 4-3) agreed with the usage pattern in the region - March- June for herbicides, April-November for insecticides and May-August for fungicides (Figure 4-1). Inclusion of the agricultural cycle greatly improved the prediction capability for levels in air. The increase was 5-10% in most cases. β-endosulfan was the CUP for which the improvement was quite high and was seen at all the sites: by 42% at DV (20-62%), 34% at HP (21-55) and 24% at LD (24-48).The improvement was also significant for CIAT at HP (39 to 73%) and lindane at LD (29 to 59%).

TABLE 4-3 Center of agricultural cycle (a5 , days) of different classes of CUPs in the Delmarva Peninsula

CUP class	center of agricultural cycle (d)
herbicide	101 - 175
insecticide	135 - 315
fungicide	169 - 211

The improvement in co-relation and prediction capacity by including the agricultural cycle while evaluating the levels of CUPs shows that agricultural activity in rural areas does impact the levels observed in places close to agricultural regions. The fact that atrazine and lindane responded only to the agricultural cycle at the background location highlights the fact that the CC equation does need to be modified to include relevant parameters when examining the atmospheric levels of current use pesticides to properly reflect local activities.

4.3.3 Processes impacting the occurrence in atmosphere

The process controlling (or most impacting) the occurrence of organic compounds in the atmosphere can be determined by examining the heat of phase transition (ΔH) obtained from field data and comparing it to the enthalpy of different phase transitions. Since the main process controlling the occurrence in air for CUPs is likely to be volatilization from agricultural fields, enthalpy of vaporization ΔH_{vap} is the most relevant parameter to evaluate the occurrence in air. Unfortunately, ΔH_{vap} values for most CUPs (except endosulfans) is not readily available. Also, since determination of field requires long term studies, which for CUPs are not that common, the field values from any other site are also not available. Therefore, it is not possible to compare the processes controlling the occurrence of CUPs in the atmosphere of the Delmarva Peninsula to other agricultural areas in the U.S. One exception to this is lindane. The reported ΔH from the Great Lakes (23 ± 3 kJ/mol) compares well with the Delmarva Peninsula (24 – 33 kJ/mol) and suggests the same processes being active at both locations.

ΔH for the CUPs were generally low and did show some variation with class of pesticide - in general, values for herbicides lower than that for the insecticides (Table 4-1). When only temperature was considered (Eq. 4,2-1), the OC compounds had higher ΔH as compared to other compounds (herbicides and the OP insecticide diazinon). Inclusion of wind parameters altered the values a bit but the change was not large for most compounds. The agricultural cycle made a big difference in the values of ΔH. The values for some CUPs almost halved (alachlor, α-endosulfan) while that for some others almost doubled (CEAT, CIAT, diazinon) (for HP). The decrease in the value for chlorothalonil and chlorpyrifos (10-15 kJ) is also significant

The high change in the value of ΔH made a big difference in the predicting the controlling process. If the value of ΔH had not altered appreciably after incorporation other factors, it would have meant that temperature is the main factor controlling the air levels (and volatilization is the main process). The change in value of ΔH with the incorporation of agricultural cycle shows that temperature and agricultural cycle are acting in conjunction. Application pattern is more important in some cases (halving of ΔH) while volatilization after application dominates in others (doubling of ΔH).

The possibility of error in judgment by non-inclusion of agricultural cycle for CUPs in rural areas is evident by examining endosulfan. . The original ΔH for the endosulfans were close to their enthalpy of vaporization (80 KJ/mol) and would suggest that vaporization is the process dominating it's occurrence in the atmosphere and that temperature is the driving force. However, inclusion of the agricultural cycle halves the ΔH and shows that temperature is not the driving force, agricultural activity is equally important. In contrast, β-endosulfan responds only to the agricultural cycle showing that local agricultural activity controls atmospheric occurrence. The agreement in value of heat of phase transition obtained with agricultural cycle (62 ± 15 kJ/mol) and heat of vaporization (82 kJ/mol) suggests that volatilization during time of agricultural activity is the chief source. Although the ΔH_{vap} for other OCs are not available, the values are likely to be close to those for the endosulfans (~ 80 kJ/mol). The field ΔHs of most OCs (~ 30-50 kJ/mol) are rather low as compared to this value. This suggests that volatilization from surfaces is not the sole process controlling their level in the atmosphere.

At LD and DV, the regression with the agricultural cycle was not statistically significant for most CUPs. However, the values from the other two regressions were quite similar to those from HP suggesting that the presence in the atmosphere is being controlled by similar processes at the two sites (and the Peninsula in general). An exception to this observation is diazinon. It's ΔH at LD (90 kJ/mol) is almost double that at HP (46 kJ/mol) and is likely to be close to the enthalpy of vaporization. Combining to this the observation that the levels of diazinon in air at LD were statistically higher than at the other sites (and concentrations at LD increase when the wind is from the east) suggests that vaporization from close agricultural fields (most likely to the east of the site) controls the levels of diazinon at LD. Unlike the other sites, the ΔH at of $\alpha-$endosulfan DV remained quite high (107 kJ/mol) with all the equations which suggests the existence of some very close source.

The results of regressions show that volatilization from fields is not the sole process controlling the levels of CUPs in the region. Agricultural usage pattern is equally important and it's inclusion in regression enables a better understanding of the processes involved.

4.3.4 Half lives of CUPs

The half lives of CUPs were generally small. They varied by class of pesticide: lowest for herbicides (~1 yr) followed by insecticides (~1.5 yr). The highest observed was that of the two OP insecticides (chlorpyrifos and diazinon) and fungicide chlorothalonil (~15 years and shows the high persistence of these CUPs. The half lives of CUPs at LD and DV were either non significant or negative (which means concentrations increasing with time) and have not been reported in Table 4-2. The non significance can be attributed to small datasets at these two sites. The concentration increasing tendency can be explained by weather conditions. Samples at DV were collected in the drought year (2002) and with above average rainfall (2003). The amount of CUPs used is likely to have been below average in 2002 and above average in 2003 and this would translate into higher air concentrations in 2003. This trend was observed for most insecticides at DV (Appendix J). The half lives did not show much variation with the inclusion of the wind parameters and agricultural cycle. Half life of lindane in this region (1.5 yr at HP) is almost 10 times less than that in the Great Lakes (12 yr, Cortes et al. 1999) and highlights the difference in the degradation pathways in the cold and temperate zones. Non-availability of data from other rural areas in the U.S. does not permit any comparison with any other location.

4.4 CONCLUSIONS

Evaluation of the aerial concentration data reveals that volatilization is not the only process influencing aerial agrochemical concentrations. Agricultural activity greatly impacts the levels of CUPs in air in a rural area. Wind erosion from fields (represented by wind speed) does not impact air levels as much as the location of a site. Places located downwind from an agricultural field experience greater than expected levels of CUPs.

With agricultural activity and temperature peaking at the same time, levels in the atmosphere can be quite high. A decrease in ΔH with comparable increase in fit of model (with agricultural cycle) with levels in the field reiterate the fact that non inclusion of agricultural cycle results in giving vaporization a greater than realistic importance in the occurrence of CUPs in the gas phase in atmosphere. CC equation needs to be re-examined to increase its prediction capacity for CUPs, especially in rural areas where agricultural activity and proximity to the agricultural location strongly impacts the levels. Our results also illustrate the difficulty in addressing the fate and levels of pesticides in the atmosphere without large data sets available (both specially and temporally). While the 3 years duration of this study at 3 different locations around the base represent one of the largest datasets available, in some instances it was not enough to discern the relative importance of the different factors.

CHAPTER 5 - FACTORS IMPACTING AERIAL PHASE DISTRIBUTION OF PESTICIDES: STUDY OF VAPOR PARTICLE PARTITIONING

5.1 INTRODUCTION

Semi volatile organic compounds (SVOCs) have intermediate volatilities, i.e., vapor pressure in the range of 10^{-1}-10^{-6} Pa (Cotham and Bidleman, 1992) and as a result, these compounds distribute themselves to various degrees between the gas and the particle phases in the atmosphere. The phase in which these compounds are present will affect their deposition (Bidleman and Harner, 2000), chemical reactions, long-range transport, and public health and ecosystem effects. Knowledge of the vapor-particle partitioning of the SVOCs is critical to understanding their fate in the environment.

In most environmental risk assessment studies, data on the partitioning behavior of toxic chemicals is not available and it is often estimated from available models. The most widely used theoretical models for estimation of SVOC partitioning to aerosols is the Junge-Pankow model (Junge 1977; Pankow 1987). It is essentially a Langmuir isotherm which relates the fraction of the compound adsorbed to particles (Φ) to the sub-cooled liquid-phase vapor pressure of the pure compound (p_L^0) and the particle surface area per unit volume of air (θ, cm^2 aerosol/cm^3 air). Although the model has several limitations (e.g. ignores absorption which, depending on aerosol properties, can also be an important sorption process), the simplicity of the J-P model makes it a handy tool to estimate partitioning. The model has been found to work well for the more hydrophobic compounds (such as the PAHs and the PCBs) and for predictions in urban environment (Bidleman et al. 1999). However, it does not work equally well for all situations. It doesn't work well for rural environments and low volatility compounds. The model has been found to both over predict (OCs Bidleman et al. 1999) and under predict (Sofuoglu 2004) the particulate fraction of pesticides in rural environment. Such deviations suggest that volatilization is not the sole source of these compounds to the atmosphere.

Incorrect predictions can be due to several reasons. The occurrence of the compound in a non-exchangeable form within the particle can result in greater than expected loads in the particle phase (Sansui et al. 1999). Others have suggested limitation in the experimental protocol, they have suggested that gas sorption onto the filter as another likely factor contributing to the increased load present on the filter and thus an overestimation of the amount present in the particulate phase (Mader and Pankow, 2000; Cotham and Bidleman 1992). Besides physical properties of the chemical such as vapor pressure, polarity, and hydrophobicity (Junge 1977; Pankow 1987) and temperature, partitioning has been found to be influenced by aerosol properties such as organic content (Sofuoglu et al. 2004), meteorological conditions such as relative humidity (Goss 1993; Pankow et al. 1993; Sansui et al. 1999) and wind speed (Sofuoglu et al. 2004).

So far, studies are scarce on the partitioning behavior of modern agrochemicals (such as herbicides) which are more polar than OCs. For many SVOCs, meteorological factors such as relative humidity have also been found to affect the partitioning behavior. No studies are available which evaluate partitioning in the rural areas where these compounds are used. In rural areas it is highly probable that agricultural cycle influences the amount that occurs in the particle phase. We speculate that the amount on the filters may not be in equilibrium with the gas phase concentration and just as in the gaseous phase, the agricultural cycle in the region is driving the concentrations on filters.

Wind erosion of soil particles from fields that have recently received pesticide applications could also contribute to the atmospheric particulate concentrations. Pesticide laden soil particles take time to equilibrate with the surrounding air. The idea of soils particles as a source of atmospheric aerosols in this region is a theory that has been suggested by Kim et al. (2000). While studying the wet deposition of trace elements to regional bays (Chesapeake and Delaware Bays), a seasonal variation in the fluxes of Al, Fe and Mn (originate from earth's crust and most enriched in coarse aerosols) was noticed with pronounced inputs during spring/summer (also reported by Wu *et al*. 1994) as compared to the rest of the year. This appears to be associated with timing and intensity of soil disturbances related to regional agricultural practices. Moreover, the Al/Fe ratio in the air particles was close to that found in the earth's crust, indicating the sources of Al and Fe primarily from the resuspended natural soils. These observations by Kim et al. suggest that during spring and summer, the large disturbance of surface soils lead to an increase in the coarse sized fraction (with large fraction of mineral surfaces) of particulates in the atmosphere. The tilling of fields or even moving planting and spraying equipment through the field, prior to and during pesticide application would result in the suspension of soil particles and could also be a source. These soil particles can be expected to contain the aged residue of the pesticide applied in the previous years which would then become airborne and may take longer times to equilibrate.

The objective of this study is to determine the factors influencing the partitioning behavior of pesticides (OCs, OPs and other modern agrochemicals) in the rural region. The influence of meteorological parameters, agricultural cycle (for current use pesticides) and the possibility of gas sorption on filters have been examined. The contribution of wind erosion from agricultural fields as a source of pesticides to the atmosphere has been looked into. The usefulness of the J-P model in predicting the partitioning of pesticides in rural areas will also be evaluated.

5.2 SAMPLE COLLECTION AND DATA ANALYSIS

271 air samples were collected in the 4 year of sampling from the three sites (Table 5-1). As seen in Figure 5-1, the sampling apparatus included two PUFs and one filter (2000-2001) and two filters (2002-2005). Second filter was included to investigate possible gas sorption on the filter. Back filters analyzed for include all 71 collected from HP (2002-2003), 39 collected in 2002 from LD and at least one representative from each month (n=15 in year 2002) from DV. The values used for temperature and relative humidity are 24 h averages for the sampling period.

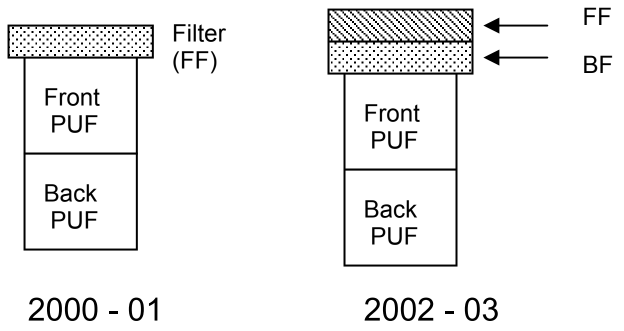

FIGURE 5-1 Difference in the setup apparatus of the air sampling (2000-01 and 2002-03)

TABLE 5-1 Air samples collected (2000-2004)

	2000	**2001**	**2002**	**2003**	**# samples**
HP	31 (4/18-12/19)	27 (5/9-11/13)	39 (3/5-11/26)	32 (3/31-9/26)	129
LD		29 (4/11-11/28)	42 (3/6-12/20)	24 (4/14-9/16)	95
DV			22 (4/2-11/26)	25 (3/27-9/16)	47
Total	31	56	103	81	**271**

5.2.1 Predicted partitioning

The J-P model was used to predict partitioning. It relates the fraction of the compound adsorbed to particles (Φ) to the sub-cooled liquid-phase vapor pressure of the pure compound (p_L^0) and the particle surface area per unit volume of air (θ, cm^2 aerosol/cm^3 air) as:

$$\Phi = \frac{c\theta}{p_L^0 + c\theta} \qquad (5.2\text{-}1)$$

Where, parameter c is related to the excess heat of desorption from the particle surface, the moles of adsorption sites on the aerosol (Ns, mol/cm^2) and temperature. Typical values of θ are 1.1×10^{-5} (urban air), 3.5×10^{-6} (rural air) and 4.2×10^{-7} (rural air with some urban influence) (Bidleman et al. 1999). The model basically accounts for the temperature dependence of partitioning through the temperature dependent vapor pressure.

Our sampling sites being agricultural, θ value for rural air (3.5×10^{-6}) have been used. The temperature dependent sub-cooled liquid vapor pressures (P_L^0) were determined using parameters listed in Table 5-2. The temperatures used were the 24h average during sampling.

TABLE 5-2 Parameters for estimating the vapor pressure at a given temperature

$$\text{Log } P = A/T + B$$

	A	B	Source
Atrazine	-5749	17.3	a
Metolachlor	-6727	20.2	a
Trifluralin	-16296	53.1	a
Chlorothalonil	-4085	12.7	b
Chlorpyrifos	-4402	13.9	b
Diazinon	-642	3.5	b
)-endo	-4201	11.9	c
)-endo	-4306	12.1	c
endosulfate	-4470	12.1	c
)-chlor	-4284	12.0	c
)-chlordane	-4216	12.0	c
mirex	-4718	12.3	c

a: based on two data points
b: this study, unpublished data
c: Hinkley et al. 1990

5.2.2 Observed partitioning

From the amount of compound present on the PUF and on the filter, the observed phase distribution was determined as:

$$F_{obs} = \frac{A_p}{A_p + A_g} \tag{5.2-2}$$

Where, A_p is the amount (ng) of the pesticide in the particulate phase (on filter) and A_g is the amount of compound in the gaseous phase (front and back PUFs). The fraction observed on the particles was determined using one filter for 2000-2001 and two filters for 2002-2003.

The usefulness of the second filter in predicting partitioning behavior was evaluated by assuming that the amount present on the back filter represents the extent of the gas sorption onto the filter material (Bidleman 1999). The actual amount present in the gaseous and particle phase was determined as:

$$A_p = FF - BF \tag{5.2-3}$$

$$A_g = PUF + 2BF \tag{5.2-4}$$

Where, FF, BF and PUF are the amounts present on the front filter, back filter and polyurethane foam plugs, respectively.

5.2.3 Influence of meteorological parameters

In addition to temperature, the influence of sampling time (t), relative humidity (RH) and wind speed (WS) on partitioning was examined by computing the percentage on filter and regressing it against RH and WS.

The equation:

$$\%F = a_0 + a_1\left(\frac{1}{T}\right) + a_2(t) + a_3(RH) + a_4(LnWS) \qquad (5.2\text{-}5)$$

Where, %F is the percentage of the compound present on the filter. For atrazine, metolachlor and γ-chlordane, data from 2002-2003 from HP was used and %F was computed as (FF-BF)/(FF+BF+PUF) x100. For the other compounds, the amount present on the BF was ignored and data from 2001-2003 was used. The results are compiled in Table 5-3.

The usefulness of the traditional method of examining partitioning (using the partitioning coefficient K_p) depends critically on the availability of correct TSP (total suspended particulate matter). Even though the annual average TSP value for the Chesapeake Bay region are available (Leister and Baker 1994), TSP values are likely to be much higher during the spring and summer time when tilling of fields will result in greater wind erosion and suspension of particles in air. Since TSP values for our samples were not measured, the partition coefficient method has not been used.

5.2.4 Influence of agricultural activity on partitioning

To investigate the influence of agricultural cycle on V-P partitioning of compounds, the amount of pesticide found on the filter was regressed with respect to agricultural cycle, time of sample collection, relative humidity and wind speed using the following equation:

$$\log FF = a_0 + a_1 t + a_2 RH + a_3 Ag + a_4 \log WS \qquad (5.2\text{-}6)$$

Where t is the time (in relative julian days) and Ag represents the agricultural cycle (approximated by a Lorentzian function, see Chapter 4 for details). Temperature was not included. For the estimation of the agricultural cycle, parameters (a_3, a_5 and a_6) determined through multiple regression technique of the gas phase concentration data (values of parameters listed in Appendices V-X) were utilized here. The analysis has been performed on data from HP and agricultural parameters for that site have been utilized. However, for diazinon and metolachlor, not all the parameters were significant at HP and hence values determined for samples from LD were used in these cases. For these two compounds, although analysis has been performed on data from HP, data from 2000 has not been used (since some agricultural-cycle data is from LD where sample collection started in 2001). The results from this analysis are summarized in Table 5-5.

Temperature has not been used in the analysis to clearly see the influence of the agricultural cycle. To discard the influence of gas sorption, the amount present on the front filters (FF) has been used.

5.2.5 Agricultural soils as a source of herbicide in atmospheric aerosols

As a means to estimate the potential magnitude of pesticide which may be present on airborne particles due to residues from the prior year's application, surface soil samples were collected from an experimental corn field on the premises of the USDA-ARS Beltsville

Agricultural Research Center (BARC) in Beltsville, MD which has received the same rate of atrazine and metolachlor applications each year over the last 5 years. Soil samples were collected from the field just prior to and after pesticide application. Although the geographical location for the soil sampling is not the same as that of air sampling (the two sites are located on either side of the Chesapeake Bay), the sandy loam soils present at the experimental site are not uncommon in certain regions of the Delmarva Peninsula, and the detailed dataset available from the soil sampling site makes it suitable for estimation purposes.

Atrazine and metolachlor soil concentration for 5 consecutive days after application (in 1999-2003) are known (personal communication, Tim Gish). 20 soil samples were also collected from the field in June, 2004- 10 months after the herbicides had been last applied and just before the fields were tilled for the next application. To compute the concentration of herbicide present on the particles in the atmosphere (μg herbicide/g particles), the TSP (total suspended particles) concentration in the air was taken as 34 $\mu g/m^3$ which has been reported as the annual average TSP value for the Chesapeake Bay region (Leister and Baker, 1994).

For the soil samples collected from the field 10 months after application (June 2004), the recovery of the surrogates was ~50% (diazinon d_{10}: 42.3±9.7%, triphenylphosphate: 50.7±19.8%) (See section 2.2 and 2.3 for details on soil sample collection and analysis). The soil level results were not corrected for recovery and where only used to provide an indication whether soil particles could represent a significant source of pesticides residues in the atmosphere.

5.3 RESULTS AND DISCUSSIONS

5.3.1. Overview of pesticide detections in the particulate phase

Considering all the samples collected from our 3 sites, the organochlorines occurred in <20% of the filter samples (Figure 3-1, Figure 3-2). The DDTs, aldrin, heptachlor and oxychlordane were not detected at all on the filters. In contrast, current use pesticides occurred much more frequently. Metolachlor, atrazine and chlorothalonil were the three most frequently detected compounds (50-60%). It was surprising to note that metolachlor, which is less likely to be present in the particle phase than most other compounds (such as endosulfans) dominated the particle phase detections. This most likely is due to the much higher usage rate of metolachlor as compared to other pesticides. Another reason can be the difference in polarity. Higher binding forces for polar than for non-polar compounds, probably due to hydrogen bonds have been reported (Goss, 1992) and can account for the greater presence of more polar herbicides in this region of high atmospheric humidity.

Pesticides were detected in back filters as well. In general, pesticides in current use were detected more frequently on the back filters than the banned organochlorines. For HP, (n=71) atrazine, metolachlor and endosulfan sulfate were present in more than 50% of the samples. α-chlordane, γ-chlordane, α–endosulfan and mirex occurred in 17-33% of the back filters. Acetochlor, alachlor, CIAT, trifluralin, chlorpyrifos oxon, diazinon and fipronil were present in less than 10% of the samples. Simazine, chlorothalonil and chlorpyrifos occurred in just 1 sample each (<2%). For LD (n= 39) β−endosulfan was the most frequently present (46%) followed by trifluralin (41%), metolachlor (28%) and atrazine (21%). At DV (n=15) too metolachlor was the most frequently detected (53%) followed by β-endosulfan (~50%) and α−endosulfan (40%).

Gas sorption on filters

Since HP has the greatest number of data points in terms of back filters, the analysis has been performed mainly on samples from HP (unless otherwise noted). The fact that target analytes were observed on the back filter suggests that some degree of gas sorption does occur for our compounds. A statistically significant (α=0.05) positive correlation between the amount on BF and PUF for atrazine, metolachlor and endosulfan sulfate at HP, supports this view (Table 5-4). It appears that the occurrence on the BF is related to polarity of the molecule– the greater the polarity, the greater the chance of detection on BF. This is supported by the endosulfans. Both the isomers have similar structures- the only difference is the nature of S=O bond. The conformations of the bond is symmetric in β-isomer which lowers its polarity compared to the α-isomer where the bond is asymmetric. So, α-isomer had greater gas sorption (17 % samples) whereas β-isomer was negligible (<2%)..

TABLE 5-4 Correlation between amount on BF and PUF

	Pearson co-reltaion coefficient, r
	HP
Atrazine	0.48
Metolachlor	0.43
Trifluralin	
α-chlordane	*0.24*
γ-chlordane	*0.09*
α-endosulfan	*-0.12*
β-endosulfan	
endosulfan sulfate	0.59

Note: Numbers in italics represent corelation not statistically significant ($p > 0.05$)

5.3.2 Partitioning vs. gas sorption

To evaluate the contribution of gas sorption to the observed partitioning, the relation between the amount present on FF and BF was also examined. For α-endosulfan and α-chlordane, there was no statistical difference (α=0.05) between the amounts present on the front and back filters (samples from HP). This suggests that gas sorption to filters is the main source of the 'particle phase' sample. For this reason, the V-P partitioning behavior of these compounds will not be discussed further. For γ-chlordane and metolachlor, the amount on front filter was significantly higher (α=0.05) than on the back filter. In case of atrazine although there is no statistical difference the p-value (=0.054) for the correlation is very close to our limit (α=0.05) and hence we can say that chances are the amount on FF is higher than the BF. For atrazine and metolachlor, the fact that the amount on the FF is usually greater than on the BF suggests that both gas sorption and V-P partitioning are active.

In certain instances, the load on the back filter was actually higher than was present on the front filter, especially for the herbicides atrazine and metolachlor (Figure 5-2 and Figure 5-3). Greater loadings on the back filters can be explained if we consider the hypothesis put forth by Cotham and Bidleman (1992). In their equilibration experiments with double glass fiber filters (GFF), these authors concluded that the test compounds found on the back filter were not adsorbed to the GFF matrix itself but rather sorbed onto a layer of organic matter which had been stripped from the particles on the FF and captured by the BF. This organic matter acts as the stationary phase and sorbs the compound from the gas phase. The amount sorbed by the material on the BF, irrespective of its sorption property, will be related to the amount present in the gas phase. This also explains the correlation seen between the amount present on the BF and PUF (Table 5-4). In our study, most of the anomalous observations (more herbicide on the back filter) were in the colder months in 2002, when the herbicides are no longer being applied. Therefore, when the overall concentrations in both the gas and particulate phases are low, we are more likely to see the effect of this behavior than when concentrations are higher.

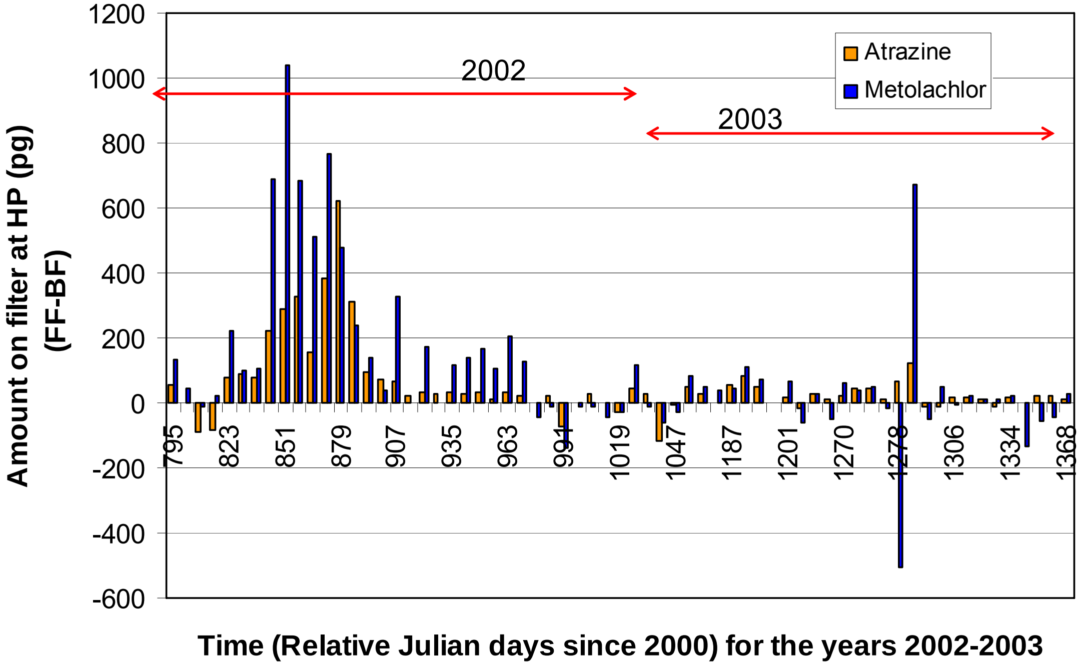

FIGURE 5-2 Relative amount of atrazine and metolachlor on the FF and BF at HP

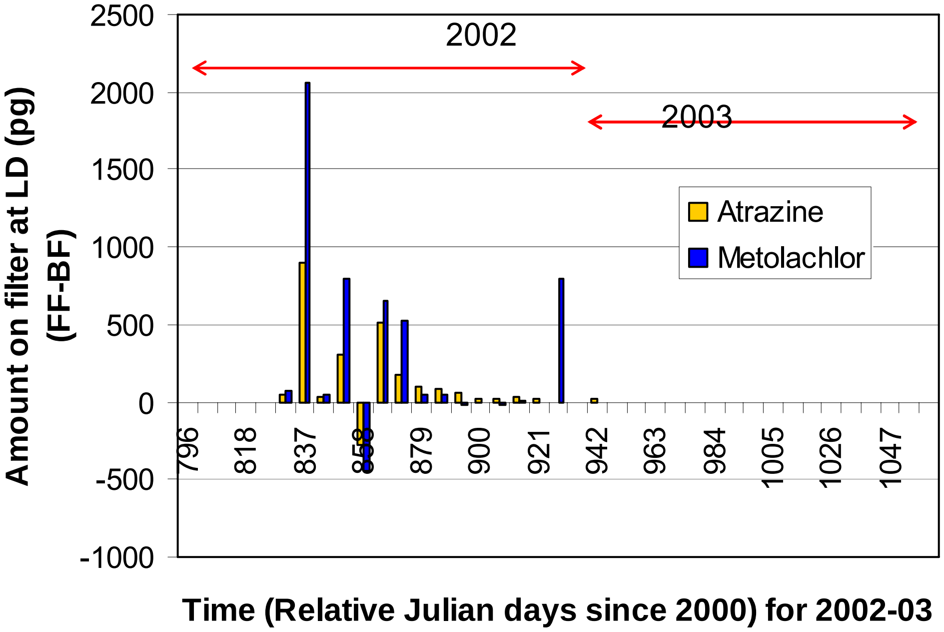

FIGURE 5-3 Relative amount of atrazine and metolachlor on the FF and BF at LD

The difference in the occurrence of amounts in FF and BF was drastic in the years 2002 and 2003. In 2003, the amount on the filters was much less than what was seen in 2002 at both HP and LD. Also, the amount on back filter was higher than on front filter in 2002 on more occasions than was observed in 2003 (5 and 1 in 2002 vs. 12 and 5 in 2003 for atrazine and metolachlor, respectively). The drastic differences between the particle phase concentrations in 2003 as compared to 2002 may also have been due to differences in rainfall patterns between the two years. 2002 was a dry year (39 rain events for the period of April-September at HP) whereas 2003 was wetter than average (62 rain events from April-September). In 2003, most of the rainfall occurred in the principle planting season with the maximum number of events in May (16). More frequent rainfall in 2003 may have effectively "washed out" the herbicides quite effectively resulting in low overall aerial concentrations. This is supported by the difference in median gas phase concentrations – atrazine: 47 vs. 21 pg/m^3 and metolachlor: 256 vs. 88 pg/m^3 - in 2002 and 2003, respectively. Since particles are scavenged more efficiently than gases, lesser number of particles may have been available in the air in 2003 resulting in lesser loads being captured by the samplers.

The observations in this study reveal that gas sorption does occur in GFF for pesticides. The sampling methodology used here, which is most commonly used in most studies, cannot distinguish clearly between gas and particle phase - what is actually present in gas phase can be reported as particle phase . This will lead to errors in estimating environmental fate since phase distribution is a basic key in evaluating atmospheric transport potential. More efficient sampling strategies require to be developed to determine phase distributions with greater accuracy.

5.3.3 Predicted vs. Observed distribution

The agreement between the observed (without correcting for gas sorption) and predicted partitioning is shown in Figure 5-4. As is evident from the plots, the J-P model under-predicts the fraction on the particles.

As has been discussed before, gas sorption does occur for some pesticides on GFF. The usefulness of the second filter in correcting for gas sorption and predicting partitioning behavior vs. the J-P model was evaluated. The results for atrazine and metolachlor (Figure 5-5) show that using two filters in place of one did not result in any significant improvement over one filter, in terms of agreement between the observed and predicted fraction on the filter. The observed fraction on the particulate phase is still much higher than predicted by the model. Several authors (Mader and Pankow 2001; Volkens and Leith 2002) have suggested that backup filter corrections are possible only after both the front and back filter have become saturated (or are in equilibrium) with a given SVOC which is unlikely to occur when sampling SVOC mixtures. In the case our study it appears that 24h sampling is not sufficient for the equilibrium to be reached between the front and back filters. This suggests that the two filter train is not suitable for this type of sampling scheme.

In general, the predicted and observed phase distributions do not agree (Figure 5-4). For the α-endosulfan, however, the prediction is still comparable to the observed distribution. Even though our results show that predictions are better for α-endosulfan than for the herbicides, the J-P model works as a lower boundary at best. Earlier also (Bidleman 1999), it has been shown that J-P does not work well for organochlorines in rural environments. However, in that study, it over-predicted partitioning to aerosols; whereas, in our case it under-predicts particle association. Under prediction of particulate fraction by sorption model has been observed for organochlorines (Sofuoglu et al. 2004). Assumption of a fixed fraction of organic carbon (f_{OM}) in the JP model is one of the important factors resulting in under-prediction as has been observed by Sofuoglu et al. (2004). These authors found that the f_{OM} in their samples (collected from an area close to forested region) was 53% -more than twice as high as the assumed value of 10-20% in predictive models- and resulted in much better agreement in observed and predicted partitioning behavior. Yellow deposited material observed on our filters points to the high pollen content of the air during the sampling period and show that f_{OM} must have been higher than assumed in J-P model.

It is seen that the J-P model, in its present form, does not work well for the pesticides, especially in rural areas close to the sites where these pesticides are applied. The model generally under-predicts whereas the sampling methodology tends to over-predict the percentage occurring in the particle phase. Both sampling methodology and parameters used in predictive models need to be revised to better understand and predict the phase distribution of organic compounds (especially pesticides in agricultural areas).

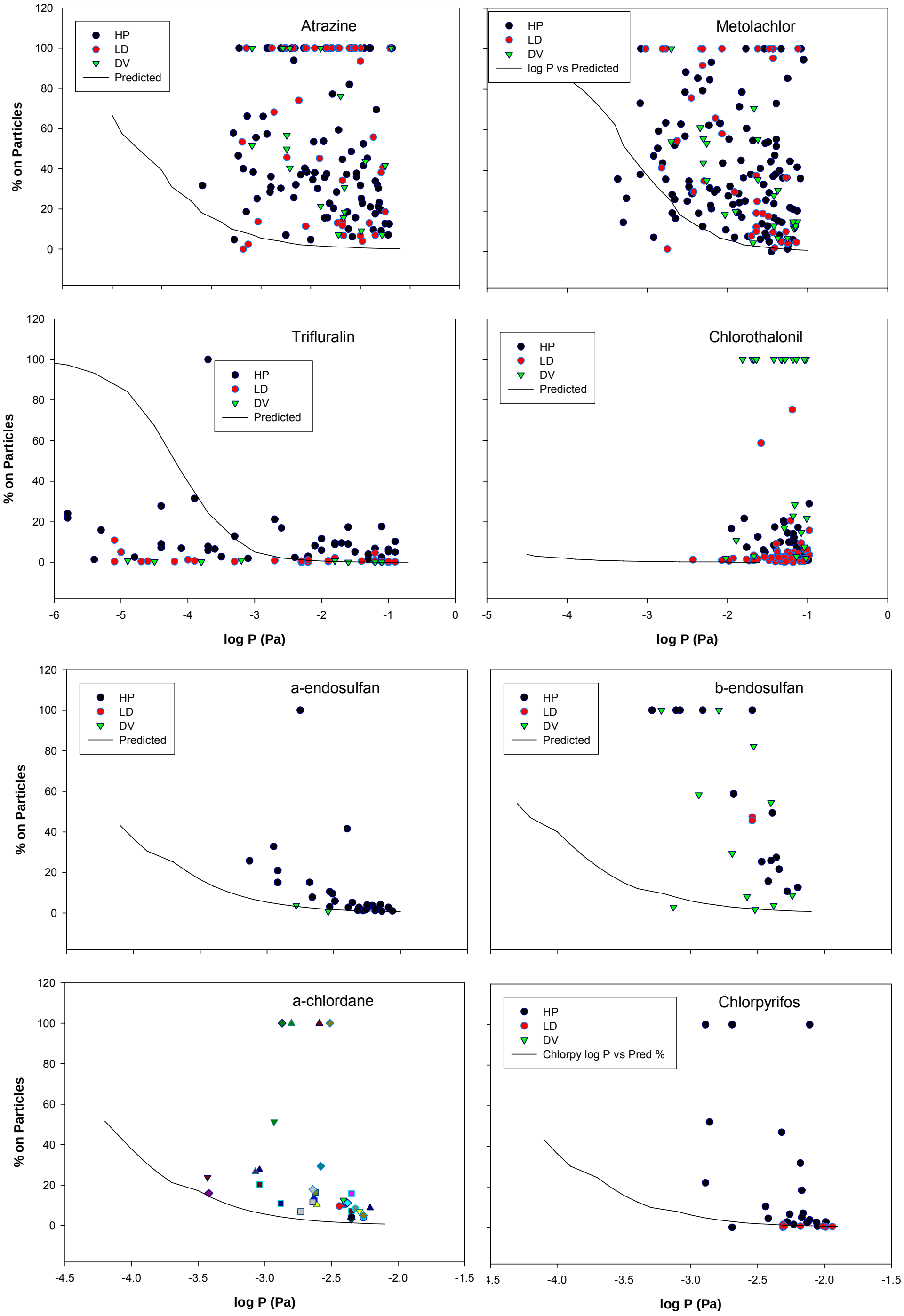

FIGURE 5-4 Predicted (J-P model) and observed vapor-particle partitioning (only FF)

5.3.4 Influence of meteorological parameters on partitioning

Volatilization from soils/ plants (temperature dependent) is believed to be the main source of pesticides to the atmosphere. Under ideal conditions, once they enter the atmosphere after volatilization (or spray drift during application) pesticides partition onto the natural aerosols and their particle/air distribution is in equilibrium. However, exhaustive literature reviewed by Bedos et al. (2002) reveals that meteorological factors (other than temperature) influence the phase distribution and occurrence in atmosphere of pesticides. Wind speed has been found to influence volatilization and seems to have the same influence on pesticide volatilization from plants as from soil: increase in wind velocity increases the volatilization rate. Increase in wind speed increases volatilization from surfaces and reduces the amount occurring on soil particles. It has also been reported that wind erosion of soil particles can be a significant source of aerosols to the atmosphere, especially in rural areas right after soil tillage (Wu et al. 1994). Under certain soil water content conditions wind erosion (not post-application volatilization) was found to be the process controlling entry of pesticide into the atmosphere (Glotfelty et al. 1989). Higher mineral content occurring in aerosols collected during the agricultural season in Chesapeake Bay region (Kim et al. 2000) reaffirm soil erosion being a significant phenomenon influencing occurrence of particles in atmosphere of the Delmarva Peninsula. Organic carbon content (f_{OM}) and pesticide polarity are among the important factors controlling the partitioning of pesticides onto particles. Binding forces for polar compounds are higher (Goss 1992). More hydrophobic compounds can penetrate inside the particle and occur in non exchangeable form (Sansui et al. 199). Once particles enter the atmosphere (though wind erosion) equilibrium may not be achieved even after long exposure times. Soil moisture conditions also impacts occurrence on soil

(Sansui 199). Pesticides have been found to volatilize more from moist soils (Lembrich et al. 1999).

For most pesticides, meteorological conditions (T, RH, and WS) explained more than 50% of amount present in the particle phase (Table 5-3). Yet, for the most commonly used pesticides in this region, and thus the ones most frequently detected on the filters (atrazine, metolachlor and chlorothalonil) the correlations with the meteorological factors are not statistically significant. As discussed later (section 5.3.6), agricultural cycle in the region controls their occurrence and phase distribution in the atmosphere.

As would be expected, temperature significantly influences the percentage of compounds present on the particulates (except diazinon). Except for the endosulfans, relative humidity is also a significant factor. An inverse relationship between RH and sorption coefficient of organic compounds (volatile as well as semi-volatile e.g., ethanol, naphthalene) has been reported (Goss 1992). In this study, decrease in the fraction on the filter in response to increase in RH was observed for hydrophobic compounds (trifluralin, chlordanes), and the opposite effect was observed for the more soluble analytes (chlorpyrifos, diazinon). These observations support the theory of competition between pesticide and water molecules in the gas phase for sites on the particle (Sansui 1999). Diazinon presents an interesting case- it is the only compound which exhibited a dependence on time (t) but no dependence on temperature (T). This shows that timing of local agricultural usage, rather than local meteorological conditions, influences the levels in the particulate phase more strongly (see next section 5.3.6).

Wind speed had a statistically significant influence only on diazinon and α-endosulfan. Positive co-relation for α-endosulfan (highly hydrophobic insecticide with low annual usage which might occur in non-exchangeable form in soil particles) shows that wind erosion, resulting in re-suspension of soils, is an important mechanism influencing the phase occurrence of pesticides. Influence of increased volatilization and wind erosion, as mentioned earlier, is the most likely hypothesis explaining the negative co-relation of diazinon (and negative, though statistically insignificant correlation for other pesticides). Increase in wind speed results in greater volatilization from soils which results in lower amount being present on soil particles. Greater wind speed enhances wind erosion and makes air-borne the particles with lower level of pesticides on them.

This analysis shows that apart from temperature, relative humidity and wind speed can also influence the vapor-particle partitioning of compounds and need to be accounted for in prediction models.

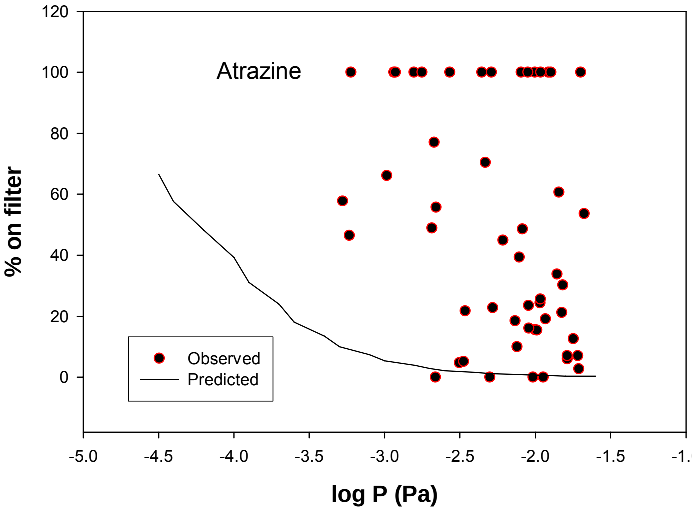

FIGURE 5-5 The predicted (J-P) and observed fraction of atrazine on filter after applying correction for the back filter (data from HP only)

TABLE 5-3 Co-relation of percentage on filter with met parameters

	atrazine	metolachlor	trifluralin	chlorothalonl	Chlropyfs	Diazinon	α-endosulfan	β-endosulfan	γ-chlordane	α-chlordane
r^2	*0.17*	0.14	0.24	*0.08*	0.56	0.65	0.62	0.83	0.82	0.69
p	0.344	0.217	0.039	0.379	0.021	<0.0001	0.0002	0.023	0.0002	0.034
Intercept			*-69.8*		-727.3	*72.8*	-405.6	-1832.8	*-36.2*	*-36.8*
1/T			27573		195866	*41055*	105998	599975	14120	11034
t			*-0.01*		*-0.04*	-0.06	*0.03*	*-0.05*	*0.00*	*0.01*
RH			-0.23		0.88	0.24	*0.18*	*-1.66*	-0.08	-0.12
WS*			*(-2.7)*		*(-6.2)*	-22.32	13.13	x	*(-0.17)*	*(-0.86)*

note : x - this parameter excluded to get statistically significant corelation

* values in paranthesis are statistically insignificant (p>0.05)

5.3.5 Partitioning for pesticides in greater use

The fraction of atrazine, metolachlor, chlorothalonil and diazinon on the filters does not appear to be strongly dependent on any of the meteorological parameters. The J-P model for these compounds grossly under-predicts the load present in the operationally-defined particle phase (Figure 5-4 and Figure 5-5). It appears that the amount on the filters is not in equilibrium with the gas phase concentration and just as in the gaseous phase, the agricultural activity in the region is driving the concentrations on filters.

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TABLE 5-5 Co-relation between amount in particle phase with agricultural activity and meteorological conditions

	Atrazine	Metolachlor	Diazinon	Chlorothalonil
r^2	0.61	0.28	0.52	0.45
p	<0.0001	<0.0001	<0.0001	0.0002
Intercept	2.64	2.61	3.72	1.51
time	-0.0004	-0.0003	-0.001	-0.0005
RH	-0.008	-0.009	-0.016	*0.008*
Ag-cycle	0.88	3.02	*-0.24*	0.60
log WS	*-0.25*	*-0.36*	-0.59	*-0.48*

The results (Table 5-5) clearly suggest that the agricultural cycle is the single most important factor influencing the amount present on the front filter (except diazinon). For diazinon, the wind speed is the most important factor. Diazinon is among the most volatile pesticides. It is most likely to occur in the gas phase and, even in equilibrium conditions, the amount on the particles is not expected to be high. The dependence on wind speed suggests that wind blown dust from the fields is the most likely source. Relative humidity also influences the amount present on the front filter. Including temperature in the equation (data not shown) did not appreciably improve correlations.

Wind erosion of soil from agricultural fields as source of pesticides to atmosphere

The concentration of atrazine on the soil samples was 0.003±0.002 µg/g and for metolachlor it was 0.028±0.024 µg/g. The levels for the amount present on soils a year after application was quite low compared to levels reported for day 1 on wet soil (metolachlor: 5.7 µg/g; atrazine : 2.7 µg/g, in 1999). This was not surprising since the levels decrease rather fast. Available data from this field showed that the levels decreased by 25-63% (for metolachlor) resulting in levels as low as 1.7 µg/g five days later (in 2002). The lowest concentrations on the filters of air samples were 0.02 µg/g (atrazine) and 0.06 µg/g (metolachlor). Concentrations as low on the soil were never seen on the filters. Although it appears that tilling prior to planting does not result in any appreciable contribution of the herbicides to the atmosphere, it needs to be acknowledged that the particles which would be suspended would be the finest particles not “diluted” by the bulk soil material which was analyzed in the field. Also, this is only one field, and concentration will vary from year to year and field to field.

The highest concentrations on particles were typically seen in the months of April-May when the herbicides are applied (Figures 5-5 and 5-6). The concentrations for these months are expected to be higher side the residues from the previous year's load will be present along with the fresh pesticide application. Also, this analysis is also likely to be biased on the higher side since the TSP concentration is likely to be higher than the annual average value. The amount on the particles was highest in 2002, which incidentally was also the driest year and probably had a higher TSP concentration than normal. Most of the data points (the average concentration on the particles for each month) fall between the soil concentration on days 1 and 5 after application. Even after taking into consideration the error introduced due to the estimation of the TSP, this points to the soil particles being the source of these herbicides in the atmosphere. This phenomenon is likely be more important for more hydrophobic pesticides like OCs and OPs which (generally less biodegradable and have longer soil half lives) may have high concentrations in soils much longer after application. This observation is strengthened by the fact that wind speed does significantly influence the amount present on the filters for diazinon (OP) and α-endosulfan (OC) (Table 5-3).

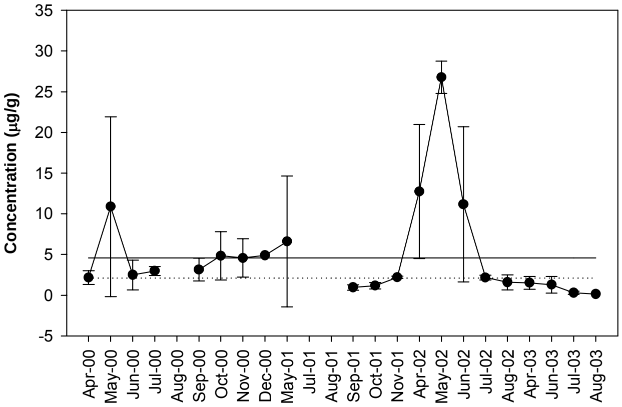

FIGURE 5-6 Atrazine on particles and on soil

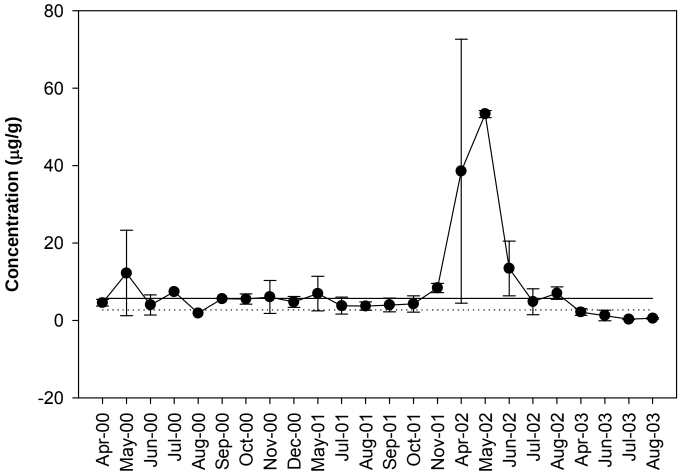

FIGURE 5-7 Metolachlor on particles and on soil

5.4 CONCLUSIONS

Our results suggest that levels of CUPs in the particle phase are not in equilibrium with gas phase. Both agricultural activity and location of the Peninsula play an important role in impacting the occurrence and levels in particles. The highest amount on the filters is primarily seen during the time of field application of pesticides. The amount on filters is higher than predicted (hence not in equilibrium) and it is also influence by wind speed. This suggests that volatilization from fields (and subsequent balanced phase distribution) is not the sole source of these compounds to the atmosphere. Wind erosion from agricultural fields, the extent of which will depend on wind speed, can result in resuspension of pesticide laden soil particles which take time to equilibrate with the surrounding air. Local weather and high average humidity also influence phase distribution. The most commonly used predictive model (J-P) under predicts partitioning for CUPs in rural areas and needs to be revised to include the influence of agricultural cycle and meteorological parameters which greatly impact phase distribution. While sampling, gas sorption to the GFF impacts mostly polar pesticides. The air sampling techniques being most commonly used need to be re-examined to ensure that distribution in particle phase is not over-estimated.

CHAPTER 6 - TEMPERATURE DEPENDENCE OF VAPOR PRESSURE

This chapter has been submitted for publication to Journal of Environmental Science and Health.

Goel, A., McConnell, L.L. and Torrents, A. "Determination of Vapor Pressure-Temperature Relationships of Current Use Pesticides and Transformation Products"

6.1 ABSTRACT

Sub-cooled liquid vapor pressure (P_L^0) of current use organochlorine and organophosphate pesticides (chlorothalonil, chlorpyrifos methyl, diazinon, fipronil) and selected transformation products (chlorpyrifos oxon, heptachlor epoxide, oxychlordane, 3,5,6-trichloro-2-pyridinol) were determined at multiple temperatures using the gas chromatography retention time technique. Results were utilized to determine vapor pressure-temperature relationships and to calculate enthalpies of vaporization (ΔH_{vap}). While results for chlorothalonil and diazinon were comparable with published values, the measured value

for fipronil (1.5×10^{-6} Pa) is almost an order of magnitude higher than the reported literature value (3.7×10^{-7} Pa). The availability of vapor pressure temperature relationships for these chemicals will aid in pesticide risk assessment development and improve the effectiveness of mitigation and remediation efforts.

6.2 INTRODUCTION

Pesticides are among the most widely used chemical compounds. In United States alone, more than $11 billion annually are spent on pesticides (Kiely et al. 2004) and 400 million kilograms of active ingredients are purchased each year for agricultural use (Donaldson et al. 2004). Although they are essential for crop protection, exposure of wildlife, sensitive plant species and humans is of concern since many can be carcinogenic, neurotoxic, cholinesterase inhibitors, endocrine disruptors, developmental and reproductive toxins. (Connelly 2001; Harnly et al. 2005; Interim Registration Eligibility Decision Diazinon, Nolan et al. 1984; Toxicological Profile for Heptachlor/ Heptachlor Epoxide 1987; Review Report for the Active Substance Chlorothalonil 2005; Interim Registration Eligibility Decision Diazinon 2004; Review Report for the Active Substance Chlorpyrifos Methyl 2005; Review Report for the Active Substance Chlorpyrifos 2005). Furthermore, such exposure is not limited to locations around application sites, some pesticides may travel long distances after application via atmospheric transport (Seiber et al. 1993; vanDijk et al. 1999) and affect biota in remote regions.

Knowledge of accurate physical and chemical properties is a requirement for accurate and reliable environmental fate and risk assessments. Vapor pressure (VP) is among the most important physical properties as it plays an important role in governing the gas-phase concentration of pesticides and their tendency for long range transport. Vapor pressure is highly dependent on temperature, hence, spatial latitude, longitude and seasonal conditions greatly influence compound phase distribution and transport. The sub-cooled liquid VP (which does not include the lattice energy present in the solid phase) is more relevant to the low level concentration conditions present in the environment. The sub-cooled liquid vapor pressure has been successfully used to predict the vapor-particle partitioning of organochlorine compounds in the atmosphere (Junge 1977; Pankow 1987; Bidleman et al. 1999).

Another important physical property in assessing pesticide fate is the air-water partition coefficient or Henry's Law constant (HLC). This temperature-dependent constant is useful in estimating the volatilization potential of a chemical from surface water to the atmosphere (Staudinger et al. 1996). When coupled with atmospheric concentration data and rainfall information, HLC may also be used to estimate the wet deposition flux of pesticides. HLC is often estimated using vapor pressure and aqueous solubility. While solubility values as a function of temperature and other basic physical properties (like melting and boiling points) are readily available for many compounds, vapor pressure data for most semi-volatile organic compounds are scarce. VP values are typically available at only one temperature (20 or 25 ºC), and extrapolation over the ambient temperature range may be inaccurate. The lack of vapor pressure values at required temperatures results in inaccurate estimations of HLC values. Hence, there is a need to experimentally determine vapor pressures and their temperature dependence.

The objective of this study was to determine the vapor pressure-temperature relationships for some commonly used pesticides and selected transformation products. The knowledge of these relationships enabled the determination of the enthalpies of vaporization (ΔH_{vap}) values thereby facilitating the calculation of vapor pressure across a large temperature range. The gas chromatographic retention time technique (Bidleman 1984) was utilized to determine the sub-cooled liquid vapor pressures. This technique is better suited for low volatility compounds when compared with other traditional methods such as manometric determination and the determination of boiling points at reduced pressure. The advantage of this technique over the methods (like gas saturation, gas effusion) lies in speed, smaller sample size, purity and stability (Kim et al. 1984). Furthermore, as this method measures sub-cooled liquid vapor pressure, it allows accurate measurements above and below the compound's melting point. This technique has been used for several organic compounds of environmental interest, with good results, including organophosphate pesticides (Kim et al. 1984), napthalenes and organochlorines (Hinckley et al. 1990; Lei et al. 1999).

The results from this study contribute to the small body of vapor pressure-temperature relationship data available for some commonly used pesticides and will enhance our capability to accurately determine the phase distribution of these chemicals in the environment. For this study, 8 test compounds were selected. The 8 test compounds may be categorized as current use pesticides (CUPs) or transformation products of important pesticides (Table 6-1). The pesticides are organochlorines (OCs) and organophosphates (OPs), which are historically among the most commonly-used groups of pesticides. As of

2001, OPs formed 70% of the insecticide market in the U.S. (Kiely et al. 2004). Chlorothalonil is the only fungicide included while the remaining analytes are insecticides or their products. Fipronil is a relatively new insecticide (U.S. registration in 1996 (Connelly 2001). All the CUPs are registered for use in U.S. and (except chlorpyrifos methyl) in Canada. Among the parent compounds, only chlorpyrifos is registered for use and the use of chlordane and heptachlor (known carcinogens) has been banned in U.S. and Canada. Chlorothalonil, diazinon and chlorpyrifos are intensively used in the agricultural as well as the industrial/commercial sector (Kiely et al. 2004). None of the transformation products are registered for use (neither U.S. nor Canada) yet they have been detected in the environment (Braune 1999; Glotfelty et al. 1990; Jantunen et al. 2000).

6.3 MATERIALS AND METHODS

All the compounds in this study were obtained from AccuStandard (New Haven, CT), Chem Service (West Chester, PA), Dow Elanco (now Dow Agrosciences, Indianapolis, IN), Velsicol Chemical Corporation (Rosemont, IL) and Riedel-de Haen (Seelze, Germany). The purities were in the range 98 – 100 %. Acetone and acetonitrile (Chromatographic Grade, Fisher Scientific, Fair Lawn, New Jersey) were the solvents used and the concentrations utilized in the experiments were low (0.07 – 0.13 μg/μL).

Briefly, the gas chromatographic retention time method involves the determination of retention times for the test, reference and standard compounds under isothermal conditions. After many runs over a range of temperatures, the retention time data is then analyzed to obtain values for vapor pressure and enthalpy of vaporization. Vapor pressures of the 7 pesticides standard compounds (Table 6-1) and at different temperatures for the reference compound (p, p'-DDT) are available with great accuracy (Hinckley et al. 1990; Lei et al. 1999)

A Hewlett Packard gas chromatograph (5890 Series II) with a flame ionization detector (FID) was used for analysis. The column used was DB-1MS, 1.0 m length x 0.25 mm i.d. and 0.25 µm film thickness. The split ratio was 20:1. The carrier gas was helium and the flow rate ranged from 1.5-4 mL/min. The injector and detector temperatures were 280 and 300 ºC, respectively. A series of 7 isothermal runs in the temperature range of 100 – 130 ºC were made for all compounds (up to 150 ºC for fipronil and heptachlor epoxide). The retention times at every temperature were collected and analyzed. For selected compounds and selected temperature (120 ºC), duplicate runs were conducted and GC retention times were not significantly different (less than 0.02 min.)

The correlation between relative retention times ($V_{r,}$) and enthalpies of vaporization (ΔH_{vap}) is expressed as:

$$Ln\left[\frac{V_{r,1}}{V_{r,2}}\right]=\left[1-\left(\frac{\Delta H_{vap,1}}{\Delta H_{vap,2}}\right)\right]LnP_{L,2}^{0}-c \tag{6.3 - 1}$$

where, 1 and 2 refer to the test and reference compounds, and c is a constant. $P^0_{L,2}$, the liquid-phase saturation vapor pressure of the reference compound (p,p'-DDT) at temperature T (K) was determined using Eq. 6.3-2 (Lei et al. 1999):

$$\log P_L = 12.48 - \frac{4695}{T} \qquad (6.3\text{-}2)$$

The vapor pressure of a test compound was then computed using the ratio of enthalpies and c (from Eq. 6.3-1) as:

$$Ln\left(P^0_{L1}\right)_{GC} = \left(\frac{\Delta H_{vap,1}}{\Delta H_{vap,2}}\right) LnP^0_{L,2} + c \qquad (6.3\text{-}3)$$

where, $(P^0_{L1})_{GC}$ is the value obtained by the retention time data.

Variation in retention time (V_r) and numerical estimation of $P_{L,2}$ (Eq. 6.3-2) are the factors influencing the error in estimating the P_L of the test compound. Bidleman (1984) reports that numerically estimated P_L (of p, p'- DDT) fell within 21% RSD of literature values (i.e. σ=0.21). The non-availability of duplicate runs on GC in this study limit estimation of errors related to variation in retention time, but (as has been mentioned before), the maximum variation in retention time observed in the one duplicate run at 120 ^{0}C was 0.02 minutes (and max $\sigma = 0.0035$). Combination of these uncorrelated errors propagates errors in the estimation of P_{GC} by 20 %. In other words, the values of vapor pressure determined experimentally (P_{GC}) carry an uncertainty of 20% due to errors in the estimation of vapor pressure of reference compound and variations in retention times.

The correlation between the experimental and literature values for the standards (Eq. 6.3-4) was used to correct for the experimental inequalities for the test compounds by:

$$\log P_L^0 = m \log P_{GC}^0 + c_1 \tag{6.3-4}$$

Temperature dependence of vapor pressure was determined using the Clausius-Clapeyron equation:

$$\log P_L = A_L + \frac{B_L}{T} \tag{6.3-5}$$

where, $B_L = -\Delta H_{vap}/R$ and was used to obtain the enthalpy of vaporization (ΔH_{vap})

6.4 RESULTS AND DISCUSSION

In order to validate the accuracy and dependability of our experimental design, vapor pressures for standard compounds were determined and compared to literature values. An excellent correlation was observed between the experimental (P^0_{GC}) and reported literature vapor pressure values for the standard compounds (Figure 6-1). Reliable literature values of vapor pressure were used to determine correlation and values of the parameters (with 95% confidence intervals) for the conversion of P^0_{GC} to P^0_L (Eq. 6.3-4) ($m = 1.182 \pm 0.449$ and $c_1 = 0.049 \pm 0.115$ ($r^2 = 0.97$)).

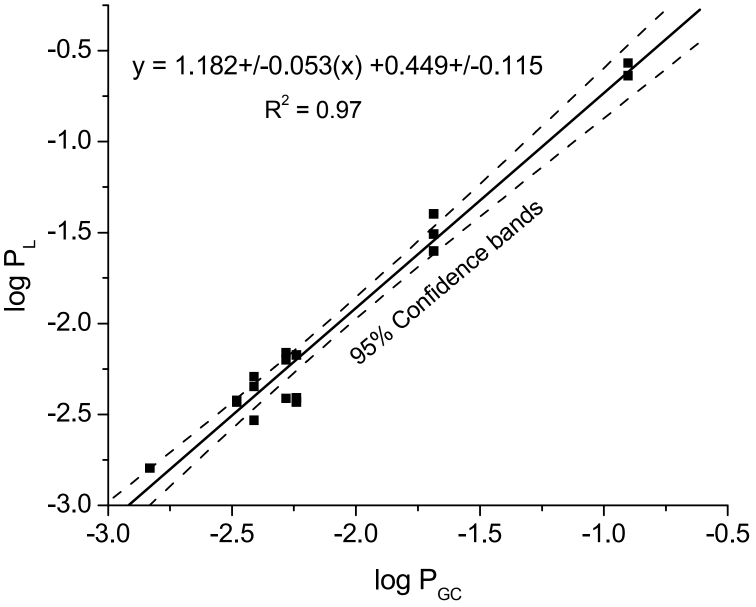

FIGURE 6-1 Correlation (with 95% confidence) between experimental and literature values of the standard compounds

TABLE 6-1 Compound type, registration status and chemical information on test, reference and standard analytes

Compound	Compound type	Registered for use in U.S.	CAS #	Chemical formula	Chemical name
Test					
chlorothalonil	OC Fungicide	Yes	1897-45-6	$C_8Cl_4N_2$	tetrachloroisophthalonitrile
chlorpyrifos methyl	OP Insecticide	Yes	5598-13-0	$C_7H_7Cl_3NO_3PS$	O,O-dimethyl-O-3,5,6-trichloro-2-pyridyl phosphorothioate
Diazinon	OP Insecticide	Yes	333-41-5	$C_{12}H_{21}N_2O_3PS$	diethyl 2-isopropyl-4-methyl-6-pyrimidinyl phosphorothionate
Fipronil	phenylpyrazole in secticide	Yes	120068-37-3	$C_{12}H_4Cl_2F_6N_4OS$	5-amino-[2,6-dichloro-4-(trifluoromethyl)phenyl]-4-[(1R,S)-(trifluoromethyl)sulfinyl]-
heptachlor epoxide	TP (parent: heptachlor)	No	1024-57-3	$C_{10}H_5Cl_7O$	1, 4, 5, 6, 7, 8, 8-heptachloro-2, 3-epoxy-3a, 4, 7, 7a-tetrahydro-4, 7-methanoidan
oxychlordane	TP (parent: chlordane)	No	27304-13-8	$C_{10}H_4Cl8O$	2,3,4,5,6,6a,7,7-octachloro-1a,1b,5,5a,6,6a-hexahydro-2,5-methano-2H-indeno
chlorpyrifos oxon	TP (parent: chlorpyrifos)	No	5598-15-2	$C_9H_{11}Cl_3NO_4P$	3,5,6-trichloro-2-pyridyl diethyl phosphate
TCP	TP (parent: chlorpyrifos)	No	6515-38-4	$C_5H_2Cl_3NO$	3,5,6-trichloro-2-pyridinol
Reference					
p,p'- DDT	OC Insecticide	banned	50-29-3	$C_{14}H_9Cl_5$	1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane
Standards					
α-HCH	OC Insecticide	banned	319-84-6	$C_6H_6Cl_6$	1,2,3,4,5,6- hexachlorocyclohexane (α-isomer)
α-chlordane	OC Insecticide	banned	5103-71-9	$C_{10}H_6Cl_8$	1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methano-1H-indene
β-chlordane	OC Insecticide	banned	5103-74-2	$C_{10}H_6Cl_8$	1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene
cis-nonachlor	OC Insecticide	banned	5103-73-1	$C_{10}H_5Cl_9$	1,2,3,4,5,6,7,8,8-nonachloro-2,3,3a,4,7,7a-hexahydro-
trans-nonachlor	OC Insecticide	banned	39765-80-5	$C_{10}H_5Cl_9$	1,2,3,4,5,6,7,8,8-nonachloro-2,3,3a,4,7,7a-hexahydro-
Heptachlor	OC Insecticide	banned	76-44-8	$C_{10}H_5Cl_7$	1, 4, 5, 6, 7, 8, 8-heptachloro-3a, 4, 7, 7a-tetrahydor-4, 7-methanoindene
chlorpyrifos	OP Insecticide	Yes	2921-88-2	$C_9H_{11}Cl_3NO_3PS$	O,O-diethyl O-(3,5,6-trichloro-2-pyridyl) ester

6.4.1 Vapor Pressure at Standard Temperature

To enable comparison of literature VP values (available mostly at 25 °C) and measured values (this study), VP results at 25 °C were calculated using the Clausius-Clapeyron equation (Table 6-2). The measured vapor pressures of the test compounds varied greatly, spanning four orders of magnitude**.** The variation among the values for OPs was greater than among the OC pesticides.

TABLE 6-2 Comparison of experimental (± 95% confidence) and published values of sub-cooled liquid vapor pressure values (Pa) @ 25 ^{o}C

Compound Name	Experimental P^{o}_{L} (Pa) at 25 ^{o}C (this study)	Literature values at 25 ^{o}C Range of P^{o}_{L} (Pa)	Selected Literature Value (Pa)
chlorothalonil	$8.6 \pm 2.7 \times 10^{-5}$	7.6×10^{-5} - 232 [1]	7.6×10^{-5} [1]
chlorpyrifos methyl	$2.2 \pm 0.7 \times 10^{-5}$	3.0×10^{-3} [2]	3.0×10^{-3} [2]
chlorpyrifos oxon	$6.2 \pm 2.4 \times 10^{-6}$	na	
diazinon	$2.8 \pm 0.8 \times 10^{-2}$	8.7×10^{-3} -1.13×10^{-2} [1]	2.0×10^{-2} [3]
fipronil	$1.5 \pm 0.6 \times 10^{-6}$	3.7×10^{-7} [4]	3.7×10^{-7} [4]
heptachlor epoxide	$8.0 \pm 3.0 \times 10^{-6}$	2.56×10^{-3} - 9.97×10^{-2} [1]	
oxychlordane	$7.5 \pm 2.8 \times 10^{-6}$	1.2×10^{-2} [5]	1.2×10^{-2} [5]
TCP	$6.0 \pm 1.7 \times 10^{-4}$	na	

TCP : 3,5,6-trichloro-2-pyridinol

na: not available

[1] Mackay et al. 1997

[2] Review Report for the Active Substance Chlorpyrifos Methyl 2005

[3] Hinckley et al. 1990, [4] Bobe 1998, [5] Paasivirta et al. 1999

The available literature values for chlorothalonil are the most widespread among our group. The measured value from this study (8.6 x 10^{-5} Pa) falls on the lower end of the literature value range and is similar to the value selected by Mackay et al. 1997 (7.6 x 10^{-5} Pa). The experimental value for the OP insecticide diazinon (2.8 x 10^{-2} Pa) also agrees well with the reported literature values (8.7 x 10^{-3} -1.13 x 10^{-2} Pa) and within the 95% confidence range is identical to the value reported by Hinckley et al. 1990. Diazinon has the highest VP in the group and is, therefore, the analyte most likely to volatilize from the point of application in the absence of other competing loss processes.

In contrast, fipronil has the lowest reported vapor pressure of all the test compounds (3.7 x 10^{-7} Pa); however, the measured value (1.5 x 10^{-6} Pa) is almost an order of magnitude higher than the reported literature value. Current estimates regarding the fate of fipronil indicate that it does not readily volatilize and, except for loss through drift during spray applications, it is not likely to be found in the air (Connelly 2001). However, results from this study suggest that it is more volatile and mobile than previously predicted. Alternatively, the measured value for chlorpyrifos methyl (2.2 x 10^{-5} Pa) is lower than literature values by a factor of 100 (3.0 x 10^{-3} Pa) (Review Report for the Active Substance Chlorpyrifos Methyl). Its low volatility suggests a more likely presence in soils and water bodies. Besides hydrolysis, it also undergoes aerobic degradation in soil and one of the major metabolites is TCP.

The experimental values for the two OC transforms - heptachlor epoxide (8.0 x 10^{-6} Pa) and oxychlordane (7.6 x 10^{-6} Pa) are three to four orders of magnitude lower than the available literature values (Paasivirta et al. 1999). The literature values are estimates and experimental measurements are not available. The results from this study support the requirement for direct measurements for a compound as has also been suggested by Paasivirta et al. 1999. These vastly lower vapor pressure values indicate that these two compounds will be more persistent in soils and perhaps biota rather than the atmosphere. Both the compounds are very highly toxic to fish (Environmental Health Criteria 38: Heptachlor). Heptachlor epoxide, the main heptachlor-related compound observed in the environment, bioconcentrates in aquatic organisms (Toxicological Profile for Heptachlor/ Heptachlor Epoxide 1987), and has been found in the fat of fish (Environmental Health Criteria 38: Heptachlor). The parent pesticides of both these compounds are no longer registered in U.S. Heptachlor is also a major component of technical chlordane. The sources for these compounds, though not vast, still exist and studies on their occurrence and effects in aquatic environments remain important.

Literature vapor pressure values for the chlorpyrifos transforms, chlorpyrifos oxon and TCP, are not available. Experimental results show that both the compounds are less volatile than the parent compound (3.35×10^{-3} Pa, Review Report for the Active Substance Chlorpyrifos 2005) and are, therefore, of greater concern in the water system. Chlorpyrifos is bioactivated in the liver to chlorpyrifos oxon which is then rapidly hydrolyzed to TCP. TCP is 100 times more volatile than the oxon (Table 6-2). The stability and volatility is a likely reason why TCP is the principal chlorpyrifos transformation product detected in the environment (Nolan et al. 1984). Chlorpyrifos oxon is a potent cholinesterase inhibitor (Health-Based Investigation Level for Chlorpyrifos 2005) while TCP is not regarded as toxicologically important.

TABLE 6-3 Parameters of the Clausius-Clapeyron equation (B_L, A_L) and Enthalpies of Vaporization. (ΔH_{vap})

Compound	B_L	A_L	ΔH_{vap} (kJ/mol)
chlorothalonil	-4294	13.3	82
chlorpyrifos methyl	-4702	14.1	90
chlorpyrifos oxon	-5069	14.8	97
diazinon	-675	3.7	13
fipronil	-5445	15.4	104
heptachlor epoxide	-4826	14.1	92
oxychlordane	-4835	14.1	93
TCP	-4046	13.4	77

6.4.2 Influence of chemical structure on enthalpy of vaporization

Enthalpy of vaporization (ΔH_{vap}) is defined as the amount of heat (or energy) required per unit mass of a substance to completely vaporize the substance, and it reflects the ease of volatilization. In other words, enthalpy change of vaporization can be viewed as the energy required to overcome the intermolecular interactions in the liquid phase (or solid, in the case of sublimation). Physical state (solid or liquid) and chemical structure (number of rings, asymmetry, polarity etc.) both influence the enthalpy of vaporization.

Liquids, with lower bond strengths, are known to have lower ΔH (Schwarzenbach et al. 2003). As expected, the lowest ΔH is that of diazinon (13 kJ/mol), the single liquid in the test group (Table 6-3).

For the solids it is known that increase in the number of aromatic rings, halogens and/or nitrogen atoms increases polarity and makes the bonds harder to break and this increases the ΔH. Polarizability, a physical property, defines the tendency of charge distribution to be altered by external forces which causes changes in polarity of the compound. More polar nature of charge distribution results in greater forces to be overcome before change in state can be achieved. Since the impact of most other factors is difficult to quantify while polarizability can be readily determined, polarizability was utilized to investigate the influence of molecular structure on ΔH.

Polarizability was determined using the on-line calculator SPARC. Briefly, providing the CAS # of the compound to the calculator results in SMILE of the chemical being determined which is then used to calculate different physical properties, one of which is polarizability. Other than diazinon (13 kJ/mol), the ΔH for other test compounds fall in the range 77-104 kJ/mol. The compound with the most polar nature, Fipronil, had the greatest ΔH (Table 6-3). As expected, increasing polarizability resulted in increased ΔH (Figure 6-2).

Most pesticides are applied onto soils and crops not as pure compounds but from commercial formulations where the active ingredient is dissolved in solvents and surfactants. The sub-cooled liquid vapor pressure, P_L (which unlike solid-phase vapor pressure P_s does not include the lattice energy present in the solid phase) has been shown to more closely relate to the properties of the pesticide in commercial formulations. It has also been illustrated that the P_L more closely controls the phase transfer of the active ingredients at the low levels present in the environment. Other researchers have applied P_L successfully to predict the vapor-particle partitioning of OC compounds in the atmosphere (Bidleman et al. 1999). It has also been illustrated that P_L values are strongly influence by temperature and that ΔH allows determination of the P_L at different temperatures. As stated earlier, the compounds chemical structure is an important factor in determining the magnitude of ΔH. This suggests that knowledge of variation of ΔH with physical structure of the compound will help in better estimation of P_L and will allow more realistic risk assessments of pesticides and their transformation products.

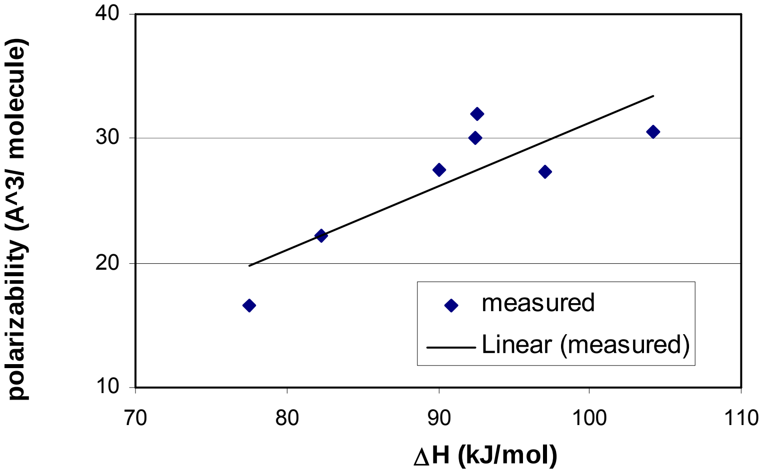

FIGURE 6-2 Correlation of heat of vaporization and Polarizability

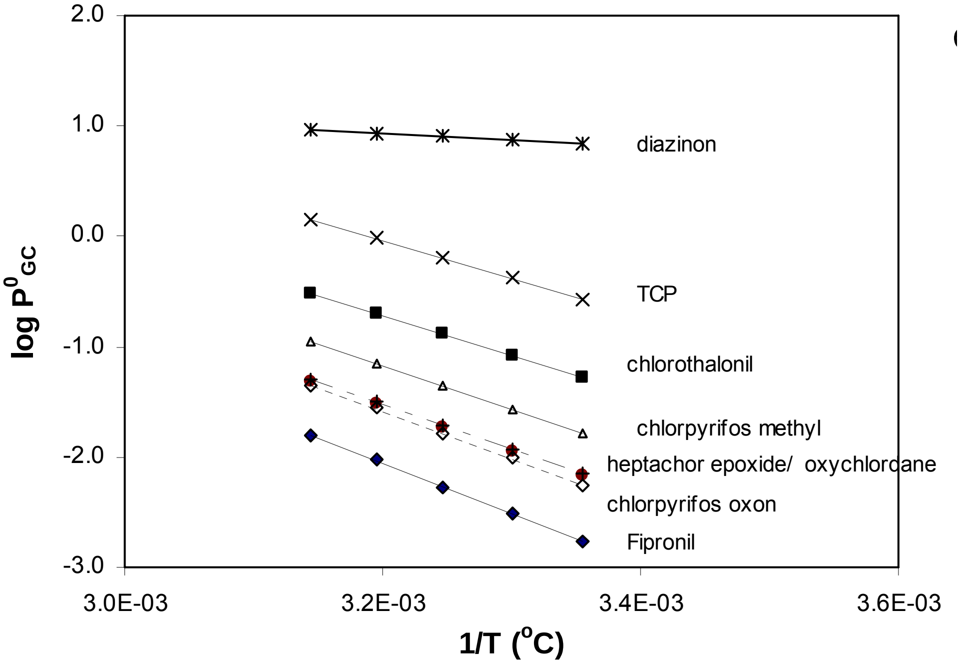

FIGURE 6-3 Vapor pressure-temperature relationships for all test compounds

6.4.2 Vapor Pressure Variation with Temperature

The vapor pressure-temperature relationship is different for each of the chemicals in our study (Figure 6-3). The most valuable data generated in this study are the required coefficients, A_L and B_L, for the Clausius-Clapeyron equation (Eq. 6.3-5) (Table 6-3). The availability of these coefficients enables the calculation of vapor pressure at different ambient temperatures for each compound. For example, when the temperature rises from 20 to 40 ºC the VP of fipronil increases by two orders of magnitude (7.2×10^{-7} to 1.1×10^{-5} Pa) while the increase for diazinon is much less (26 to 36 Pa). The vapor pressures of all compounds with higher values of the coefficient B_L (Table 6-3) rose by an order of magnitude with temperature change from 20 to 40 ºC. This shows their greater susceptibility to temperature changes and errors in environmental estimations are likely if temperature corrections are not incorporated. Heat of vaporization (ΔH_{vap}) is defined as the amount of heat (or energy) required per unit mass of a substance to completely vaporize the substance at its boiling point, and it reflects the ease of volatilization. In this respect, fipronil is the most difficult to volatilize and diazinon the easiest in this group.

6.5 CONCLUSIONS

Results from these experiments reveal that some current use pesticides have higher (fipronil) and some have lower (chlorpyrifos methyl) volatility than previously reported. Hence, model predictions of their phase distribution may provide quite different results from previous assessments. Experimental measurements are essential since literature values are mostly estimates and may vary widely. Vapor pressure values for most transformation products are not available at all and will have very different volatilities as compared to the parent compound. Vapor pressures of more pesticides and their degradation/transformation/breakdown products, especially those which are most commonly used or are being newly introduced, should be experimentally determined and relationship with temperature established to ensure realistic environmental distribution predictions.

CHAPTER 7 - WASHOUT RATIOS OF CUPs

This chapter has been prepared for submission to a journal

7.1 INTRODUCTION

Long-distance atmospheric transport of an organic compound depends on the media that it occurs in (gas vs. particulate) and it's response to precipitation. Washout (washed out in rainfall) is an efficient removal mechanism from the atmosphere for airborne compounds. The overall washout ratio is defined as:

$$W = \frac{C_r}{C_a} \qquad (7.1\text{-}1)$$

where, C_r and C_a are the concentrations in rainfall and air, respectively.

Gas and particle scavenging are the two contributors of the total atmospheric washout of the compound. Even though particle scavenging is the main washout mechanism (Atla and

Giam 1988) for hydrophobic organic compounds (e.g. HUPs which have a great affinity for the particulate phase), gas scavenging can also be important for CUPs which are generally more polar. In certain regions with significant rainfall, this process may govern the potential of some chemicals for long range atmospheric transport. The gas scavenging ratio W_g (or washout ratio of vapors), under equilibrium, depends on Henry's law constant (HLC) and can be determined as:

$$W_g = \frac{RT}{H} \tag{7.1-2}$$

where, H is the Henry's constant (Pa m^3/mol), T the atmospheric temperature (K) and R the gas constant (Pa m^3/K mol). A high HLC value indicates a higher vapor pressure and lower water solubility. Thus, compounds with a high HLC value will experience long atmospheric residence times while those with low HLC values will be more effectively washed out by precipitation. The assumption of this derivation - equilibrium conditions which means constant concentration in the gas and particulate phase- is not always true in field.

Correct prediction of WRs is essential to estimate the wet deposition in a rain event. The predictions are compared to field studies. Under field conditions, Wg is determined from the concentrations in air (C_a) and precipitation (C_r) as:

$$W_g = \frac{M_r / V_r}{M_a / V_a} \tag{7.1-3}$$

where, M represents the mass off SVOC in rain (or air) and V is the volume of rain (or air) collected. It is important to note that correct determination of gas scavenging requires that the air and rain samples be collected simultaneously for the same duration.

Among the two contributors to atmospheric washout, studies have focused primarily on particle scavenging (Ligocki, 1985) which depends on the amount present on the particles. Most of the data available is about two decades old and is mostly for organochlorines pesticides and polycyclic aromatic hydrocarbons (PAHs) (Ligocki et. al. 1985, Atlas and Giam, 1988). Studies on the WRs of pesticides are rare and values are mostly reported for composite WR and not for gas and particle phase separately. Even the data that is available reveals that predicted and observed gas washouts do not necessarily agree. One main reason is that predictions assume equilibrium between the gas phase and falling raindrops and chemical neutrality of the compound. Even though it has been estimated that gases will reach equilibrium with falling raindrops within a few tens of meters of fall distance (Slinn et al. 1978), it is true if they do not participate in chemical reactions with drops. The polar nature of most CUPs does not rule out reaction with water drops.

Also studies have not focused on a predominantly rural region where the nature of air column is different than in the urban areas and equilibrium may not exist. In an agricultural region, due to the close proximity to agricultural fields, CUP levels in the air column are not well mixed. The levels in a few meters above the ground are much higher than in the upper region. Hence it is likely that the time of contact between the rain drops and CUP level in gas phase is much shorter than required to reach equilibrium.

Temperature dependence of HLC is another cause for non agreement between the predicted and observed values of gas WRs. HLC is highly temperature dependent (Staudinger, 1996)- for some organic compounds it increases by roughly a factor of two for every 10 C increase in temperature. Temperature dependence of Henry's constant is generally expressed by the Vant Hoff eq.

$$H_T = H_{298} \exp\left(\frac{-\Delta H_{solv}}{R} \left(\frac{1}{T} - \frac{1}{298} \right) \right) \qquad (7.1\text{-}4)$$

where, ΔH_{solv} is the enthalpy of solvation.

Another form of the Vant Hoff equation more generally applied is:

$$\log H = \frac{-A}{T} + B \qquad (7.1\text{-}5)$$

HLC data is available at 25° C (298 K) for most compounds while the ambient temperatures at which the samples are collected can be as low as 5-10° C. Using the data available at 25° C underestimated Wg a factor of 3-6 but the correlation between the observed and predicted W_g was really good if the temperature dependence of HLC was known (Ligocki, 1985). HLC of most pesticides are either unknown, or known with limited accuracy.

The focus of this study is to determine the gas washout of potential of pesticides. Our WRs are not actual WRs since they don't include particulate phase. However, since most of our analytes are CUPs that are more polar (and were not detected above MDLs in the precipitation particulates (Kuang 2001)) gas scavenging is likely to be the more important deposition pathway to the region. The available data was analyzed to determine the field gas WRs, to investigate the influence of precipitation parameters (duration and intensity) and to compare the usefulness of the Henry's law constant in predicting gas WRs. Those compounds for which the temperature dependence of HLC was available have been examined in greater detail. To the best of our knowledge, this is the first attempt at measuring /determining the gas washout ratios for CUPs. Most of the data available is about two decades old and is mostly for HUPs (OCs) and PAHs (Ligocki et. al., 1985, Atlas and Giam, 1988). This study is expected to highlight the importance of gas washout as a source of agrochemicals to the terrestrial region, especially in rural areas.

7.2 EXPERIMENTAL

In this study there are 71 data points (HP: 31, LD: 27 and DV: 13) where both air and rain samples were collected on the same day. The duration of air samples was 24 h while the duration of rain samples ranged from 0.3-18 h. Except for 18 samples, all samples were collected from April-Sept. Ambient temperatures (24h average) ranged from 270 – 302 K for the sampling dates with an average value of 290 K.

The dissolved phase rain concentration C_r (ng/L) and gaseous phase air concentration C_a (pg/m^3) were used to calculate the gas scavenging ratio (dimensionless) as

$$W_g = 10^6 \frac{C_r}{C_a} \qquad (7.2\text{-}1)$$

The influence of rainfall duration on washout was examined as:

$$\log W = a(D) + b \qquad (7.2\text{-}2)$$

where, D is the rainfall duration (hr), a and b are constants. Influence of precipitation intensity was also examined by replacing D by rainfall intensity (I -total rainfall/total time it rained)) as well.

Both the predicted and observed values are only for gas phase scavenging. The predicted values of washout ratios were calculated from Equation 7.1-2 and the 24 h average ambient temperature during air sampling was used. Observed values of gas WRs were determined using Eq. 7.2-2. The predicted and observed WRs were compared for the compounds for which the temperature dependent Henry's constant is available. The equations describing the temperature dependence of Henry's constants were taken from several sources (Feigenbrugel et al. 2004; Gautier et al. 2003; Rice et. al. 1997; Staudinger and Roberts 1996, Endosulfan: Draft Dossier prepared in support of a proposal of endosulfan to be considered as a candidate for inclusion in the UN-ECE LRTAP protocol on persistent organic pollutants, German Federal Environment Agency, 2004).

7.3 RESULTS

Detections in precipitation were dominated by CUPs (chlorothalonil: 75 %; trifluralin: 50 %; chlorpyrifos and metolachlor: 45 % each and β-endosulfan; 40 %) which was expected given their high level of usage and timing of sample collection (April-Sept, main agricultural season). In 2000, 145 tons metolachlor, 13 tons chlorothalonil and 8 tons Chlorpyrifos were used in the MD counties alone in the Peninsula (NASS). Data to compare our observations is scarce. However, in general, the gas WRs from our sites are quite comparable (Table 7-1) to other regions.

The washout ratios covered a wide range: from 10^3 to 10^7 (Figure 7-1). The average WRs for all of our analytes are > 10^4 (Figure 7-1) and as suggested by Atlas and Giam (1988) (dimensionless Henry's constant, $H/RT < 10^{-4}$ or $W_g > 10^4$) gas exchange is the prominent washout process for this region. The observation that gas scavenging is the main washout process for most pesticides is also supported by the predicted WRs for most compounds (β-endosulfan, diazinon, alachlor etc.) under the temperature conditions in the region (Figure 7-2). However, more hydrophobic compounds (such as HCHs, α-endosulfan), have predicted WRs below 10^4 at higher temperatures. For these compounds particle scavenging will be an important part of the washout process from the atmosphere as compared to more polar compounds.

TABLE 7-1 Gas phase WRs observed in the Delmarva Peninsula and reported for other places

	Delmarva Peninsula this study		Portland, OR (1)	College Station, TX (2)
	max	min		
a-HCH	2.1E+05	1.3E+04	3.1E+04	5.0E+03
g-HCH	5.5E+05	1.4E+04		3.3E+04
p,p-DDE	1.2E+06	3.1E+04		2.0E+01
Dieldrin	9.9E+04	6.5E+03		6.0E+03

(1) Ligocki, 1985 (mean at 8 C)
(2) Atlas and Giam, 1988 (estimated at 23 -25 C)

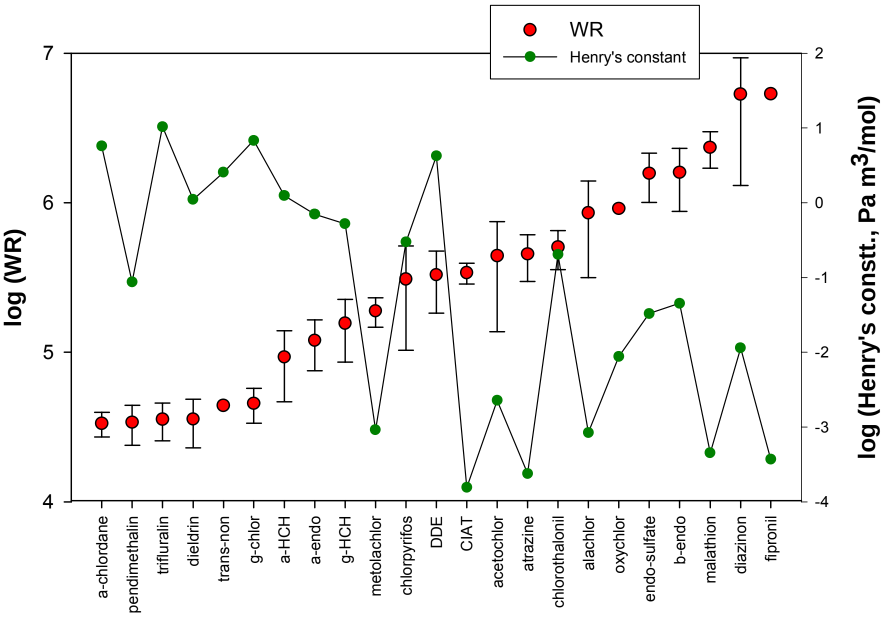

FIGURE 7-1 Observed gas WRs and literature values of HLCs at 293 - 298 K

As is expected, compounds with higher Henry's constants showed lower WR and vice versa (Figure 7-1). The maximum variability in observed WRs is for diazinon, chlorpyrifos, alachlor and acetochlor. Chlorothalonil and metolachlor, although among the most frequently detected, had among the least variability in WRs. Variation in the temperature range available to determine HLC (either 293 or 298 K) and that at which the samples were collected (270 – 302 K) had an impact on the non-agreement between observed and predicted WRs (explained later).

The washout ratios for atrazine, metolachlor and chlorothalonil (among the most used pesticides) showed some dependence ($p<0.1$) on the duration of the rainfall (Table 7-3). The washout ratios did not show any correlation with the intensity of rainfall.

TABLE 7-3 Co-relation of WR with duration of rainfall

log WR = a(Duration) + b

	Atrazine	**Metolachlor**	**Chlorothalonil**
r^2	0.7062	0.7472	0.8968
p	0.075	0.059	0.053
a	11.03 ± 0.07	11.97 ± 0.22	13.51 ± 0.34
b	0.28 ± 0.11	0.099 ± 0.034	(-0.31) ± 0.07

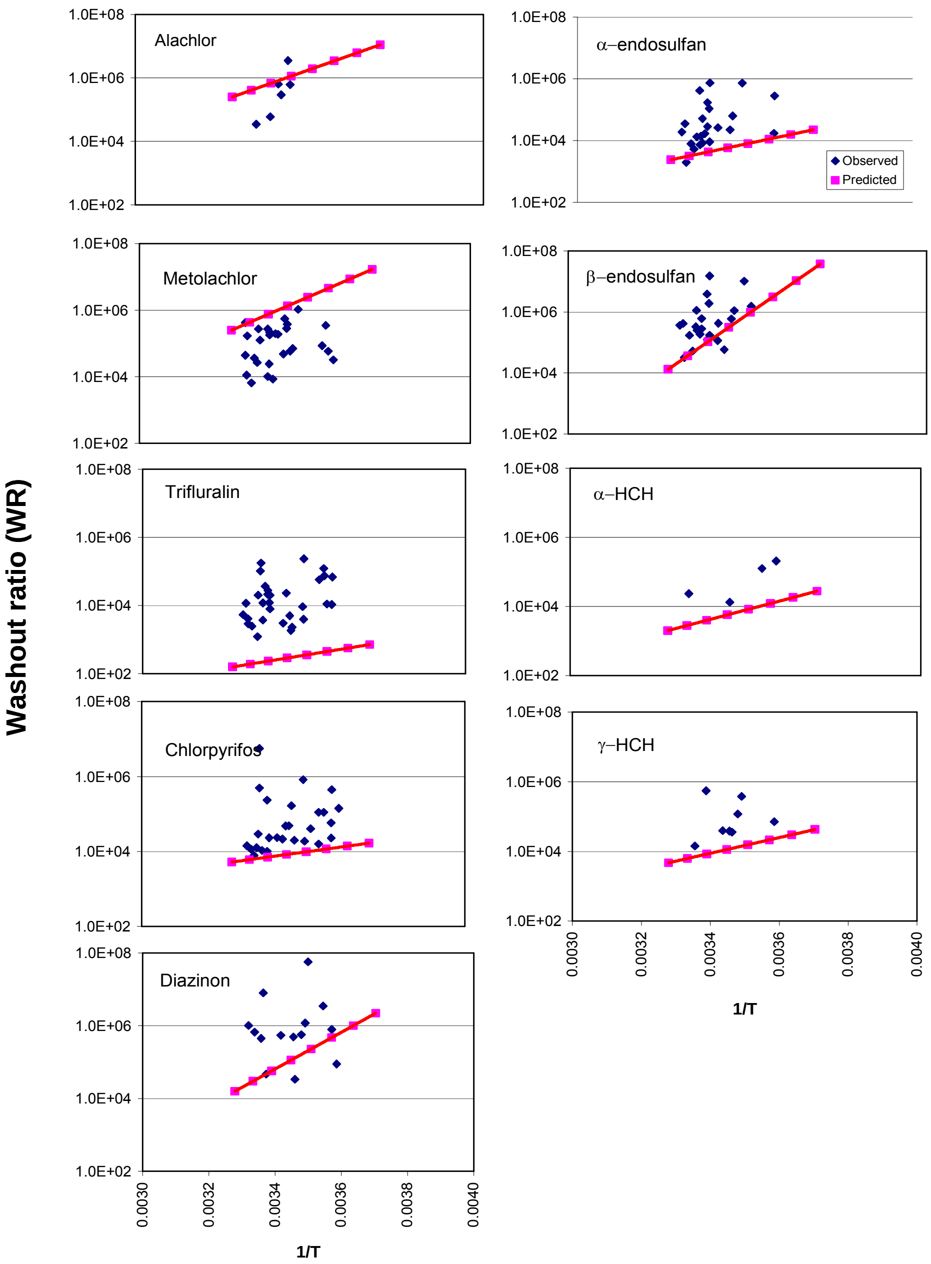

FIGURE 7-2 Observed and predicted gaseous WRs.

7.4 DISCUSSIONS

WRs predicted with temperature dependent HLC values (Figure 7-2) showed a better co-relation with observed value. The observed and predicted ratios are reasonable for diazinon and β-endosulfan. HLCs appear to over predict for two herbicides - metolachlor and alachlor. It seems to under predict for the other herbicide- trifluralin- and the insecticides- chlorpyrifos, HCHs and α-endosulfan.

The difference between observed and predicted values depends on both the physical properties and the sample collection protocol. Other issue is that air concentrations measured from the ground which may have higher air concentrations or non-equilibrium concentrations with respect to height around the air sampler. Rain water is falling through the air column and may have less time to interact with higher air concentrations closer to the ground. Those chemicals coming from some distance may be closer to equilibrium in the air column and therefore more evenly scavenged by the rain.

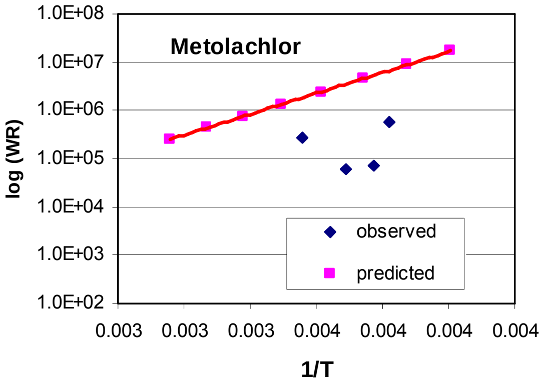

FIGURE 7-3 Observed and predicted gaseous WRs when rainfall duration >= 12h.

TABLE 7-2 Physical properties of some pesticides

	Type	MW (g/mol)	Solubility (mg/L)	VP (Pa)	HLC (Pa m^3/mol)	log K_{ow}
Current Use						
Alachlor	H	270	242	2.9E-03	8.4E-04	3.5
Atrazine	H	216	35 (26 ^{0}C)	3.9E-05	2.4E-04	2.6
Metolachlor	H	284	530 (20 ^{0}C)	4.2E-03	9.1E-04	3.1
Trifluralin	H	335	< 1 (27 ºC)	6.1E-03	1.0E+01	5.3
Chlorpyrifos	I	351	1.2	2.7E-03	2.9E-01 (20 ºC)	5.0
α-Endosulfan	I	407	0.5 (20 ºC)	4.0E-04	7.2E-01	3.8
β-Endosulfan	I	407	0.5 (20 ºC)	8.0E-05	4.0E-02	3.8
Diazinon	I	304	40	1.2E-02	1.1E-02 (23 ºC)	3.8
Chlorothalonil	F	266	0.6	7.6E-05	2.0E-01	3.1
Historical Use						
DDE	TP	318	0.04	8.0E-04	4.2E+00	6.5
α-HCH	I	291	2	6.0E-03	1.2E+00	3.8
γ-HCH	I	291	7.3	5.6E-03	5.2E-01	3.7

note: unless otherwise noted, all values are at 25 C
MW- molecular weight: VP - vapor pressure; HLC - Henry's Law Constant

The difference in the properties of the endosulfan isomers can help explain the difference in observed levels of WRs. The β-isomer of endosulfan is more persistent while the α-isomer is more volatile and dissipative. Concentrations of α-endosulfan were higher than β-endosulfan in air at all sites and vice versa (Appendix N-O). Similar observations have been reported by the IADN study for the Great Lakes. However, when the two isomers occur together in solution, β-isomer (symmetric in S=O conformation) readily converts to the

□-isomer (S=O asymmetric) (Schmidt et al. 2001). After a precipitation event, the time taken to drip through the SPE cartridge in the rain sampler could be long enough to ensure conversion of a significant amount of β- to α- isomer. This would cause greater amount of α-isomer being measured than actually occurring in precipitation and would result the values of WRs being higher than predicted.

The two compounds for which there is over prediction – alachlor and metolachlor- have the highest solubility and lowest octanol-water partitioning in the group (Table 7-2) and are most likely to occur mostly in the dissolves phase (and have high gas WRs). Since metolachlor volatilization from soil is greatly dependent on the soil water content (Prueger et al. 2005), a moist soil will lose more metolachlor to the air than a dry soil. Although data is not available, the same is likely to be true for the other chloroacetanilide herbicide alachlor. Hence if it rains only for a short while during a sampling period, the air concentrations after the rain event are likely to be higher than before the event. In other words, averaging the air concentrations over 24 hours is likely to give a higher concentration in air and would result in lower WR than predicted. For events with rainfall duration 12h or more the difference between the observed and predicted WR was not that pronounced (Figure 7-3). The same was true for most pesticides. Positive coefficients for Eq. 7.2-1 (Table 7-3) mean that as the duration of rainfall increases, the WR increases. Also, low duration of rainfall means low WR (or high air concentration).Thus our measured WRs likely give a lower bound. It is possibly the reason why the predicted and observed values for metolachlor (Figure 7-2) do not agree. This shows that to estimate the actual washout ratios from field studies it is necessary that the air and rain samples be collected at the same time and for the same duration.

The other compounds in Figure 7-2 have much lower water solubility but higher Kow than the others. They are expected to associate to a larger degree in the particle phase and have lower gas WRs as seen in Figure 7-2. However, the observed rain concentrations depend on the amounts captured by the sampling devices. For large rain events, it can be several hours before the sample trickles past the filter-cartridge assembly. As has already been suggested (Atlas and Giam 1988) greater time the washed particles spend with the water, the greater they lose the compound to the dissolved phase and concentration increases. This can also be the reason explaining the high variability observed for DDE (Figure 7-1) where gas WR is much higher than would be depending on the high HLC. Particle scavenging has been predicted to contribute 99% to washout for DDE (Atlas and Giam, 1988). Although our rain samples were filtered, the time spent in the sampler before filtration could result in over-saturation of water phase and result in greater gas WRs.

Temperature dependent HLC for chlorothalonil is not available but the negativity of the coefficient b suggests that as precipitation duration increase, the WR decreases exponentially. Given the low water solubility of chlorothalonil (which lowers the scavenging) this is not unexpected. Longer rain duration basically reduces the overall concentration in rain samples and leads to lower values of WR. Also, chlorothalonil undergoes aquatic degradation which depends on water pH. The rate is negligible below pH 7 but can be quite high above that (Szalkowsky 1977). When the rainfall amount is high, it takes a while before the total sample volume trickles down the sampler. This result in enhanced degradation time, and even though the pH is most likely lesser than 7, some degradation is likely to occur. This will cause the amount of chlorothalonil reaching the sampling cartridge to be lesser than actually washed off, and result in lower than predicted WRs.

The observed WRs also depend on determined air concentrations. Trifluralin and the HCHs were detected very frequently and at high levels in the back PUFs (could be up to 74% of the total amount for trifluralin and α-HCH and 61 % for γ-HCH). The significant breakthrough shows that the air concentration determined through the sampling was on the lower side and would cause the observed WR to be higher than predicted.

7.5 CONCLUSIONS

This is the first time it has been attempted to determine the gas WR for current use pesticides. The values vary widely and are quite different from what would be predicted based on the physical properties alone. The sample collection process plays an important part in the study. As would be expected different classes of pesticides behave differently with respect to washout. Local usage can have a significant impact on WRs by acting as sources even during a rain event. For the historical organochlorines, the WRs measured in this study compare reasonably with the values reported from earlier studies. Gas scavenging is the dominant contributor to wet deposition of pesticides for the Peninsula. During the cooler parts of the year, particle washout may be more important for more hydrophobic organochlorines. Temperature dependence of Henry's constants for the more polar compounds needs to be examined to determine environmental fate of compounds with greater precision.

CHAPTER 8 - IMPACT OF RAINFALL PATTERN AND AGRICULTURAL ACTIVITY ON WET DEPOSITION OF CUPs

This chapter has already been published by Journal of Agricultural and Food Chemistry

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8.1 ABSTRACT

Event-based precipitation samples were collected during the main agricultural season (April-Sept) over four years (2000-2003) at one site in the Choptank River Watershed on the Delmarva Peninsula. The samples were analyzed for 19 agricultural pesticides to determine the contribution of wet deposition as a source of these compounds to the Chesapeake Bay and the factors affecting the temporal trends in

deposition. Chlorothalonil was detected most frequently (92% samples) followed by metolachlor (66%) and endosulfans (49%). Although chlorothalonil is the single biggest contributor to pesticide flux (33-46%), pesticide wet deposition is dominated by herbicides (46-61%) with the greatest fluxes occurring during the time of herbicide application on corn and soybeans. Our analysis suggests that, the extent of wet deposition of herbicides depends on the timing of precipitation relative to herbicide application. The insecticide and fungicide flux was greater in years with above average rainfall (2001 and 2003) suggesting that for these pesticides deposition flux is dependent on the total amount of rainfall in the agricultural season. Our data indicates that the use of chlorpyrifos, an organophosphate insecticide which is on the Toxics of Concern list for the Bay, is on the increase. Total pesticide flux ranged from 90 $\mu g/m^2$ (2001) to 180 $\mu g/m^2$ (2000). Wet deposition can account for up to 10-20% of the annual loadings of pesticides to the Bay.

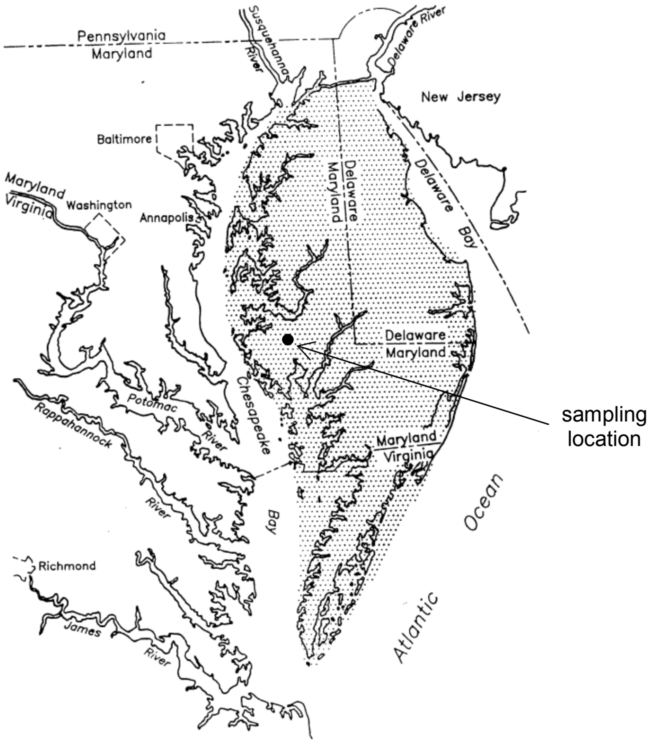
8.2 INTRODUCTION

The Choptank River watershed is an intensely agricultural region. It is part of the Chesapeake Bay estuarine drainage area where pesticide application rates are among the highest in United States (Pait et al. 1992). The watershed is located on the Delmarva Peninsula (Figure 8-1), a rural, agricultural region. Corn, soybeans, wheat, fruits and vegetables are the main agricultural commodities. Maryland counties on the Peninsula used about 2.1 x 10^3 tons of pesticides in 2000 (Maryland Pesticide

Statistics for 2001). Aquatic organisms in the Bay, its tributaries and associated wetlands may be at risk from exposure to pesticides (Chesapeake 2000). Research shows that exposure to agricultural pesticides can alter both functional and structural aspects of the estuarine microbial food web (DeLorenzo 1999). For instance, it has been found that long-term exposure to low levels of atrazine may lead to shifts in species sensitivity and potential alterations in phytoplankton population dynamics (Penington and Scott 2001). Similarly, exposure to endosulfan and chlorpyrifos adversely effects abundance of bacteria and heterotrophic ciliates and flagellates, respectively, in an estuarine environment (DeLorenzo 1999).

A major portion of the pesticide load to the Bay is expected to occur via runoff contributions to its tributaries. However, aerial deposition, which is recognized as a major pathway for organic contaminant loading to water bodies (Nelson 1998, van Jaarsveld and van Pul 1999), may also be a significant source of pesticides. Pesticides are effectively scavenged from the atmosphere by rainfall (Simcik 2000; Karlson and Muir 2000) and have been detected in precipitation throughout the world. Pesticides of concern include chlorpyrifos, atrazine, and endosulfan among others because of their widespread use and/or high toxicity potential (Eisler 1989; Leight and van Dolan 1999).

The Chesapeake Bay has a large surface area to mean water volume ratio and receives 75-100 cm of precipitation annually, which makes the atmosphere a likely source of contaminants (Gustafson and Dickhut 1997). For example, it is estimated that a quarter of the total nitrogen load to the Bay comes from atmospheric deposition (Bay Pollutants 2004). The Chesapeake Bay region is not well characterized with respect to presence of pesticides in the atmosphere. The existing studies are few, sporadic and mostly short term (Glotfelty et al. 1987; Goolsby et al. 1997; McConnell et al. 1997; Wu 1981; Harman-Fetcho et al. 2000). Long term monitoring is required to better understand the different factors affecting the wet deposition of pesticides in this region. Concentrations in precipitation depend not only upon the amount of pesticides present in the atmosphere, but also on the amount, intensity, and timing of rainfall (vanDijk and Guicherit 1999). Moreover, the usage of pesticides varies from year to year in response to weather conditions and farming practices.



sampling location

FIGURE 8-1 Sampling site along the Choptank River, Delmarva Peninsula

This study was undertaken to elucidate the effects of agricultural activity and rainfall patterns on the wet depositional fluxes of current use pesticides in the region. The importance of wet deposition as a source of these compounds to the Bay has also been investigated.

8.3 EXPERIMENTAL

8.3.1 Precipitation Sampling

Precipitation samples were collected from April to September for the years 2000-2003 at one site on the campus of the University of Maryland, Horn Point Environmental Laboratory, near the mouth of the Choptank River in Cambridge, MD (38^{o} 36′ 04″ N, 76^{o} 07′ 47″ W) (Figure 8-1). The site is adjacent to a 10-m meteorological tower in an open field with no large obstructions within at least 100-m and no agricultural production in the immediate proximity (at least 800 m).

Rain samples were collected on an event-basis using a modified, MIC-B rain sampler (Meteorological Instrument Center, Ontario, Canada) having a 0.2 m^2 stainless steel funnel covered with a rain sensor activated lid. Each rain event was any precipitation collected during a 24-hr period from 10 A.M. to 10 A.M. (± 1 hour) the following day. Rainwater passed through a filter-cartridge assembly. Particles were retained on the filter whereas pesticides in the dissolved phase were retained on the solid phase extraction (SPE) cartridge. Samples with volume <50mL, representing less than 0.025 cm rainfall were not analyzed. After a rain event, the cartridge and filter were removed, stored at 20^{o}C, and shipped to U. S. Department of Agriculture, Beltsville, MD for analysis. More details on the sample collection, extraction procedures and efficiencies can be found in Kuang et al. (2003).

A total of 203 rain samples were collected from April to September in the 4 years of sampling from 2000-2003. There were 17 rain events where the rainfall was below the sample cutoff size of 50 mL and were discarded. Hence, the dataset includes more than 90% of the rain events that occurred from April to September for the four years. Fewer events were received in 2001 and 2002 (36 and 39, respectively), while 67 and 62 events were received in 2000 and 2003, respectively. Median volumes for each year ranged from 0.79 L in 2002 to 1.7 L in 2003. For the year 2003, sampling was terminated on 15th September due to Hurricane Isabelle. In some years additional samples were collected in March or from October and November to assess concentrations outside the main agricultural season (n=39).

8.3.2 Pesticide extraction

The SPE cartridges were dried using high purity (>99.9%) nitrogen gas. Absorbed analytes were eluted with 6mL dichloromethane (DCM) followed by 9 mL 3:1 acetone: acetonitrile (MeCN) solvent mixture. The resulting extracts were concentrated to a volume of 1.0 mL under a gentle stream of high purity (>99.9%) nitrogen gas, exchanged into MeCN and quantitatively transferred to a 2 mL amber glass vial. Pesticide recoveries from dissolved-phase rainwater following our collection and extraction method ranged from of 68-104% (Kuang et al. 2003). The collection capacity of the SPE sorbent material was assessed by placing two cartridges in series and extracting several volumes (up to 10 L) fortified with a mixture of target analytes through the sampler. For majority of the compounds, the extraction efficiency was lowest at 10 L (Kuang 2001). The maximum rain sample volumes reported for 2000, 2002 and 2003 were the only rain events in those years which exceeded 10 L (except for another 11 L sample in 2003). It is probable that the measured pesticide concentrations from these high volume events are lower than the actual values. The data presented in this paper is for dissolved-phase pesticide concentrations only; previous work has shown that particle-phase pesticides are not present above the limit of quantitation at the typical sample volumes collected (Kuang et al. 2003).

8.3.3 Instrumental Analysis

Pesticide concentrations in rain extracts were determined using a Hewlett-Packard (HP) (Palo Alto, CA) 5890 gas chromatograph coupled to a HP 5989A mass spectrometer (GC-MS) in selected-ion monitoring mode using electron impact (EI) and negative chemical ionization (NCI) mass spectrometry. Samples from 2000 were analyzed as in Kuang et al. 2003. For samples from 2001–2003 the chromatographic conditions were as follows. In EI mode, the injection volume was 1 μL; column, J&W DB-1MS, 30-m, 0.25 mm i.d., 0.25 μm thickness. Flow rate through the column was 1mL/min; temperature program, 90 ºC, raised at 5 ºC/min to 150 ºC then at 2 ºC/min to 166 ºC and finally at 5 ºC/min to 280 ºC for 2 min; interface, 300 ºC; quadrupole, 100 ºC; source, 200 ºC; injector, 270 ºC. For the analysis of samples from 2003, a DB-17MS column (J&W) was used as it was observed that it gave a better separation for CEAT (6-amino-2-chloro-4ethylamino-s-triazine) and CIAT (6-amino-2-chloro-4-isopropylamino-s-triazine). In NCI mode, the injection volume was 2 μL. The chromatographic conditions were as follows: column, J&W DB-17MS, 30-m, 0.25 mm i.d., 0.25 μm thickness. Flow rate through the column was 1.4 mL/min; temperature program, 130 ºC, raised at 6 ºC/min to 205 ºC for 4.5 min and then at 6 ºC/min to 300 ºC for 5.5 min.; interface, 300 ºC; quadrupole, 150 ºC; source, 200 ºC; injector, 290 ºC. Beginning in 2001, 20 μL atrazine-d_5 (54 ppm) and 20 μL PCB-204 (4 ppm) were used as internal standards. The method of internal standards using a five-point calibration curve (ranging from 0.005 to 0.25 ppm for NCI and from 0.05 to 2.0 ppm for EI) was used for sample quantification.

8.3.4 Target pesticides

Our target analytes in this study included those pesticides that are typically used on corn, soybeans, and vegetables, as well as a few transformation products (Table 8-1). Eight compounds were analyzed in the EI mode and the remaining in NCI mode on the GC-MS. Target herbicides were the triazines (simazine, atrazine, transformation products CIAT and CEAT), chloroacetanilides (acetochlor, alachlor, metolachlor), and dinitroanilines (trifluralin and pendimethalin). Insecticides included organochlorines (endosulfans; α and β isomers as well as the transformation product sulfate, lindane (γ-HCH) and its transformation product α-HCH), organophosphates (chlorpyrifos and its degradation product, the oxon, diazinon, malathion). Chlorothalonil was the only fungicide in the study. Chlorpyrifos, malathion, endosulfan and endosulfan sulfate are among the compounds on the Toxics of Concern List for the Chesapeake Bay (Chesapeake Bay watershed chemicals of concern 2000).

TABLE 8-1 Usage of some pesticides in Maryland

	Pesticide class	**Target cropes in Maryland**	**Usage in MD Eastern shore 1997** [b]	**2000** [c]	**Henry's Constant** [a] **Pa m3/mol**
acetochlor	H	corn	71	7	2.2 E-08
alachlor	H	corn, soybeans	51	2	2.1 E-03
atrazine	H	corn	127	138	2.5 E-04
chlorothalonil	F	vine crops, greens, potatos, tomatos, orchard fruits	6	13	2.2 E-02
chlorpyrifos	I	corn, orchard fruits, strawberries	14	8	7.4 E-01
diazinon	I	melons, greens, orchard fruits	2	3	7.2 E-02
endosulfan	I	vine crops, potatos, tomatos, orchard fruits	0.3	0.3	2.9 E-02
glyphosate [d]	H	corn, soybeans, barley, wheat	106	245	< 1.4 E-07
malathion	I	strawberries	1	2	1.1 E-03
metolachlor	H	corn, soybeans,greens, potatos, tomatos	237	145	2.4 E-03
pendimethalin	H	soybeans, tomatos, greens	27	18	1.2 E+00
simazine	H	corn, orchard fruits, strawberries	46	78	9.8 E-05
trifluralin	H	greens, tomatos	1	14	1.5 E+00

[a] ARS pesticide properties database
[b] Maryland Pesticides Statistics for 1997
[c] Maryland Pesticides Statistics for 2000
[d] glyphosate is not a target pesticide and is included here solely for comparison

8.3.5 Quality Assurance/ Quality Control

The quality control and assurance procedures have been described in Kuang et al. 2003, and method detection limits (MDLs) developed for target analytes are provided in Table 8- 2. To ensure that there was no bias in results due to possible contamination of the sampler, once every month a field blank was collected by pouring 4L of distilled water into the rain sampler funnel and processing it in the same way as a sample. A total of 17 field blanks were collected for the sampling period April-September, 2001-2003. Some analytes occurred above MDL in 9 of these field blanks; chlorothalonil in 8, trifluralin in 4, and metolachlor and α-HCH in one blank each. The field blanks where the chlorothalonil was above the MDL all fell during the summer. Based on the standard deviation for the amount of chlorothalonil seen in the blanks, a new summer time MDL of 4.2 ng/L was calculated based on a 4-L volume. Therefore an MDL for chlorothalonil of 1.6 ng/L was used for samples collected from April-June and an MDL of 4.2 ng/L was used for July-September samples for all four years. Trifluralin amount in field blanks were very close to the MDL. Metolachlor occurred in one field blank from April, 2002 and the amount present in samples from this month was much higher than in the blank. α-HCH occurred in the blank from September, 2003 and surprisingly was not present in any sample from this month. Considering the timing of occurrence of these compounds in the blanks and their levels with respect to MDLs and amount present in samples, it was decided not to apply any corrections to the samples for trifluralin, metolachlor and α-HCH.

For the regression analyses performed in this study, the level of significance has been set at 5% (i.e. $\alpha=0.05$) and p-values (i.e., actual observed level of significance) have been reported throughout the text.

8.4 RESULTS AND DISCUSSION

8.4.1 Agricultural activity and pesticide usage

Agriculture is Maryland State's largest commercial industry and contributes more than $17 billion in revenue annually. The major crops in Maryland include corn, soybeans, small grains (barley, wheat, and oats), vegetables (potatoes, tomatoes), nursery products, and fruit (apples, melons etc.). Agricultural activity is mainly concentrated in the counties on the Delmarva Peninsula. The soil type in this region is mainly clay-loam. Besides being the major producers of potatoes, tomatoes and green peas, these counties accounted for 62% of corn, 72% soybeans, 70% wheat and 48% of barley produced in the state in 2002 (Maryland Agri-Facts 2004).

Vegetables such as potatoes and peas are among the first to be planted (early in March) and harvest begins end of June. Potatoes are rotated with other crops such as corn and vegetables whereas peas are followed by soybeans, lima beans and other vegetables. Row crops such as cantaloupes, watermelons, cucumbers and tomatoes are planted from early April to middle of June. Corn planting begins in April whereas soybeans are planted beginning May. Wheat and barley are winter grains and are often used as cover crops. They are sown in late Fall and harvested in Spring.

Herbicides comprised 46% of all pesticides used in the U.S. in 2001 (Pesticides Industry Sales and Usage: 1996 and 1997 Market estimates) followed by insecticides (9%) and fungicides (6%). Typically, herbicides are applied at the time of planting; atrazine and metolachlor are often applied together at corn planting, metolachlor and/or alachlor/acetochlor are applied during soybeans planting. Metolachlor, pendimethalin and trifluralin are among the herbicides that are applied pre-emergence on potatoes, late planted peas and tomatoes. Some crops also require post-emergent herbicide application. In Maryland (as per the statistics available from 1997, National Pesticide use Database) acetochlor and atrazine are used exclusively on corn (Table 8-1). Metolachlor and alachlor are used on both corn and soybeans whereas pendimethalin and trifluralin are used on vegetables. In 1997, in excess of 36 tons of glyphosate was used on corn and 62 tons on soybeans in Maryland (National Pesticide use Database). The increased acreage of glyphosate tolerant corn and soybeans (RoundUp-Ready) and consequently greater use of glyphosate is the likely reason for the sharp decrease in the use of traditional corn herbicides, such as acetochlor and alachlor, from 1997 to 2000 (Table 8-1).

Insecticides are used to combat insects and mites and are used mostly on vegetables and fruits. Depending on plant physiology, soil and weather conditions, plants may be susceptible to one or more insects during the different stages of their lifecycle. The timing and total number of insecticide applications can vary considerably from year to year, as influenced by the timing and level of infestation.

Endosulfan is used for the control of aphids (tomatoes, potatoes, melons, peaches, apples) during May-June, beetles (potatoes, tomatoes, pumpkins) during April-May and also for the control of whiteflies on pumpkins later in the season. Most of the agricultural uses of lindane (γ-HCH), another organochlorine, have been banned by the U.S. EPA. However, it can be used as a seed treatment on corn, soybeans, wheat, barley, peas, cantaloupes, squash (USEPA Documents for chlorpyrifos) and hence has been included in this study. The organophosphates, malathion, chlorpyrifos and diazinon were the top three organophosphate insecticides used in the U.S. in 2001 (Pesticides Industry Sales and Usage: 1996 and 1997 Market estimates). In Maryland, chlorpyrifos is used mainly on corn for the control of ear-damaging pests such as the European corn borer which strikes in May-June. In response to the Food Quality Protection Act of 1996, the U.S. EPA has canceled its use on tomatoes and has greatly reduced its use on apples and peaches (USEPA Documents for chlorpyrifos). Diazinon is used for the control of maggots (peas, watermelons, pumpkins) in spring. It can also be used on worms (potatoes, tomatoes) in May-June. One of the uses of malathion is also to control mites in strawberries.

Chlorothalonil is the primary fungicide used on fruits and vegetables for the treatment of diseases, such as blight, leaf spots, mildew and fruit rots. It was the most used fungicide in Maryland in 2000 (5.5 tons of active ingredients, Maryland Pesticide Statistics for 2001). The intensity of the disease depends on weather conditions; *early blight* occurs during warm rainy or humid weather whereas l*ate blight* is favored by cool, wet conditions. For tomatoes and pumpkins disease control is achieved with preventive pesticide treatments. Fungicides are typically applied every 7 to 14 days.

Thus, the major herbicide application period is from March to May. Insecticides are likely to be applied during late spring and summer. Fungicide application would depend on rainfall patterns. Greater use of fungicides is expected during years with greater rainfall quantities.

8.4.2 Trends in precipitation

During the course of this project a wide range of rainfall patterns were observed (Figure 8-2), ranging from drought conditions in 2002 (39 cm rainfall) to above average rainfall in 2003 (79 cm). The largest number of rain events were observed in 2000 (67), and the fewest events in 2001 (NASS Quick Stats). The drought year of 2002 was dominated by the largest event of the entire 4-year sampling period, a 6.5 cm rainfall on 24th July 2002, representing 17.3% of the total rainfall for the entire season (Horn Point Weather station). For any given year and month, the highest number of rain events occurred in May, 2003 (n=15). The years 2000 and 2003 (as well as 2001 and 2002) were very similar in terms of the amount of rainfall received and the frequency of rain events. For the years 2000-2002, it rained frequently during April while the frequency was quite low in 2003. Seasonable weather in spring 2002 resulted in corn being planted at a faster rate than in the other years. However, crop plantings were delayed in 2003 due to excess moisture from the snow and rain received in the region during the winter of 2002-2003 (Maryland weekly crop weather reports 2002).

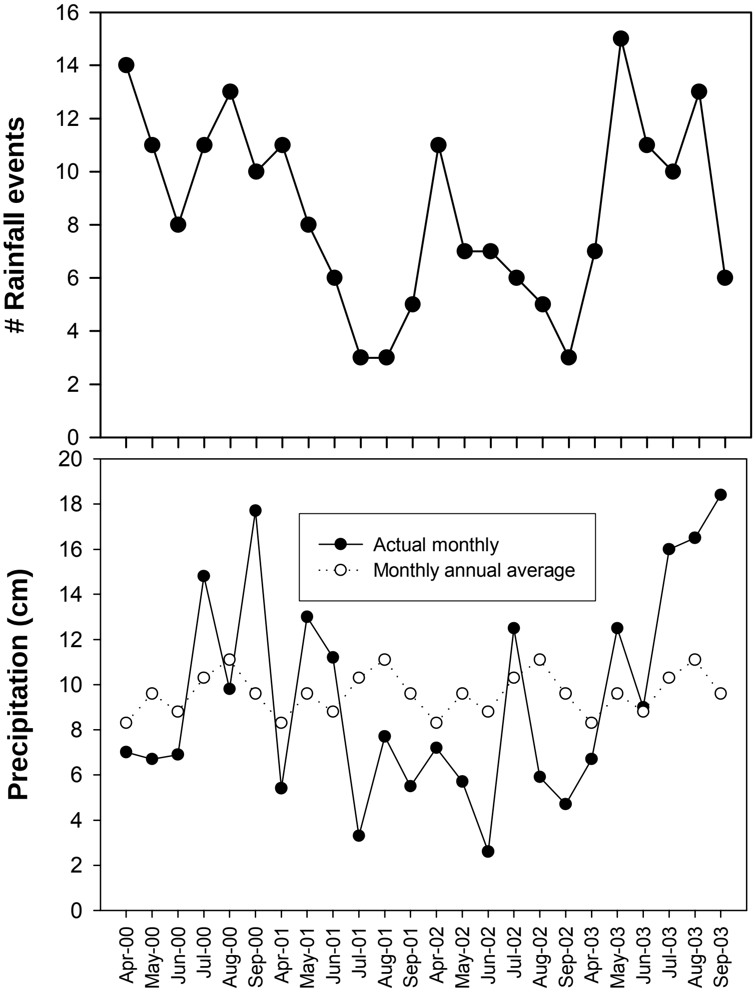


FIGURE 8-2 Number of rainfall events and amount of precipitation received (cm) on a monthly basis during the sampling period (April – September, 2000-2003). The monthly annual average rainfall represents the averages for the Maryland counties on the Delmarva Peninsula (Kent, Queen Anne's, Talbot, Caroline, Dorchester, Wicomico, Somerset and Worcester. Ref. (Maryland State Archives. Precipitation)

Considering the amount of rainfall received during the sampling period, one would expect higher fluxes in 2000 and 2003 as compared to 2001 and 2002. In general, wet deposition of pesticides would be expected to be lowest in 2002.

Considering the timing of overall planting progress for corn and soybeans combined with rainfall patterns, conditions for the greatest herbicide wet flux would be found in 2000 and 2001 with less expected in 2002.

8.4.3 Pesticide detections in rainfall

As expected, herbicides were most frequently detected in samples collected around the corn and soybeans planting season, and concentrations generally declined sharply after the end of June (Figure 8-3). The insecticides, in general, showed a greater variation in their detection and observed concentrations. Most insecticides as well as the fungicide, chlorothalonil, were detected in low concentrations throughout the year and concentrations typically peaked in July-August. During the main agricultural season (April-Sept), chlorothalonil was the most frequently detected pesticide (in 92% samples) (Table 8-2) followed by metolachlor (66%) the endosulfans ($\alpha+\beta$) (49%), atrazine (44%) and chlorpyrifos (39%). Pesticides were also detected in samples collected from March (2002), October (2001 and 2002) and November (2000 and 2002). Insecticides and chlorothalonil dominated the pesticide detections for these off-season months; chlorothalonil was detected in 74% samples followed by chlorpyrifos (69%) endosulfans and trifluralin (38% each) and diazinon (33%). Chlorothalonil and pendimethalin were the only compounds detected in samples from Nov, 2000 and October, 2001. Although primary use of pendimethalin (also trifluralin) is on beans (National Pesticide use Database), it can also be used on wheat, barley and turf grass. Application of pendimethalin as a pre-emergence herbicide on wheat and barley, which are both winter crops in the Peninsula, or on golf courses later in the year could explain its occurrence in samples from the cold months. Trifluralin was detected in low concentrations in all samples from March 2002 (n=12) which is in keeping with its use on vegetables. Metolachlor and atrazine were also present in March 2002 samples, which can be explained by the early onset of corn planting in that year due to dry conditions.

8.4.4 Current use pesticide wet flux

Pesticide concentrations in a precipitation sample are influenced by the total amount of rainfall received in that particular event. Rain concentrations are likely to be highest at the beginning of a rain event, with decreasing concentrations as the air is scavenged of airborne residues (Leister and Baker 1994). Hence, it is more informative to use mass fluxes of pesticides in precipitation to compare trends. Across the years, the median pesticide flux was highest in the month of May (Figure 8-4), decreased during June, increasing again in July, and dropping steadily during August and September. Herbicides contributed most to the flux in April and May; whereas, the flux in September was almost exclusively contributed by insecticides and chlorothalonil. The total pesticide flux for the target compounds were in the range of 90-180 $\mu g/m^2$ per season (Table 8-2). Chlorothalonil was the single biggest contributor to the overall flux (33-46%) followed by metolachlor (19-22%) and trazine (10-16%).

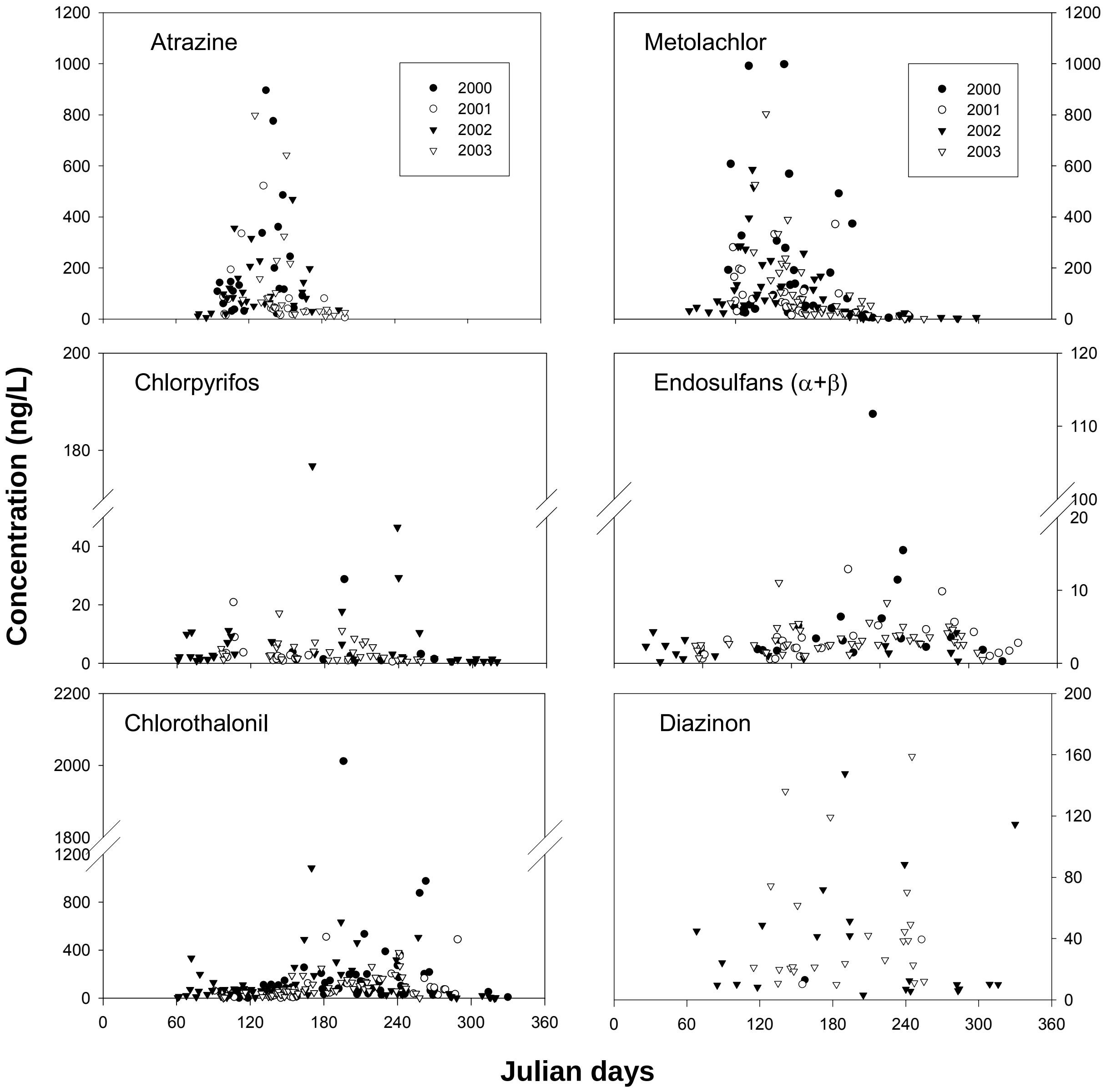


FIGURE 8-3 Concentrations in precipitation of select pesticides for the years 2000-2003. The span of sampling dates varied somewhat from year to year but generally ranged from March to November, Julian day 60 to 300

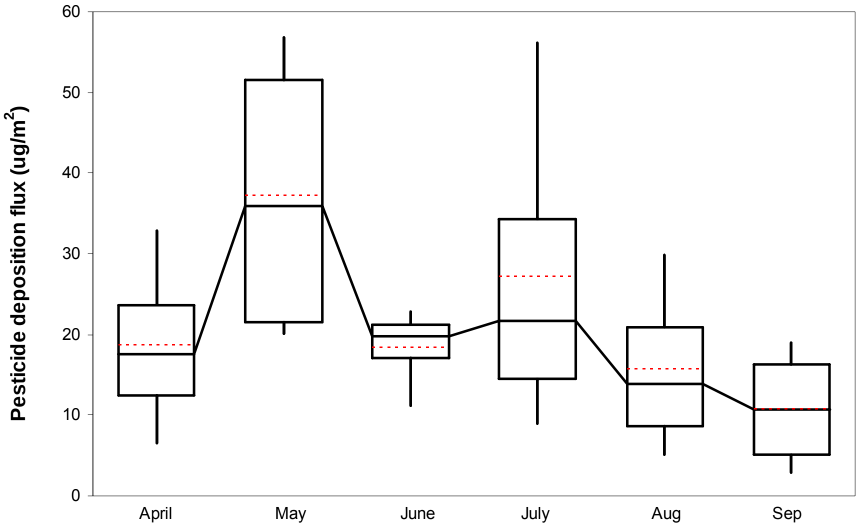


FIGURE 8-4 Box plot showing the distribution of pesticide wet flux across months (April – September, 2000-2003). Solid horizontal lines represent the 25th percentile, median and 75th percentile, respectively. The dotted horizontal line represents the mean flux. The vertical bars represent the spread of data.

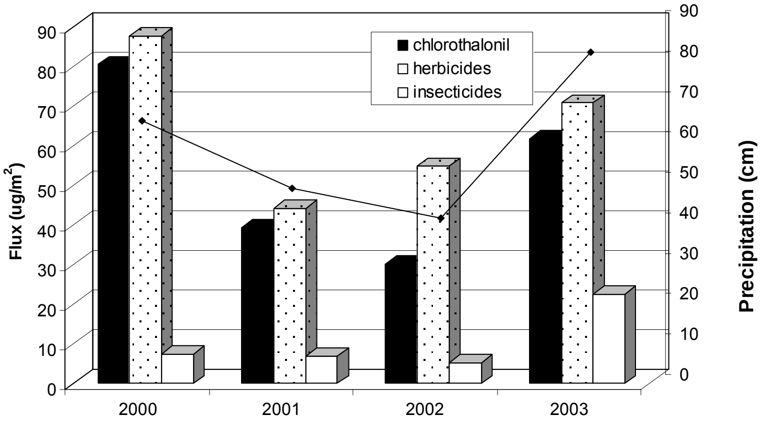


FIGURE 8-5 Pesticide flux vs. the rainfall received during the sampling period (April-September) across the four years. The solid line represents the precipitation (cm) received at the sampling station during the same time

Herbicides

As a class, herbicides were the biggest contributors comprising 46-61% of the total flux for the months April-September. Since corn and soybeans are the main crops on which herbicides are applied in large quantities, April-May was the time for greatest herbicide flux (except for 2003 where the maximum flux was in June). Herbicide fluxes were not linearly correlated with the rainfall volume in an event (Table 8-2) except for trifluralin and pendimethalin which were weakly correlated ($r_{\text{trifluralin}}= 0.15$, $r_{\text{pendimethalin}}= 0.17$; $\alpha =0.05$). Total herbicide flux also did not vary as the total amount of rainfall (Figure 8-5). Rather, fluxes for herbicides appear to be related to the frequency and timing of precipitation during the planting season (Figure 8-2). Dependence of herbicide flux on the timing of rainfall relative to application has also been reported by Hatfield et al. (1996). In our study, herbicide flux was least in the year with the wettest spring (2001) and greatest in the year with a dry spring (2000) (Figure 8-5) which is contrary to what was expected. Surprisingly, the number of rainfall events from April-June were same for 2000 and 2003 (33 each) and for 2001 and 2002 (25 each). Hence, the years with the wettest and driest springs (2001 and 2002, respectively) had the same number of precipitation events from April-June (n=25). However, in the wettest spring there was no precipitation from 4/25 to 5/11, missing a major pesticide application period (59% of the corn was planted between 4/23 and 5/13 of 2001, Maryland weekly crop weather reports 2002). In contrast, it rained frequently during the corn planting season of the driest spring (2002) although the volume of rainfall was small. Our data indicates that during the time of planting smaller but frequent rain events result in greater herbicide flux than infrequent but large rain events.

Atrazine and metolachlor together contributed approximately two-thirds of the total herbicide flux and their fluxes correlated well with the progress of corn planting. The weekly fluxes for atrazine and metolachlor for the duration of corn planting displayed a weak positive correlation (atrazine: r =0.41, p-value =0.08; metolachlor: r = 0.36, p-value =0.10) with the frequency of rain events and percentage of corn planted in that week although (as is evident from the p-values) the correlations were not statistically significant (at α=0.05). Like atrazine, metolachlor fluxes typically peaked in May. However, in 2002 (driest spring), the highest metolachlor flux was in April. This is consistent with faster progress of corn planting; 40% corn was planted by the end of April, 2002 as compared to 20% in an average year (Horn Point Weather station). However, metolachlor presence in precipitation as late as September, and second peaks in July of wet summers (years 2000 and 2003) suggest its use as a broad spectrum herbicide although the major use is on corn.

Depending on where the samples were collected and the weather conditions, the reported annual wet fluxes of herbicides vary considerably across the U.S. In the Midwest (Goolsby et al. 1997,; Hatfield et al. 1996; Majewski et al. 1999), the atmospheric inputs of atrazine (25-120 $\mu g/m^2$) and metolachlor (25-100 $\mu g/m^2$) are considerably higher than in our study (atrazine: 12-27 $\mu g/m^2$; metolachlor: 17-33 $\mu g/m^2$). Higher flux values would be expected in the Midwest region, an area with 43 million acres of corn and 38 million acres of soybeans (combined acreage for the states of Illinois, Indiana, Iowa, Minnesota and Nebraska for 2002, NASS Quick Stats) versus the Delmarva Peninsula (0.43 million acres of corn and 0.53 million acres of soybeans in 2002, Maryland Agri-Facts, NASS). These studies in the Midwest were conducted in the early to mid 90s. The introduction of glyphosate and s-metolachlor in the late 1990s has changed the herbicide usage in recent years. The acres of soybeans in the U.S. which were treated with metolachlor dropped from 7% in 1995 to <1% in 2001. For the same period soybeans treated with glyphosate rose from 20 to 76% (Agricultural Chemical Usage 2002). Glyphosate is also increasingly being used on corn. It is likely that the wet deposition flux of atrazine and metolachlor has also decreased in the Midwest since the mid 1990s.

The depositional flux for atrazine in this study (12-27 μg/m^2) is close to what was estimated for northeastern states of the US (10 μg/m^2, Glotfelty et al. 1987). Some authors (Wu 1981, Majewski et al. 1999) have reported the detection of atrazine in winter samples. Atrazine was not detected in any sample from October or November in this study although it was present in air samples from the same time at low concentrations (unpublished data). Long range transport of atrazine has been suggested as the reason for the presence of atrazine in precipitation in winter months (Wu 1981) and at non-agricultural sites (Glotfelty et al. 1990).

The flux for the triazine degradation product, CIAT (0.69-4.5 μg/m^2), was comparable to what has been reported for the Patuxent river watershed (3.6 μg/m^2, Harman-Fetcho et al. 2000). For this study, the fluxes for atrazine and CIAT were well correlated ($r = 0.46$; $p<0.0001$). Highest CIAT fluxes occurred in the months of April-May in all years. However, unlike atrazine, CIAT had higher fluxes in the drier years (4.5 μg/m^2 in 2002 compared to 0.69 μg/m^2 in 2003). CIAT is formed by the dealkylation of triazine herbicides which chiefly occurs by microbial degradation in soil but some authors have suggested that atmospheric photolysis may also be a pathway (Thurman et al. 1995). In studies from the Midwest, the ratio of CIAT to atrazine (DAR) in atmospheric deposition was 0.4 in spring application. This is higher than 0.1 that typically occurs in surface water during the first spring flush of herbicides during and after application (indicating low degradation in soil) (Thurman et al. 1994). The broad range of DAR values in spring samples from our study (0.07-1.5) suggest that atmospheric conversion of triazines to CIAT might be a contributing factor. Low DARs from April-May of 2003 (0.07-0.31) suggest low degradation and is not surprising considering 2003 was marked by delayed corn planting and large rainfall events in the months following April. Large amount of precipitation is likely to have resulted in a greater than normal loss of atrazine in runoff and leaching, and less available for degradation into CIAT. Consequently, May 2003, with the maximum number of rain events in all four years (n= 15) had the least CIAT flux (0.69 $\mu g/m^2$). DARs were higher in April-May of 2002 (0.24-1.16) which shows that conditions were conducive to degradation (earlier start of corn planting, frequent rain events but low rainfall volume) and could account for maximum CIAT flux occurring in April of 2002 (2.1 $\mu g/m^2$).

If wet deposition fluxes directly reflect local usage, alachlor use is on the decrease in the Choptank river watershed, and acetochlor use is on the rise. The total flux for alachlor decreased from 9.9 $\mu g/m^2$ in 2000 to 2.7 $\mu g/m^2$ in 2003, while acetochlor increased from 1.3-11 $\mu g/m^2$ over the same period. Acetochlor is being used mainly for corn (maximum flux in April-May and absence in rainfall beyond June) whereas alachlor is used on both corn and soybeans and is detected more frequently in precipitation. The use of simazine, another herbicide used on corn, is also on the decline in the region. Although data from 2001 is not available, the decrease in flux (10-4.8 μg/m^2), concentrations and percentage detections (18-4.8%) for simazine from 2000 to 2003 support this view.

Pendimethalin and trifluralin are more persistent than the other herbicides in this study. They were the only two herbicides to show a weak positive correlation with the amount of rainfall in individual events (Table 8-2) which is consistent with their higher Henry's constant as compared to the other herbicides in this study. Pendimethalin fluxes in the wet years (2000 and 2003) were very similar and were twice as large as in the dry years (2001 and 2002). Moreover, along with metolachlor, pendimethalin and trifluralin were the only herbicides present in precipitation as late as October in 2002. As has been mentioned before, use on winter wheat, barley and turf grass could account for the occurrence of trifluralin and pendimethalin in the later months. Trifluralin was not detected in precipitation in 2000; however, for the period 2001-2003, there was a steady increase in fluxes (0.08-0.75 μg/m^2), concentrations and percentage detections (5.6-44%). It was detected in all samples from March 2002 and flux in that month (0.24 μg/m^2) was more than twice of the total flux for the main agricultural season (0.11 μg/m^2). The use of trifluralin in MD counties on the Peninsula increased 10 fold from 1997 to 2000 while that of pendimethalin fell by 30% in the same period (commensurate with the reduction in maximum application rate recommended by EPA, Re-registration eligibility decision for pendimethalin). While usage data for the period 2000-2003 is currently not available, our data tends to support a continuing upward trend in usage of trifluralin in this region.

TABLE 8-2 Observed concentrations and wet fluxes of CUPs in precipitation

Pesticide	MDL	Percent detection	2000 Concentration range	2000 Concentration average	2000 Flux	2001 Concentration range	2001 Concentration average	2001 Flux	2002 Concentration range	2002 Concentration average	2002 Flux	2003 Concentration range	2003 Concentration average	2003 Flux	r[a] Dep. Flux vs. Sample vol.
	ng/L		ng/L	ng/L	μg/m^2	ng/L	ng/L	μg/m^2	ng/L	ng/L	μg/m^2	ng/L	ng/L	μg/m^2	
acetochlor	1.30	17	14-170	2.1	1.32	20-85	6.6	3.06	50-360	20	7.82	11-220	14	11.2	*0.08*
a-endosulfan	0.23	31	1.3-31	0.8	0.53	0.4-5.2	1.2	0.55	0.1-2.4	0.3	0.12	0.2-1.4	0.4	0.41	0.42
a-HCH	0.40	2.0	0.4	0.1	0.03	ND	NA	NA	0.03-0.5	0.1	0.04	22	0.7	0.02	0.46
alachlor	1.30	25	9.5-450	16	9.88	7.7-490	14	6.31	6.2-150	15	5.83	5.3-73	3.4	2.69	*0.03*
atrazine	1.30	44	22-900	44	27.4	4.7-520	26	12.1	21-470	35	13.6	10-800	18.5	15.1	*0.01*
b-endosulfan	0.22	47	0.3-81	2.4	1.48	0.4-7.7	1.6	0.75	0.1-2.4	0.6	0.23	0.3-11	2.0	1.53	0.35
CEAT	2.10	0.0	ND	NA	NA	ND	NA	NA	ND	NA	NA	ND	NA	NA	NA
chlorothalonil	1.60	92	12-2000	130	80.8	5.6-510	86	41.2	6.1-1100	78	30.1	2.0-380	91	61.7	0.47
chlorpyrifos	0.45	39	1.0-29	1.0	0.61	0.5-8.9	1.2	0.67	0.4-180	4.5	1.75	0.7-17	2.3	1.33	0.25
chlorpyrifos oxon	2.03	3	1.3-650	4.6	2.91	2.7-75	8.1	3.71	ND	NA	NA	4.4-48	1.5	1.34	0.15
CIAT	1.80	18	21-130	4.6	2.86	11-150	7.77	3.57	13-260	12	4.46	3.4-18	0.8	0.69	0.00
diazinon	1.96	20	13	0.3	0.21	10-39	0.5	0.23	3.1-150	6.2	2.39	10-160	18	14.6	0.26
endosulfan sulfate	0.50	34	1.0-14	0.4	0.28	0.9-3.4	0.6	0.27	0.2-7.5	0.9	0.34	0.7-4.2	0.7	0.88	0.51
g-HCH	0.54	15	1.5-22	0.8	0.53	0.3-7.1	1.2	0.53	0.3-6.3	0.8	0.32	0.7-3.6	0.3	0.32	0.32
malathion	0.88	7.4	1.9-360	1.5	0.94	31.5	0.2	0.17	7.3	0.1	0.04	4.2-83	5.9	1.80	*0.05*
metolachlor	1.20	66	4.3-1000	53	33.1	11-370	38	17	1.4-590	51	19.8	0.8-800	40	32.1	*0.11*
pendimethalin	1.20	12	20-83	4.8	3.04	12-96	3.7	2.19	14-150	4.5	1.72	2.8-76	4.3	3.45	0.17
simazine	2.00	9.9	18-500	16	10.2	–[b]	–[b]	–[b]	19-160	4.0	1.55	55-130	6.0	4.77	*0.04*
trifluralin	0.37	17	ND	NA	NA	0.2-7.4	0.1	0.08	0.1-12	0.3	0.11	0.2-24	1.2	0.75	0.15
Total					176			90.2			90.2			155	

[a] Pearson's corelation coefficient. Numbers in italics are not significant at α =0.05

[b] data not available due to problem with interfering ions

Insecticides and fungicides

The insecticides and the fungicide, chlorothalonil, were present in precipitation in all months sampled. The monthly fluxes varied across the years although they were typically high around July-August. As expected, the insecticide and fungicide fluxes are higher in wetter years (2000 and 2003). The fluxes in individual rain events (for chlorothalonil and the insecticides) showed a statistically significant positive correlation ($r = 0.15\text{-}0.51$; $\alpha=0.05$) with the amount of rainfall (Table 8-2). These pesticides are applied mainly on vegetable and fruit crops. Unlike herbicides, which have a narrow window for the bulk of application (pre-emergence), the insecticides and fungicides are often applied on the crops at regular intervals (e.g., every 7 to 14 days for potatoes and tomatoes) which would explain their frequent presence in atmospheric samples. Their high Henry's constant, lower water solubility (as compared to the herbicides) and more frequent application explain their flux dependence on rainfall volume. In contrast, the herbicides, in general, have a lower Henry's constant and partition into water more readily and are washed out effectively even with a small amount of precipitation.

If wet fluxes are considered to be representative of usage, it appears that the use of diazinon and chlorpyrifos is increasing whereas the use of endosulfan is decreasing in the region. Diazinon was detected in only one sample each in 2000 and 2001 (in the month of June). The detection frequency and the observed concentrations increased in 2002-2003 and it was present in all sampled months for these years. The detection frequency for chlorpyrifos increased steadily from 2000 (39%) to 2003 (55%). The greatest flux occurred in 2002 (dominated by a single event in August which contributed 54% of the total flux) and the least in 2000. The maximum concentration for α-endosulfan decreased steadily over the years; the concentrations for the β-species and the sulfate also dropped in the years following 2000 (Table 8-2). The decreased contribution of endosulfan to pesticide flux could, in part, be due to the fact that EPA recommended decrease in usage owing to its known toxicity to aquatic life (Leight and van Dolan 1999). Malathion was detected sporadically and in keeping with the general pattern, the detections and fluxes were higher in the wetter years (2000 and 2003). The flux for 2003 was dominated by a single event on 20th June which accounted for 53% of the total flux. Chlorpyrifos and malathion are the organophosphate insecticides among the priority chemicals selected by the Toxics Subcommittee of the Chesapeake Bay Program (Allen, Personal communication 2004). In this context, the apparent increase in the use of chlorpyrifos is a matter of concern.

The annual average wet deposition flux of γ-HCH (lindane) in the Great Lakes (0.25 $\mu g/m^2$, adapted from Hoff et al. 1996 using the total surface area of the Lakes, 245759 km^2) is similar to that observed in our study (0.32-0.53 $\mu g/m^2$) whereas the wet flux for α-HCH (0.32 $\mu g/m^2$) is about 10 times higher than observed in this region (0.02-0.04 $\mu g/m^2$). Agricultural usage of lindane in the vicinity of the Great Lakes has been suggested (Cortes et al. 1999). Although, Maryland does not have any reported use of lindane (Maryland Pesticide Statistics for 2001) it is likely to be used as a seed pretreatment on corn, soybeans, squash etc. (Specimen label, seedmate). The fact that γ-HCH was detected most frequently from April-May, support this view. α-HCH occurred sporadically; just one month each in 2000 (September) and 2003 (May), three months in 2002 (April, July and September) and not detected at all in 2001. Long range transport is a possible source of HCHs and along with some local use is likely responsible for the presence of HCHs in precipitation in this region.

Of the insecticide degradation products, endosulfan sulfate flux was highest in the wettest year (2003). Biodegradation of endosulfan in soils is the main pathway for the formation of the sulfate species. Faster degradation of endosulfan in clays under high water content-high temperature regimes (Ghadiri and Ross 2001) as well as greater wash out with high rainfall volumes could have contributed towards the high flux in 2003. Chlorpyrifos oxon had the greatest flux in 2001. Surprisingly, very high fluxes of chlorpyrifos oxon were received in March and November of 2002, whereas the oxon was not detected at all in the other months of this year. The oxon is formed by photo degradation of the parent compound under moist conditions (Racke 1993). The generally dry conditions in 2002 during the main sampling period might account for the non detection of the oxon in that year.

Chlorothalonil was the only fungicide included in this study. As has been mentioned before, it was the most frequently detected agrochemical and the biggest single contributor to the overall flux. Although it was present in rainfall in all months, the fluxes were typically highest in July-August. Chlorothalonil contributed ~ 50-98% of the flux for the months of July-September. The anomaly of the much higher contribution to wet flux as compared to its usage might be explained on the basis of the soil chemistry of this compound. The main degradation pathway for chlorothalonil is by microbial degradation in soil (Caux et al. 1996); it is not broken down by ultra violet light. The half life of chlorothalonil in soil after first application is generally short (~35 days). However, it has been reported that repeated use of chlorothalonil, alone or in combination with other pesticides such as chlorpyrifos, results in suppression of its degradation rate (Motonaga et al. 1998; Singh et al. 2002) and significantly decreases its dissipation rate in soil. The fungicide is typically applied more than once in agricultural operations in this region and is likely to have a longer soil half life. Thus, it is available for volatilization to the atmosphere over a greater period of time and is detected more frequently in rainfall.

Hence, herbicides and insecticides respond differently to rainfall patterns reflecting their chemical properties and application patterns. Herbicide fluxes illustrate a higher influence by the timing of application as well as the frequency and distribution of rainfall events relative to application. Insecticide and fungicide fluxes are dependent upon the amount of rainfall in a year. Higher herbicide flux in 2002 (driest year) offset the decrease in insecticide and chlorothalonil flux resulting in 2001 and 2002 having the same net flux (Table 8-2). Although, the April-September sampling period covers the major period when the herbicide flux is received, it is not adequate for the other two classes of pesticides which may have high fluxes even in the colder months.

8.4.5 Potential toxicological risks to biological resources in the Chesapeake Bay

Pesticide concentrations in precipitation were at levels likely to raise concern. Chlorothalonil seasonal maximum concentrations (380-2000 ng/L) were close to the 96-h LC_{50} for the Atlantic oyster (3200 ng/L, PAN Pesticides Database), a key component of the Chesapeake Bay ecosystem. U.S. EPA's chronic marine water quality criterion for endosulfan (α+β) (8.7 ng/L, National Recommended Water Quality Criteria: 2002) was exceeded in approximately 3% of the samples, for chlorpyrifos (5.6 ng/L) in 10% and for malathion (100 ng/L) in 1 sample. In addition, atrazine seasonal maximum concentrations (470-900 ng/L) approached the level of 1000 ng/L at which sub lethal effects have been observed on phytoplanktonic algae, which are an integral part of the estuarine environment (Penington and Scott 2001). Even though biota in water bodies are unlikely to be exposed to concentrations present in rainwater due to dilution effects, concentrations in precipitation point to high levels of risk especially for organisms in shallow water bodies or isolated ponds. It is important to note that our sampling site is distant from any immediate agricultural activity and, as such, is likely to have pesticide concentrations in precipitation closer to background levels for the region. Pesticide fluxes in locations closer to agricultural fields are expected to be higher in response to higher air concentration conditions.

	Atmospheric deposition[a] April-Sept (2000-2004)	Annual load rate to the Bay[b] Mar, 1992 - Feb, 1993
a-HCH	0.2 -0.3	3 [c]
Alachlor	23 - 83	126 - 169
Atrazine	102 - 229	2700
Diazinon	2 - 123	31 - 153
g-HCH	3 - 5	9 [c]
Malathion	0.3 - 15	20 - 180
Metolachlor	145 - 277	1399 - 1402
Simazine	13 - 85	1050 - 1090

[a] based on deposition fluxes from this study for the Chesapeake Bay main stem area (8384 sq. km)

[b] combined total for the Susquehanna, Potomac and James rivers at their fall lines
(adapted from Foster *(52)*)

[c] for Susquehanna river from March,1997 - Feb, 1998, ref. Liu *(54)*

TABLE 8-3 Estimated pesticide loadings to the Chesapeake Bay (kilograms per year)

Wet deposition seems to be a significant source of pesticide input to the Chesapeake Bay. Even though concurrent data for the amount of pesticides present in the Bay at the time of this study is not available, several authors (Foster and Lippa 1996; Foster et a. 2000; Liu et al. 2002) have estimated annual pesticide loadings to the Bay through the main tributaries (Susquehanna, James and Potomac River, which together provide 80% of the freshwater to the Bay) in the early 1990s. Assuming that the main stem of the Bay (8384 sq. km) receives the same atmospheric input through wet deposition as recorded at our sampling site, wet deposition accounts for less than 10% of the triazine herbicide load (Table 8-3). For the acetanilide herbicides (alachlor and metolachlor) the contribution is higher at about 10-20% or more. Owing to implementation of pest management practices in the watershed, pollutant loads to the Chesapeake Bay (via sediment transport) from agricultural lands generally declined from 1985-2000 (Chesapeake Bay land use and pollutant loads). Hence pesticide loadings in the waters of the Chesapeake Bay today are likely to be lower than what they were in the early 1990s when the studies estimating these loads in the Bay (Foster and Lippa 1996; Foster et al. 2000; Liu et al. 2002) were conducted. Keeping in mind the decade long gap between the aforementioned studies and this study which estimates atmospheric inputs, it is very likely that the contribution of the atmospheric inputs to pesticide loads in the Chesapeake Bay is greater than the 10-20% estimated here.

CHAPTER 9 – IMPACT OF WASTE DISPOSAL ACTIVITIES ON OCCURRENCE OF TOXIC COMOUNDS AT HIGH LEVELS IN ATMOSPHERE

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Goel, A.; McConnell, L.L.; Torrents, A.; Scudlark, J. and Simonich, S. Spray irrigation of treated municipal wastewater as a potential source of atmospheric PBDEs. *Environ. Sci. Technol*. 2006, 40(7), 2142-2148.

9.1 ABSTRACT

Spray irrigation facilities utilizing treated municipal wastewater are a potential source of polybrominated diphenyl ethers (PBDEs) to the atmosphere. PBDEs are used as flame retardants in many household items and have been found in wastewaters and biosolids.

Evidence of PBDE release from spray irrigation facilities was discovered during a multi-year project to measure semi-volatile organic chemical concentrations in air. Four BDE congeners (47, 99, 100 and 154) were monitored at three remote/rural locations in Maryland and Delaware from 2001-2003. Average concentrations at two of the sites (BDE 47: 10-17 pg/m3; BDE-99: 5.3-7.7 pg/m3) reflect background levels. Average concentrations at the third location were 5-10 times higher (BDE-47: 175 pg/m3; BDE-99: 26 pg/m3) and were significantly correlated ($p<0.0001$) with temperature indicating local source(s). Several spray irrigation facilities are located to the south and west of the third site, the prevailing wind direction during the spring and summer when most samples were collected. The fine mist released from the irrigation equipment may enhance release to the atmosphere via air-water gas exchange from water droplets. Temporal trends indicate that aerial concentrations of PBDEs in this area are increasing at an exponential rate; the atmospheric doubling times for the different congeners range from 4- 7 yrs (Hites 2004).

9.2 INTRODUCTION

Polybrominated diphenyl ethers (PBDEs), flame retardants that are widely incorporated into consumer products such as electronic appliances, construction materials and upholstery, have been detected globally in many environmental compartments (Hites 2004). The North American environment is more contaminated with PBDEs as compared to Europe, and levels have increased at an exponential rate, doubling every 4 to 6 years (Hites

2004). Although these compounds appear to have low acute and chronic toxicity, they are bioaccumulable and are likely to be more potent endocrine disruptors than many other classes of organ halogen compounds (Darnerud et al. 2001). Through an evaluative fate assessment procedure, Palm et al. (2002) have deduced that tetra- and penta-brominated congeners are perhaps of greatest environmental concern since they tend to remain available in the environment. Not surprisingly, the constituents of the penta-BDE product (BDE-47, -99, -100, -153 and -154) are most commonly reported in the environment (Hites 2004, Palm et al. 2002).

Since many consumer products contain PBDEs, residues are delivered to municipal wastewater streams (LaGuardia et al. 2002; North 2004) where, owing to their physical properties, PBDEs tend to focus in the resulting sludge material. Constituents of the penta-BDE product have been found in concentrations ranging from 1100-2290 µg/kg (dry weight basis) in land applied sewage sludge (biosolids) from different parts of U.S. (LaGuardia et al. 2002; Hale et al. 2001), and PBDE congener patterns in biosolids closely resembles that of the commercial penta-formulation, DE-71 (LaGuardia et al. 2002). In the U.S. over half of the sludge generated is now disposed of by application onto agricultural and other lands (Biosolids generation, use and disposal in the United States. EPA 1999), and spray irrigation operations utilizing treated wastewater are becoming more popular as direct discharge of effluents is restricted in many waterways. As biosolids and wastewater are applied to soils, PBDEs may be accumulating in organic material at the soil surface and, therefore, are available for wider dissemination.

This research represents part of a greater effort to characterize the occurrence of contaminants in the atmosphere of the Chesapeake Bay region. The work included a multi-year air sampling effort at three locations on the Delmarva Peninsula (Figure 9-1). The air sample extracts were analyzed for four penta-BDE constituents (BDE-47, -99, -100 and -154). The Delmarva Peninsula, within the Chesapeake Bay air shed, is predominantly rural with 44% of the land under cultivation. Except for some large urban centers across the Bay on the western shore (Washington D.C., Baltimore, Maryland) and the Wilmington, Delaware industrial region to the north; there are no obvious sources of PBDEs. Since higher PBDE concentrations in air have been reported near urban areas *(*Strandberg et al. 2001; Gouin et al. 2005) the relatively remote locations of our sites is an important factor in this study. Elevated air concentrations of PBDEs at one of these three monitoring stations has prompted further investigation into potential local sources. This report provides evidence that several spray irrigation facilities located upwind from this site may be contributing to the higher air concentrations. Results suggest that spray irrigation of even treated wastewater, containing relatively low concentrations of PBDEs (Biosolids generation, use and disposal in the United States. EPA 1999), may facilitate movement of these chemicals into the atmosphere such that local air concentrations are increased.

9.3 EXPERIMENTAL

9.3.1 Sampling Sites and Techniques

High volume air samples were collected at three sites on the Mid-Delmarva Peninsula (Figure SF-1). Horn Point (38° 36′ 04″ N, 76° 07′ 47″ W) is situated on the campus of the

University of Maryland Center for Environmental Studies, Cambridge, Maryland. It is a semi-rural region near the mouth of the Choptank River with no major industrial activity in the vicinity. The Washington, D.C./Baltimore metropolitan area is approximately 90 km to the west-northwest.

Lewes, Delaware (38° 46′ 26″ N, 75° 08′ 20″ W) is located on the campus of the University of Delaware at Lewes, on the southern junction of Delaware Bay and the Atlantic Ocean. The land use in southern Delaware is primarily rural-agriculture. The third site at Dover, Delaware (39° 09′ 29″ N, 75° 31′ 26″ W), is located on the grounds of the St. Jones Estuarine Research Reserve on the banks of the St. Jones River. The sampling site is situated approximately Hites 2004.5 km south-east of the Dover Air Force Base and about 82 km south of Wilmington, DE. Of the three sites, Lewes is the most isolated in terms of proximity to large urban centers.

Air sample collection was conducted from 2001-2003 at Horn Point and Lewes and 2002-2003 at Dover. Samples were collected from April-November in 2001, March-November in 2002 and April-September in 2003. Weekly air samples were collected simultaneously from all three stations over a 24-h period (details provided in Supporting Information). This study was part of a project to characterize the presence of agricultural pesticides in the atmosphere of the mid-Delmarva Peninsula. Hence sampling efforts were focused during the main growing season (April-September) and, in general, winter samples (December, January and February) were not collected. However, one sample each was collected from January, February and December of 2002 and January of 2003 at Lewes. A total of 240 air samples were collected during the period 2001-2003.

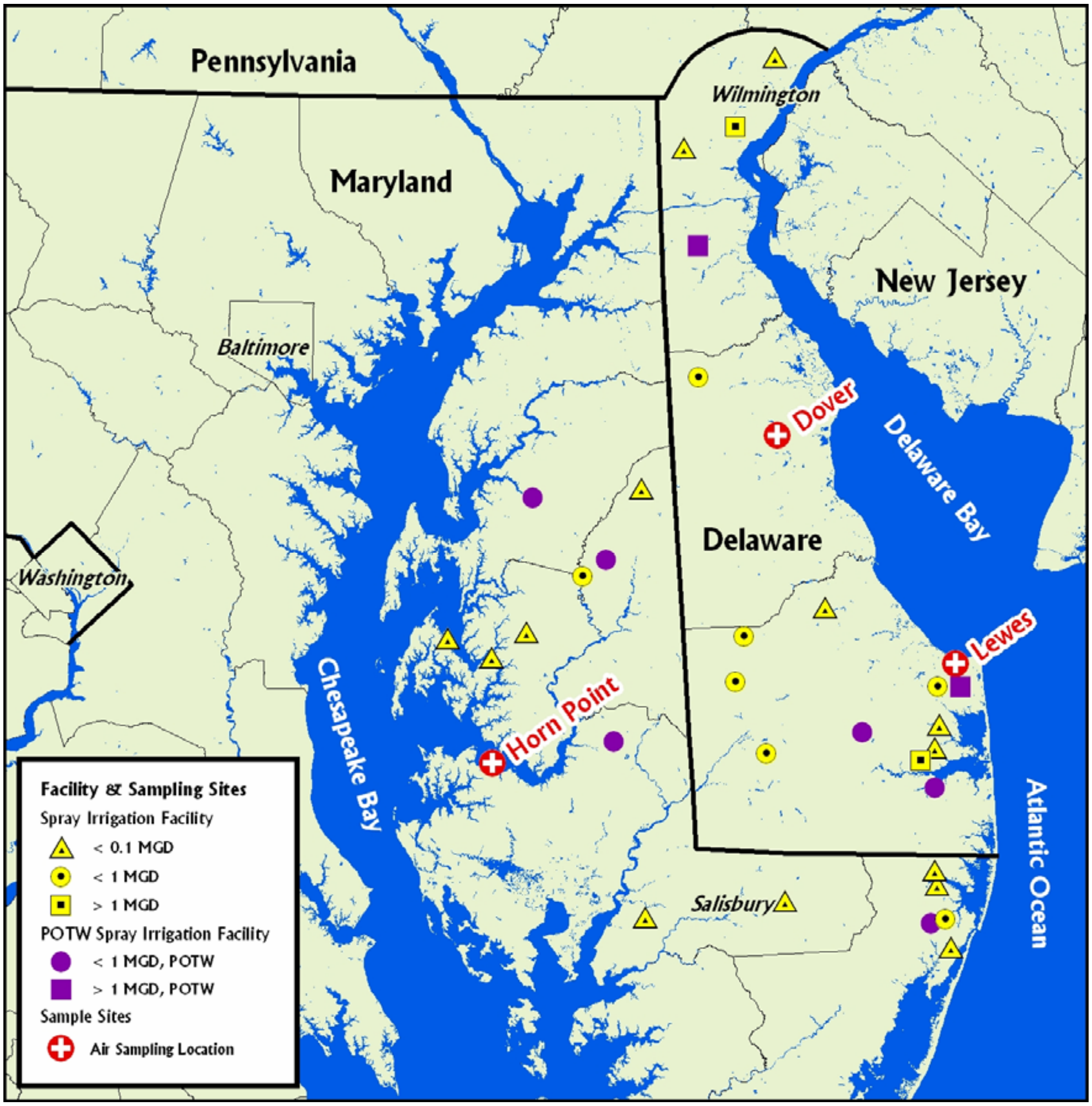


FIGURE 9-1 Location of sampling sites and spray irrigation facilities on the Delmarva Peninsula (POTW: Publicly owned wastewater treatment works, MGD: million gallons per day).

9.3.2 Sample Analysis

PUF plugs and filters were extracted with solvent (details in Supporting Information). PBDE concentrations in PUF and filter extracts were determined using an Agilent (Palo Alto, CA) 6890N gas chromatograph coupled to an Agilent 5973 mass spectrometer (GC-MS) in selected-ion-monitoring mode using negative chemical ionization (NCI) mass spectrometry (ions m/z: 79, 81, 161, 325, 484, 564, 644). In order to ascertain if any other BDE congeners were present in the gaseous phase, 20 representative samples from the three sites were sent for analysis to an independent laboratory (Dr. Staci Simonich, Oregon State University). These samples were analyzed for 39 mono- to hepta-BDEs using the isotope dilution technique recently published by Ackerman et al. (Ackerman et al. 2005).

9.3.3 Quality Assurance (QA) and Quality Control (QC)

Field blanks of PUF plug and filter were obtained monthly from each station by pulling air through the sampling train for ~ Hites 2004 min. In addition, a laboratory blank (a clean PUF plug or filter) and a laboratory spike (a clean PUF/filter spiked with target analytes) was extracted along with each batch of 20 samples to observe any matrix interference or contamination and to determine extraction efficiency, respectively. Method detection limits for the analytes were ascertained as per the U.S. EPA standard methods (Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Supporting Information).

TABLE 9-1 Selected physical constants for penta-BDE congeners. Method detection limits (MDLs) and spike recoveries in air samples from this study

PBDE congener	log Kow[a]	ΔH_{oa}[b] kJ/mol	ΔH_{vap}[a] kJ/mol	Method Detection Limit (MDL)[c] PUF pg/m^3	Filter pg/m^3	% Spike recovery PUF (n=16)	Filter (n=16)
47 (2,2',4,4')	6.19	97	92[a]-95[d]	6.0[e]	1.0	83 ± 17	83 ± 22
99 (2,2',4,4',5)	6.53	91.1	100[a]-108[d]	2.6	1.1	60 ± 15	105 ± 31
100 (2,2',4,4',6)	6.86[a,f]	105	102	3.1	1.4	59 ± 13	86 ± 29
154 (2,2',4,4',5,6')	7.39[a,f]	94.4	113	3.3	3.3	47 ± 11	73 ± 28

[a] Tittlemier *et al*. (*14*)
[b] Harner and Shoeib (*13*)
[c] MDLs are based on a sample volume of 720 m^3
[d] Wong *et al*. (16)
[e] a higher MDL of 32 pg/m^3 was used for air samples from Lewes
[f] estimated values

Laboratory spike recoveries ranged from 50-80% for PUFs and 70-105% for filters (Table 9-2). Sample concentrations were not corrected for spike recoveries. Since the average spike recovery values for BDE 99 and 100 are 60% and 59%, respectively, air concentrations reported for these congeners may be lower than actual values (BDE 154 was not detected in any PUF samples). The laboratory filter blanks (n=18) did not contain BDEs at concentrations above the MDLs except for BDE-47 (in 30% blanks, average conc.: ~4.3 pg/m^3) and BDE-99 (n=Hites 2004, conc.: 3.7 pg/m^3). BDE 99 occurred above the MDL (conc.: 6.7 pg/m^3) in only one laboratory PUF blank (n=10). Results from samples extracted along with these laboratory blanks which contained BDEs below the amounts present in the lab blanks were not considered in data analyses.

A total of 40 field blanks were collected during this study. PBDEs were not detected in field filter blanks (except BDE-47 in one blank from Lewes, conc.: 2.7 pg/m^3). Except for some blanks from Lewes which contained BDE-47, BDEs were generally not detected in PUFs. An elevated MDL of 32 pg/m^3 for BDE-47 was used for samples collected from Lewes (see Supporting Information for details).

9.4 RESULTS AND DISCUSSION

9.4.1 PBDE detections in air

PBDEs were detected in 75 % (n=240) of the samples (gaseous + particulate) indicating that these pollutants are ubiquitous and widely dispersed in this region. Among the three sites, Lewes had the highest detection frequency of PBDEs in its atmosphere (98%) followed by Dover (77%) and Horn Point (52%). In the gaseous phase, the detections generally followed the congener pattern 99 > 47 > 100 (Figure SF 9-1) except at Dover, where BDE-47 was detected more frequently than BDE-99. BDE-154 was not detected in gaseous phase samples. BDE-28 was the only other congener present in gas phase in low concentrations (< 10 pg/m^3) in 25% of the samples (n=20) analyzed by the GC-MS method of Ackerman et al. (Ackerman et al. 2005).

PBDEs occurred less frequently in the particulates; BDEs 47 and 99 occurred in <5% samples from Horn Point and Dover whereas they occurred in 40-50% samples from Lewes.

BDE-47 was the dominant particle-phase congener at Lewes and Dover. BDE-100 and BDE-154 occurred in a few filter samples from Lewes only. The greater frequency of detection of PBDEs at Lewes, especially in the particle phase, as compared to the other two sites was unanticipated given the land use in this region and its distance from major urban areas.

9.4.2 Spatial and temporal variations in air concentrations

The three sites differed markedly in terms of occurrence and concentrations of PBDEs in air (Figure SF 9-2). Concentrations were typically highest during the warmer months. Contrary to expectations based on proximity to urban source areas, the frequency of detection and mean concentrations were lowest at Horn Point and highest at Lewes (Table 9-2). For the three congeners that were detected in the gas phase (47, 99, 100), the concentrations at Lewes were statistically higher ($p<0.0001$) than at the other two sites and appear to be increasing over the years (Figure SF 9-2). Concentrations of BDE-47 were higher at Dover ($p<0.0001$) than at Horn Point; whereas, concentrations of BDE-99 were not statistically different between the two sites.

The average ΣPBDE concentrations in air at Horn Point and Dover (10-19 pg/m^3) are comparable to the 5-15 pg/m^3 reported for the rural and remote locations in the Great Lakes region (Strandberg et al. 2001). The mean values for BDE-47 and BDE-99 at Horn Point, in particular, are very similar to what has been reported at a rural location in southern Ontario in 2002 (Gouin et al. 2005). At Dover, the same is true of BDE-99; but the concentrations of BDE-47 are higher (Table 9-2) than in rural Ontario. This suggests that Horn Point represents background levels for PBDEs in the air in this region; whereas, Dover represents background levels with some local influence.

TABLE 9-2. Summary of concentration data for PBDEs in the air of the Mid-Delmarva Peninsula and data from previous studies. All concentrations in pg/m^3

	This study[a]						*Great lakes region*		
	Lewes		**Horn Point**		**Dover**		**Chicago**[b]	**3 remote sites**[b]	**Rural site (Ontario)**[a,c]
	2001-2003 (n=95)		2001-2003 (n=98)		2002-2003 (n=47)		1997-1999 (n=12)	1997-1999 (n=12)	Jan-June 2002
	Mean[d]	Max	Mean[d]	Max	Mean[d]	Max	Mean[d]	Mean[d]	Avg
BDE-47	175	671	9.7	26	17	52	33	2.9 - 8.4	4.6
BDE-99	26	178	5.3	26	7.7	17	16	2.1 - 5.3	4.3
BDE-100	17	73	5.4	5.4	5.3	5.3	2	0.3 - 0.8	nd
BDE-154	ND	ND	ND	ND	ND	ND	0.41	0.1 - 0.2	nd
ΣPBDE	174	912	10	57	19	64	52	5.5 - 15	

[a] Gaseous phase concentrations only

[b] Strandberg *et al*. (*8*) (gaseous + particulate phase)

[c] Gouin *et al*. (*9*)

[d] geometric means

In contrast, the average ΣPBDE gaseous phase concentration at Lewes (174 pg/m^3) is Hites 2004-2 orders of magnitude higher than at the other two sites and is more than three times as high as has been reported for Chicago (52 pg/m^3). The elevated levels of PBDEs at Lewes are surprising considering that it is situated in a semi-rural region with no major industry nearby. The deviations in observations from the other two sites, the high aerial concentrations combined with much greater detection on particles, indicate the presence of local sources for the sampling site at Lewes.

9.4.3 Influence of local meteorological conditions on gas-phase concentrations

The atmospheric concentrations of semi volatile organic compounds (SVOCs) have been shown to be strongly correlated to atmospheric temperature and may also be influenced by time of year, wind direction and wind speed. The prevailing wind direction on the Delmarva Peninsula is from west-southwest in summer, while during winter and early spring, easterly surface winds frequently result in incursions of relatively “clean” oceanic air. The gas phase concentrations of BDE congeners were analyzed using a modified form of the Clausius-Clapeyron equation (Hillery et al. 1997).

$$LnP = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1 \cos(WD) + b_2 \sin(WD) + b_3 (LnWS) \qquad (9.4\text{-}1)$$

This equation accounts for the effect of temperature (T, K) and time (t, relative Julian day) on partial pressure (P, atm) of the compound of interest. The coefficient a_1 (=-ΔH/R) relates to the enthalpy of air-surface exchange (ΔH, kJ) and a_2 is a first order rate constant. WD and WS are the 24-h averaged wind direction (degrees) and wind speed (mph), respectively. The regressions were performed using the general linear model procedure in SAS (SAS Institute, Inc., Cary, NC).

Regression analyses were performed for the congeners 47, 99 (all three sites) and 100 (Lewes). At Lewes, in particular, the correlations (r^2: 0.24-0.51) were highly significant (p: <0.0001 – 0.0027). Results of the regression analyses (Table ST1) reveal that wind direction governed air concentrations at Horn Point; both temperature and time of year were important at Lewes; whereas, either temperature or time was important at Dover. Wind speed had no significant effect on BDE concentrations.

Temperature dependence of aerial concentrations of semi volatile compounds is often interpreted to imply that local or regional exchange processes control atmospheric levels, whereas non-dependence on temperature suggests long range transport (Honrath et al. 1997). As stated above, PBDE concentrations at Lewes (and at Dover) were correlated with temperature but not at Horn Point. The magnitude of temperature dependence, expressed as the enthalpy of surface exchange (ΔH), is used as an indicator of the dominant exchange process. At Lewes, PBDEs exhibited enthalpies of surface exchange (BDE-47: 53 kJ/mol; BDE-99: 42 kJ/mol; BDE-100: 26 kJ/mol, Table ST1) that are much lower than the laboratory measured values of their enthalpy of vaporization (ΔH_{vap}) and octanol-air exchange (ΔH_{OA}) (Table Hites 2004). High dependence on temperature ($p<0.005$) combined with $\Delta H<\Delta H_{vap}$ suggests that the sources at Lewes are local but vaporization from surfaces was not the dominant process influencing aerial concentrations during the course of this study. More than one process or some other process with lower heat(s) of exchange could be controlling the aerial concentrations. Dependence on temperature ($p=0.02$) and the enthalpy of surface exchange for BDE-47 (= 26 kJ/mol) at Dover was lower than that at Lewes and indicates a greater distance from source(s).

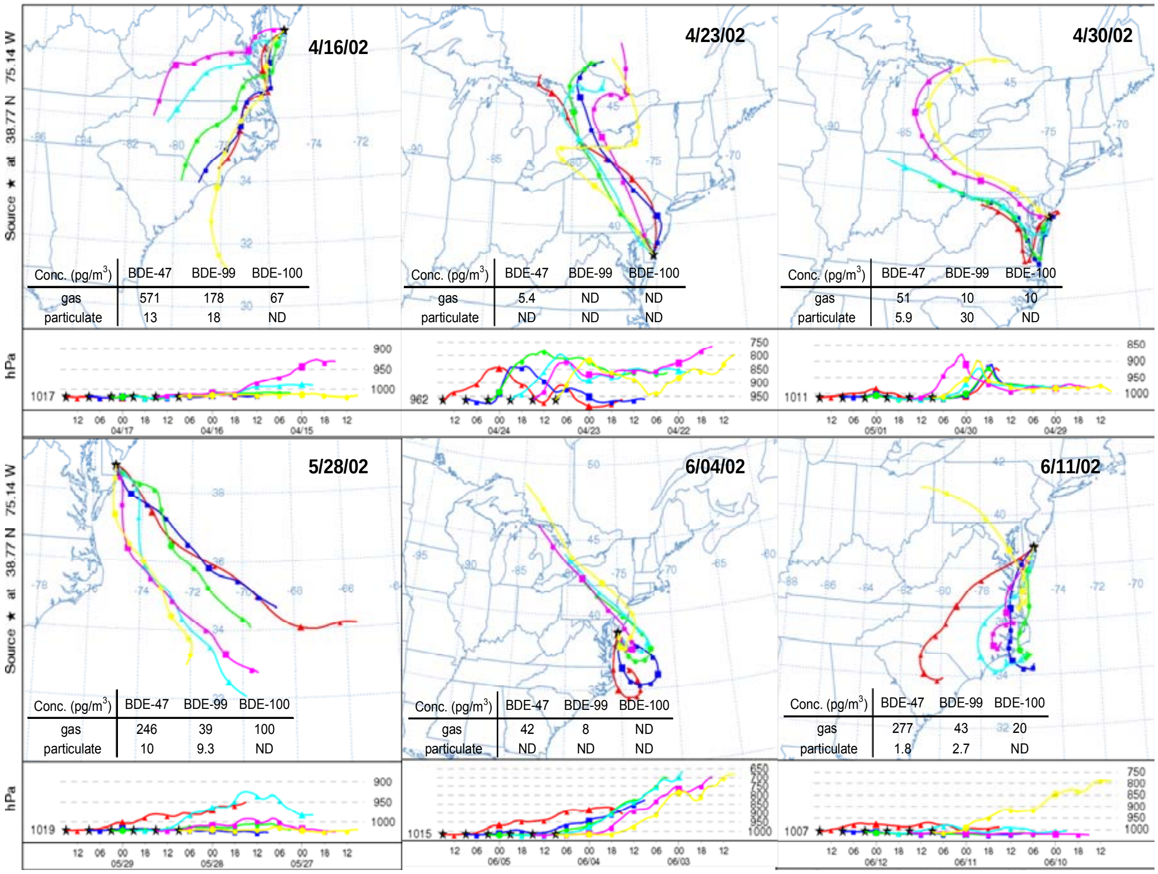
Results from the regression analysis also provide evidence that concentrations in the Mid-Delmarva atmosphere are increasing over time; however, the rate of increase is not the same for all congeners. Atmospheric doubling times ($t_2=Ln(2)/a_2$) at Lewes range from Hites 2004.Hites 2004 years for BDE-47 to Hites 2004.7 years for BDE-99 and BDE-100.

9.4.4 PBDEs in the atmosphere at Lewes: local sources on Delmarva

As has been discussed earlier, PBDEs were detected most frequently at Lewes (both in gaseous phase and on particles) and in much higher concentrations than at the other two sites. Concentrations at Lewes were high throughout the year and were significantly correlated with temperature. These observations suggest that Lewes is impacted by continuous, local, terrestrial sources of PBDEs on the Peninsula. This theory is strengthened by the fact that the prevailing wind direction during summer, when majority of the samples were collected, is from the southwest and that the PBDE concentrations on the Peninsula seem to increase from west to east.

To further investigate the possibility of local sources of PBDEs on the Peninsula, forty-eight-hour back trajectories (for 5 starting times over the 24 h sampling period) were acquired using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model available on the website of the National Oceanic and Atmospheric Administration's (NOAA) (Draxler and Rolph 2003). Trajectories were generated for 55% of the air sampling dates for Lewes (n=95) and on selected dates for Horn Point and Dover (10 each).

Lewes consistently exhibited higher PBDE concentrations even though the airmass trajectories for the three sites were similar (Figure SF 9-3). The samples where concentrations at Lewes were low (ΣPBDE <25 pg/m^3; n=6) are mostly from March-April and among these (except on Hites 2004/3/02) PBDEs were not detected in the particle phase (Figure SF 9-4). In two of these samples airmasses came over the ocean completely bypassing the Peninsula. For the remaining samples, the airmass originated over the Great Lakes and approached the site from north-west completely bypassing the Peninsula on two occasions. Since most of our samples were collected during summer when the temperatures are high and prevailing wind direction is from south-west, influence of wind direction is not always apparent during warmer months. However, there were a few instances where the influence of wind direction at Lewes was seen (Figure 9-2).



4/16/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	571	178	67
particulate	13	18	ND

4/23/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	5.4	ND	ND
particulate	ND	ND	ND

4/30/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	51	10	10
particulate	5.9	30	ND

5/28/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	246	39	100
particulate	10	9.3	ND

6/04/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	42	8	ND
particulate	ND	ND	ND

6/11/02

Conc. (pg/m^3)	BDE-47	BDE-99	BDE-100
gas	277	43	20
particulate	1.8	2.7	ND

FIGURE 9-2 Two day (48-h) back trajectories (at 10 m height) for Lewes acquired from the HYSPLIT transport and dispersion model (NOAA).

On 4/23/02 and 6/04/02, when PBDE concentrations were low (as compared to the samples collected immediately before and after them), the air mass originated in the north and either bypassed the Peninsula (4/23/02) or approached the site from over the ocean (6/04/02). In contrast when the air mass approached the site from the south and southwest over land (4/16/02, 4/30/02, 5/28/02 and 6/11/02) the concentrations were higher and PBDEs were also associated with particles, which suggests local sources or short-range transport. Hence, results of the back trajectory analysis reveal that Lewes is affected by sources that appear to be located to the west and south of the site.

9.4.5 Spray irrigation of municipal wastewater- source of PBDEs in air

Wastewater treatment facilities generally discharge their effluent to nearby surface waters, but on the Mid-Delmarva Peninsula, spray irrigation is the predominant disposal method. This is due to the availability of open land for disposal, the sandy, well-drained soils, the desire to recharge the shallow surface aquifer, and the increasing legal restrictions on direct surface water discharges (Inland Bays draft Pollution Control Strategy 2005). In Delaware, total maximum daily loads (TMDLs) for Inland Bays require that all point sources of nutrient loading (which includes wastewater discharge) to these water bodies must be systematically eliminated (Total Maximum Daily Loads (TMDL) for Indian River, Indian River Bay, and Rehoboth Bay, 1998). In Sussex County (Delaware) alone, more than 5 million gallons of wastewater per day (more than 9 MGD in summer), from 13 municipal and industrial sources, are disposed of by spray irrigation (Figure 9-1) (Hamilton, D. State of Delaware Department of Natural Resources and Environmental Control, Division of Water resources (Personal communication)). The scale of spray irrigation operations in Maryland counties on the Peninsula is relatively small; about 2.6 MGD spread over 15 facilities (Tien, C. Maryland Department of the Environment, Water Management Administration. Personal communication).

There are several spray irrigation facilities located to the south and west of Lewes. Most notable on this list is a large municipal wastewater spray irrigation facility (Hites 2004.7-4 MGD) located ~ 6 km SE of the Lewes sampling site. This facility is the largest in Delaware (and on the entire Peninsula). The wastewater effluent is sprayed onto the fields a minimum of 8 hours per day. The influent wastewater is aerated in two large storage lagoons and disinfected before it is released onto the fields using spray irrigators. Several housing communities also operate small spray irrigation facilities located to the south of Lewes. Some of the nearby facilities are engaged in agricultural processing, so their effluent would not be expected to contain PBDEs. Dover is located downwind of some facilities while there are no known spray irrigation facilities upwind of Horn Point.

A number of factors governing the timing and volume of wastewater application in the region are consistent with the observed seasonality in PBDE concentrations in air at Lewes (Figure SF 9-2). First, the area in and around Lewes is a popular summer vacation spot; therefore, both the population and the municipal wastewater volume increases during the summer months. Average daily flow at wastewater treatment facilities increases as much as 50% from winter to summer (Hamilton, D. State of Delaware Department of Natural Resources and Environmental Control, Division of Water resources (Personal communication). Application is also reduced during the winter months while the ground is frozen. Data from 2004 shows that from May-September, the facility to the south-east of

Lewes operated for at least 27 days per month (Hamilton, D. State of Delaware Department of Natural Resources and Environmental Control, Division of Water resources (Personal communication) as compared to 3 days in January.

Due to the large surface area of water droplets available during spraying, PBDE loss to the atmosphere during the spray process is likely to be significant. An estimate of the magnitude of this process may be calculated following the approach outlined by Wu et al. (2003). Assuming a constant droplet size and ignoring the concentration of PBDEs in the surrounding air, the volatilization rate, J (g/s) from a droplet can be estimated as:

$$J = h_m A C_g \tag{9.4-2}$$

Where, h_m (m/s) is the mass transfer coefficient of compound across the concentration boundary layer around a droplet, A is the surface area of the droplet and C_g ($=C_w/K'$) is the concentration in the gas phase at the droplet air interface. C_w is the concentration in the aqueous phase and K' is the dimensionless Henry's constant.

Assuming PBDE concentrations are similar to those reported by North (2004) from a municipal wastewater treatment plant effluent (BDE-47 = 10.5 ng/L, BDE-99 = 11.2 ng/L), a constant droplet size of 0.5 mm, temperature of 25°C, wind speed of 1.5 m/s (the average wind speed at Lewes) and an exposure time of 1s, we estimate that at least 22% of BDE-47 and 9% of BDE-99 present in the effluent will be lost during the spray operation. The total loss of PBDEs from the spray irrigation facility is likely to be much larger considering that the aeration lagoon and soil surface (over which the wastewater is being applied) provide additional surfaces for loss of PBDEs. Soils receiving wastewater continuously for many years may be continuing sources of PBDEs or other chemicals to the environment, even after the fields are no longer in use.

9.4.6 Vapor-Particle partitioning of PBDEs- potential for long range transport

The partitioning of semi volatile organic compounds in the atmosphere is an important factor in their fate, transport and transformation since greater association with particles results in shorter travel distances. For our data from Lewes, we examined the vapor-particle partitioning through the partition coefficient K_p = (F/TSP)/A) whose dependence on the sub-cooled liquid vapor pressure of the compound (p_L^0) is described by the linear relationship:

$$\log K_p = m_r \log p_L^0 + b_r \tag{9.4-3}$$

Where, F and A are the filter and adsorbent retained PBDE concentrations (pg/m^3), respectively, and TSP is the concentration of the total suspended particles in air (μg/m^3). For Lewes, summer (April-September) and winter (October-March) TSP values (31.3 and 25.3 μg/m^3 respectively) were taken from the measurements of Wolff et al. (1986) whose sampling site was located within ~2 km of our site. BDEs did not occur in sufficient filter samples from the other two sites to permit similar analysis.

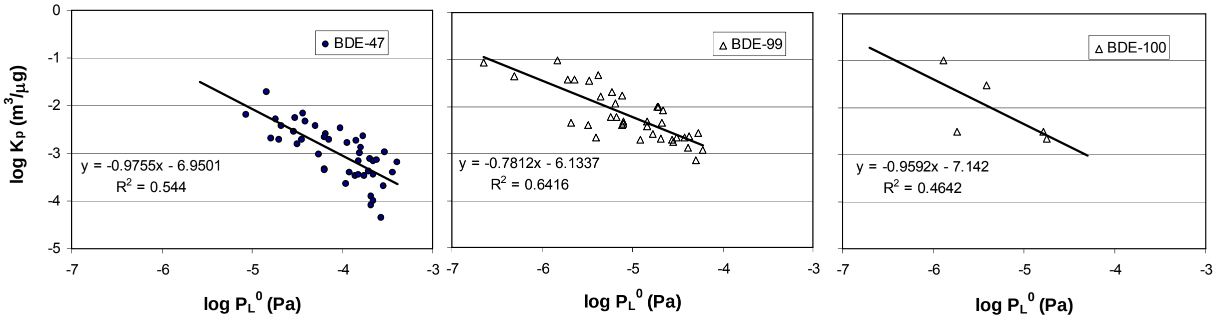


FIGURE 9-3 Vapor-particle partitioning behavior of PBDEs at Lewes

Temperature dependent sub-cooled liquid vapor pressure was calculated as $\log P_L^0 = A/T + B$. A and B were taken as averages of values available from references Tittlemeir et al. 2002 and Wong et al. 2001 (BDE-47: A= -4872.5, B= 12.74; BDE-99: A= -5435.5, B= 13.77; BDE-100: A= -5339, B=13.37).

Gas-particle partitioning for BDEs 47 and 99 is highly correlated (r^2 = 0.54-0.64, $p<0.0001$) with sub-cooled liquid vapor pressure (Figure 9-3). Correlation for BDE-100 is not significant (□=0.05) probably due to fewer data points (n=5). Statistically, the slope (m_r) for BDE-47 (-0.98) is not different from -Hites 2004 (Table ST 9-2) and suggests equilibrium in the vapor-particle partitioning of this compound (Pankow 1991). However, a slope of -Hites 2004 is not a necessary condition and equilibrium can exist even when the slopes are shallower as has been shown for PCBs in the Great Lakes region (Simcik et al. 1998). In this context, the slope for BDE-99 (-0.75) is close enough to -Hites 2004 for us to argue that there exits equilibrium for this congener as well. Other meteorological factors such as wind speed and relative humidity were not found to significantly affect partitioning. This finding of equilibrium for both BDE-47 and BDE-99 is not surprising given that the kinetics of gas-particle sorption for SVOCs are fast and a few hours is sufficient to reach equilibrium (Rounds et al. 1990).

Even though equilibrium exists in vapor-particle partitioning, the association of BDEs with the particles is much smaller than has been observed in other studies. At Lewes, for the samples collected when the 24-h average temperature was in the range 25±3 °C, an average of Hites 2004.2% of BDE-47 (n=9, range: 0.Hites 2004-3.2%) and 6.0% of BDE-99 (n=6, range: 2.2-9.3%) was present in the particulate phase. This is about an order of magnitude less than the predicted association with particles at 25°C; 17% and 45% for BDE-47 and BDE-99, respectively (Harner and Shoeib 2002) and observed association at 20±3°C in Great Lakes region; ~20% for BDE-47 and ~40% for BDE-99 (Strandberg et al. 2001). The discrepancy could reflect the influence of aerosol composition. Since PBDEs are highly hydrophobic (Table 9-1, Hites 2004) the fraction present in the particulate phase will be directly proportional to the organic carbon (OC) content of the aerosol which is generally higher in urban locations (Offenberg and Baker 2000). The reported average particulate OC concentrations for the Chesapeake Bay region range from 6.0 $\mu g/m^3$ (Baltimore, Brunciak et al. 2001) to 4.Hites 2004 $\mu g/m^3$ (over the Bay and on the Atlantic coast, Brunciak et al. 2001, Wolff et al. 1986) with higher concentrations in summertime, both in terms of absolute values (Wolff et al. 1986) and in terms of fraction of TSP (Offenberg and Baker 2000). The low OC concentration, in general, at our rural/remote site than in the urban environment combined with still lower OC in wintertime, when the PBDEs would have a greater affinity for the particles, could account for the lower percentage of PBDEs present in the particle phase in our samples.

This study provides evidence for a potentially important source of PBDEs to the atmosphere. Spray field irrigation is an important wastewater management alternative for many regions of the United States where nutrient contamination is degrading the quality of surface waters and their associated ecosystems. However, this practice should be examined further to determine the magnitude of persistent bioaccumulative chemical emissions to the atmosphere.

9.5 SUPPORTING INFORMATION

Air Sample Collection

Air samples were collected using a high-volume sampler (Model GPNY 1123, Grasby General Metal Works, Village of Cleves, OH). Air was pulled at a flow rate ranging from 0.29 to 0.54 m^3/min through a 20.3 × 25.4 cm rectangular glass fiber filter (Gelman A/E, Gelman Sciences, Ann Arbor, MI) followed by two 7.6 × 7.6 cm polyurethane foam plugs (PUF) held within a glass sleeve. The sample volumes ranged from 415-1050 m^3. PUF plugs were precleaned using tap water, distilled water, followed by extraction with pesticide grade acetone (Fisher Scientific, NJ) and high purity ethyl acetate (Fisher Scientific, NJ), sequentially, for 12 hours using a Soxhlet apparatus. The PUF plugs were dried within a vacuum oven and stored in individual, pre-cleaned glass jars with Teflon lined lids until use. Filters were wrapped individually in aluminum foil pocket and baked at 400^{o}C. At the end of each sampling period, the filter was folded face inward and placed back into the original clean foil pocket and PUF plugs were returned to the original jars. The PUF plugs and filters were kept frozen (-20 ^{o}C) until extraction.

Sample Extraction

Air PUF plugs were extracted separately using a Soxhlet extraction apparatus using ethyl acetate for 8 h. All samples were spiked with 20 μL of diazinon (diethyl-d_{10}) (50.8 ppm) as an extraction efficiency surrogate. Extracts were reduced to 5-10 mL using a rotary evaporator and further reduced to 0.5 mL using a gentle stream of chromatographic grade

(99.9%) N_2 gas. Filter samples were extracted in the same manner as PUFs except that the extraction solvent was chromatographic grade DCM (Fisher Scientific, NJ, high purity solvent). The surrogate recoveries were 75 ± 30% for the PUFs and 100 ± 50% for the filters.

Chromatographic details

The chromatographic conditions were as follows: column, J&W DB-17MS, 30-m, 0.25 mm i.d., 0.25 µm thickness. Flow rate through the column was 0.9 mL/min; temperature program, 130 ºC, raised at 6 ºC/min to 205 ºC for 4.5 min and then at 6 ºC/min to 300 ºC for 6.2 min; interface, 300 ºC; quadrupole, 150 ºC; source, 150 ºC; injector, 230 ºC. The ionization gas was ultra high purity methane supplied at 60 kPa. PCB-204 (80 ng) was added to all extracts just before analysis and used as an internal standard. Sample quantitation was performed using the method of internal standards with a five-point calibration curve ranging from 0.005 to 0.1 ppm. The analyte mass on the back and front PUFs were combined to calculate the gas–phase concentrations.

Meteorological data

The primary meteorological data for Horn Point was obtained from a 10-m tower located next to our sampling station. Data for Lewes was obtained from the meteorological center on the premises of the University of Delaware campus at Georgetown, located 15 km southwest from Lewes. Data for Dover was obtained from the meteorological tower on the premises of the St. Jones Reserve, close to our sampling station. For the three sites, temperature, wind direction, and wind speed were averaged over each 24-h sampling period.

Average wind direction was determined using vector averaging. The meteorological conditions varied greatly during the sampling period. For the site at Lewes, samples were collected over a temperature range of -8 to 29 °C and the winds were predominantly from the west. The temperature range was 4-29 °C at Horn Point and 6-28 °C at Dover. The lower temperature range at Lewes reflects the extra samples collected during the winter months.

Quality Assurance (QA) and Quality Control (QC)

The method detection limit (MDL) for each compound in gaseous and particulate phase air samples was determined by spiking 2.5 ng of each compound (the equivalent to the lowest point of the GC-MS calibration curve) onto precleaned PUFs or filters (8 replicates) and extracting and processing them in the same manner as samples. Standard deviations of measured replicate concentrations from these low-level spike experiments were used to calculate the MDL for each compound according to the U.S. EPA standard methods.

A total of 40 field blanks were collected during this study (n; Lewes: 11, Horn Point: 21 and Dover: 8). PBDEs were not detected in field filter blanks (except BDE-47 in one blank from Lewes, conc.: 2.7 pg/m^3). BDE-99 occurred in PUF field blanks (Horn Point: n=2, avg. conc.: 2.8 pg/m^3; Lewes: n=3, avg. conc.: 5.3 pg/m^3). Since the occurrences were inconsistent and sporadic and the amount of BDE-99 present in samples from these months was at least 4 times higher than in the blanks, no corrections were applied. BDE-47 occurred in 9 PUF field blanks from Lewes (except for one value of 44 pg/m^3, conc. range: 7.2-14 pg/m^3). Based on the standard deviation of the average amount of BDE-47 present in field blanks (replacing non-detects with MDL), an elevated MDL of 32 pg/m^3 for BDE-47 was used for samples collected from Lewes.

Results of sample analysis as per Ackerman et al.

20 gas phase samples (including blanks and samples from the three sites) were analyzed by the Ackerman method. Results from the two analytical methods compared very well in terms of concentrations of BDE-99, -100 and -154. Paired t-test analysis revealed that the means for the 20 samples were not statistically different (α=0.05). However, the mean concentrations for BDE-47 by the Ackerman method were 44% lower than that by our method. However, this difference is within limits of variation among laboratories, we have reported the results from our GC-MS analysis.

Back Trajectory Analysis

Forty-eight-hour back trajectories were acquired using the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model available on the website of the National Oceanic and Atmospheric Administration's (NOAA) Air Resource Laboratory (ARL) (*30*). The trajectories were generated using the Eta Assimilation System (EDAS) and were calculated at the starting altitude of 10 m above ground level. Since our samples were collected over a 24-h period, we generated 5 back trajectories spread over the 24 hour sampling period. Thus, trajectories were calculated for 5 time points within the collection period, 1000, 1600, 2200, 0400 and 1000 Eastern Standard Time (EST) the following morning (model inputs in Coordinated Universal Time (UTC) or EST plus 5 h).

TABLE ST 9-1. Results of linear regression analysis (Eq. 9.4-1) on the gaseous phase PBDE concentrations at the three sites.

	Horn Point	Lewes	Dover
		BDE-47	
r^2	0.31	0.51	0.20
p-value	0.05	<0.0001	0.03
ΔH (kJ/mol)	ns	53 ± 7	28 ± 11
t_2 (yr)	ns	1.1 ± 0.2	ns
b_1	-0.552	ns	
b_2	-0.353	ns	
b_3	ns	ns	
		BDE-99	
r^2	0.15	0.30	0.58
p-value	ns	<0.0001	0.02
ΔH (kJ/mol)	ns	42 ± 8	ns
t_2 (yr)	ns	1.7 ± 0.6	0.95 ± 0.25
b_1	ns	ns	ns
b_2	ns	ns	ns
b_3	ns	ns	ns
		BDE-100	
r^2		0.24	
p-value		0.0027	
ΔH (kJ/mol)		26 ± 8	
t_2 (yr)		1.7 ± 0.5	
b_1		ns	
b_2		ns	
b_3		ns	

Note: (1) ns means corelation was not significant at α=0.05

(2) For BDE-47 at Dover, use of wind parameters resulted in statistically insignificant corelation and hence the wind parameters were ignored

(3) $\Delta H = -a_1(R)$

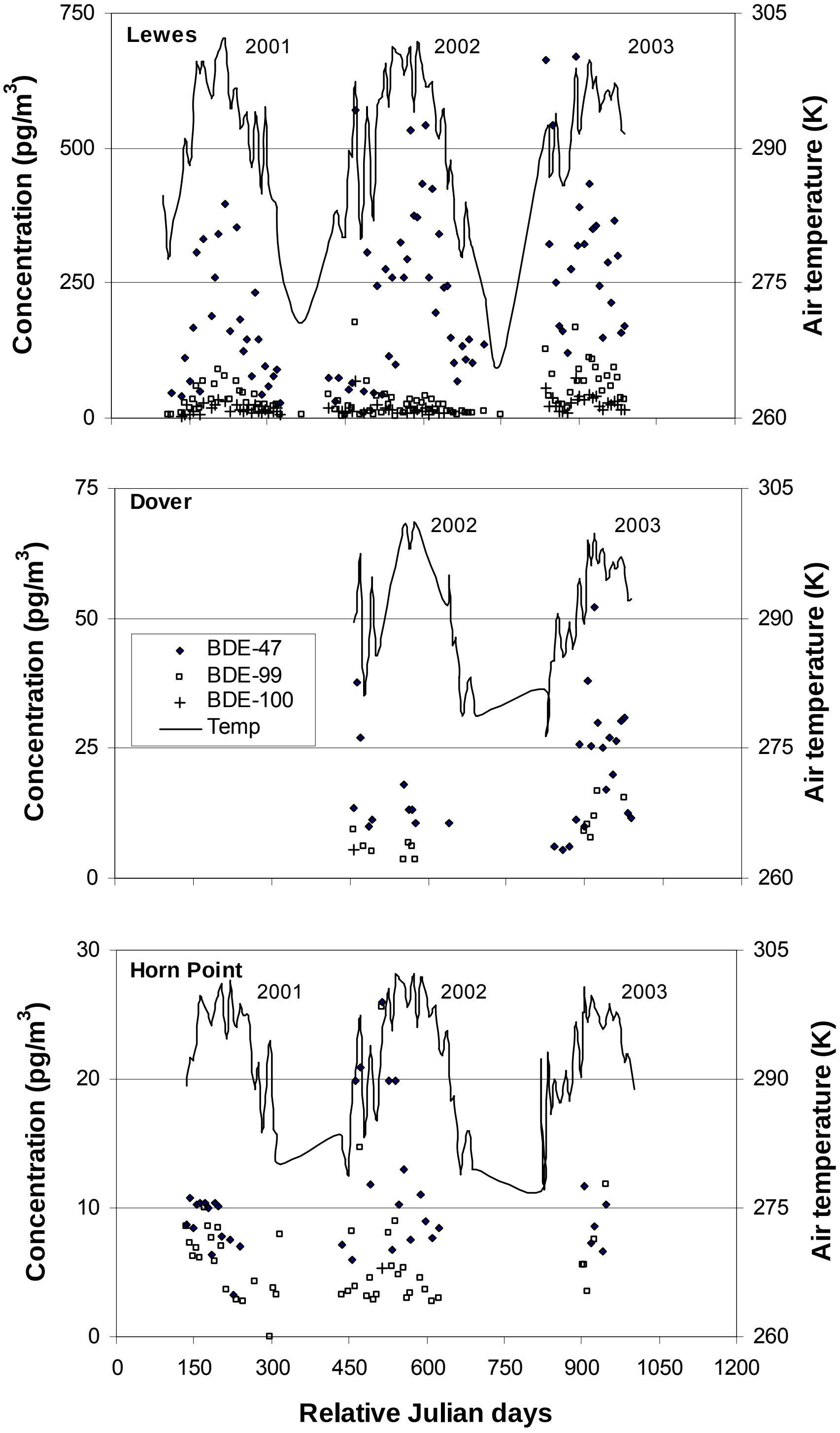
(4) $t_2 = Ln(2)/a_2$

TABLE ST 9-2. Regression analysis for Equation 9-2 for data from Lewes

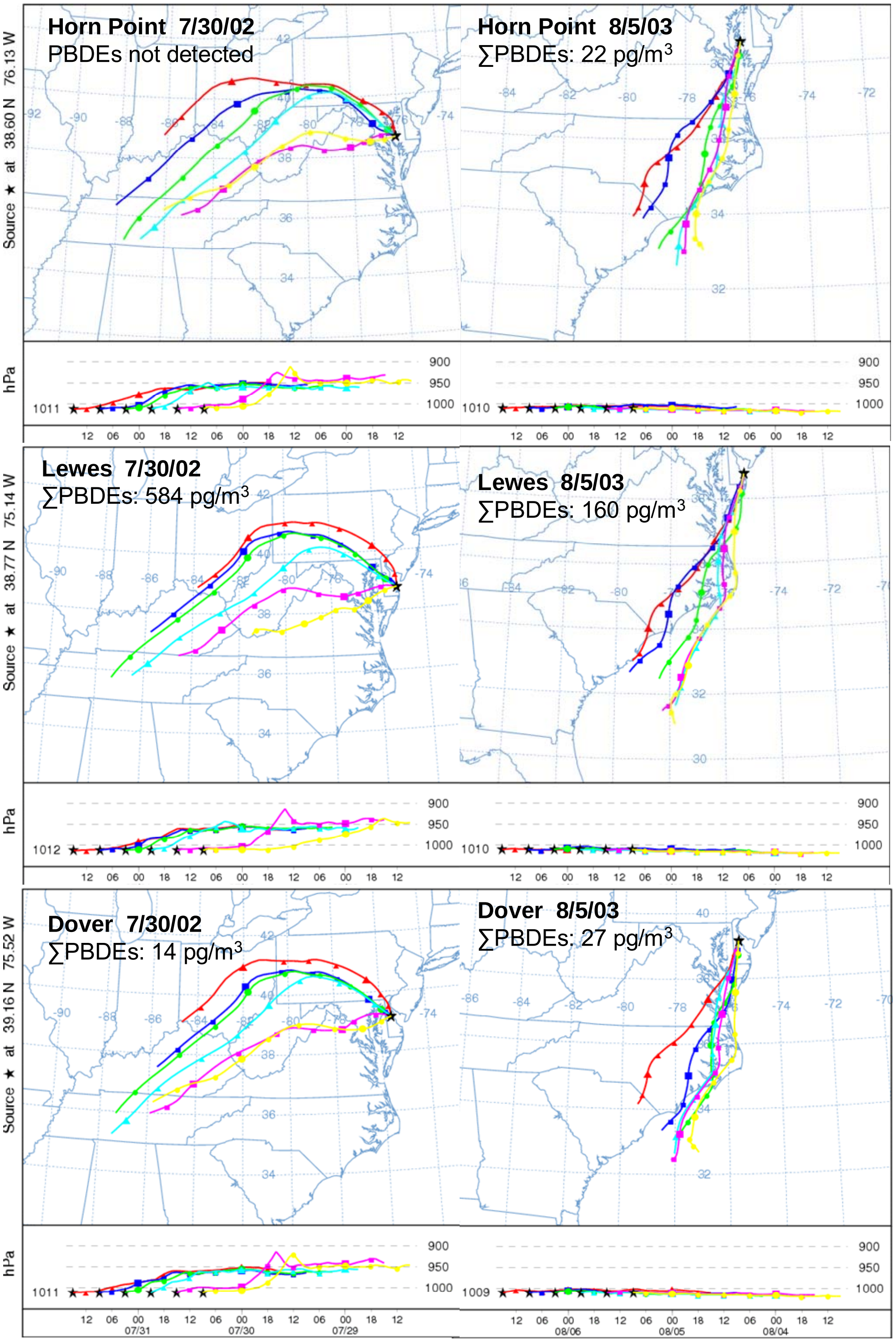
SE is the standard error of the mean. Values not significant at α=0.05 are given in italics.

	r^2	p-value	Slope	SE	lower 95%	upper 95%	Intercept	SE	lower 95%	upper 95%
BDE-47	0.5440	<0.0001	-0.975	0.138	-1.246	-0.705	-6.950	0.561	-8.050	-5.850
BDE-99	0.6416	<0.0001	-0.781	0.099	-0.975	-0.588	-6.134	0.501	-7.115	-5.152
BDE-100	0.4642	0.2053	*-0.959*	*0.595*	*-2.125*	*0.207*	*-7.142*	*3.175*	*-13.366*	*-0.919*

FIGURE SF 9-1. Percent detection of PBDEs in air at the three sites a) gaseous phase and b) particulate phase



E SF 9-2. Gas phase concentration of PBDEs and 24-h average ambient air temperatures at the three sampling locations (the scale for Relative Julian day begins at Jan 1, 2001).



Horn Point 7/30/02
PBDEs not detected

Horn Point 8/5/03
∑PBDEs: 22 pg/m^3

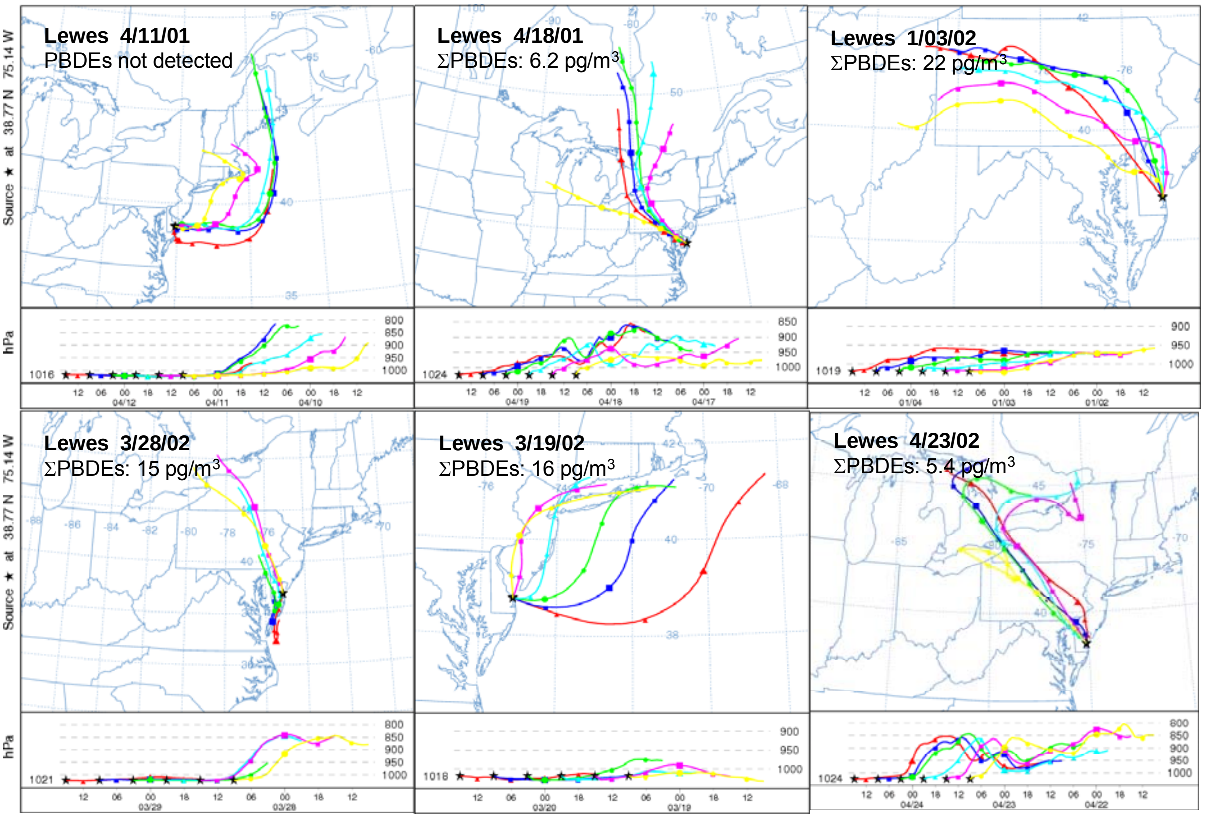
Lewes 7/30/02
∑PBDEs: 584 pg/m^3

Lewes 8/5/03
∑PBDEs: 160 pg/m^3

Dover 7/30/02
∑PBDEs: 14 pg/m^3

Dover 8/5/03
∑PBDEs: 27 pg/m^3

FIGURE SF 9-3. Back trajectories at the three sites for the samples collected on 7/30/02 and 8/5/03. ΣPBDEs represents sum of gaseous and particulate phase concentrations.



CHAPTER 10 – CONCLUSIONS AND RESEARCH NEEDS

Pesticides are commonly used to assure a food supply, yet their use can induce toxic effects in biota, including aquatic, terrestrial and aerial species. Their (CUPs and HUPs) ubiquitous presence in air and water bodies of the Delmarva Peninsula, which is mainly an agricultural region located right along the Chesapeake Bay, combined with the fact that atmospheric inputs have been identified as possible major sources contributing to the progressive decline in water quality and biotic health of the Bay, has raised considerable interest in the environmental fate of pesticides in the peninsula. Knowledge of their atmospheric transport and the factors influencing their phase distribution is essential to determine and assess their environmental fate.

When the present work was initiated the biggest obstacle was the non-availability of data on the occurrence and levels of pesticides in the atmosphere. That led to the first phase of this research (as outlined in chapter 1), collection of atmospheric samples at different locations to better understand and characterize the Upper Delmarva Peninsula with respect to the presence of pesticides in its atmosphere and better elucidate the role of the atmosphere as a source of pesticides to the Chesapeake Bay. This was accomplished by sampling (air and precipitation) at three locations (rural, semi-rural and background) for a period of four years.

As part of this effort, this work has produced the largest data set available in the area for the presence of pesticides In the atmosphere.

The second phase involved analysis of the data to investigate levels and trends as well as to assess what are the most important factors determining the observed levels and trends. . Both HUPs and CUPs where found to be ubiquitous in the atmosphere of the Delmarva Peninsula. HUPs occurrence is predominant in the air and where not observed, at significant levels, in precipitation, while CUPs where present in both phases, in the air and in precipitation.

Levels of HUPs are lower than in the Great Lakes region and follow the north to south decreasing trend for the continent, also observed and reported by other researchers. As the analysis in chapter 3 illustrates, the rate of decrease in air concentrations is much higher than in the upper north and the levels are expected to fall below detection limits much faster (i.e., we observed shorter half-lives than those reported for the Great Lakes). Our results also suggest that long range transport is not the sole source of these compounds to the Peninsula. Winds from the direction of main agricultural region (which is the same as the direction of urban region) resulted in statistically higher levels of DDT transformation product (DDE) at the background site (DV) as compared to the other two sites. This shows that presence of agricultural (or urban areas) where these compounds were used earlier, still influences the observed levels of some HUPs in the region .

The CUPs were detected frequently. Insecticides occurred in up to 95% air samples while herbicides and fungicide in almost 90% air samples. The results from this study reveal that the levels of CUPs in the Delmarva Peninsula are lower than that in other major agricultural regions of the U.S including Corn Belt. As discussed in chapter 4, temperature and application cycle are the main drivers for the occurrence of pesticides in the atmosphere. Aerial concentrations are consistent with the agricultural practices and respond to the usage patterns across years. The levels are not consistent across the region. Proximity to (and location downwind of) an agricultural region results in higher levels. This study shows that omission of agricultural cycle while analyzing aerial concentrations of current use pesticides, especially close to regions where they are applied, results in temperature being accorded more importance and may lead to errors in data interpretation. The levels of CUPs in the atmosphere decline quite rapidly- herbicide levels halve in a year as compared to a year and a half for insecticides- and suggest that transport should be limited. The possibility of long – range transport for chlorothalonil exists by it's relatively greater persistence in atmosphere (half life ~15 years).

Results from chapter 6 reconfirm that vapor pressures of CUPs and their transformation products are highly temperature dependent and experimental determination is essential for realistic risk assessment and phase distribution determination. The non- stability of air concentrations is reflected by the non-equilibrium gas-particle phase distribution. Both agricultural activity and location of the Peninsula (high relative humidity) greatly impact the phase distribution of polar CUPs. Analysis in chapter 5 reveals that the most commonly used predictive model (J-P) under predicts partitioning for CUPs in rural areas. We speculated that this is due to the assumption of organic matter content of the particles (10-20%) and the non inclusion of meteorological parameters in the model. Assumption of lower organic matter level results in under-prediction of fraction that occurs in the particle phase. Relative humidity impacts different classes of pesticides differently – increase in humidity was seen to increases sorption for more polar compounds while decrease it for more hydrophobic compounds. The J-P model requires revision to include the factors that impact partitioning in rural areas in coastal regions where meteorological conditions can play a bigger part in partitioning than in drier areas.

Analysis of precipitation data revealed that CUPs readily partition onto rainfall and were detected quite frequently in precipitation. Detection frequencies were dominated by fungicide chlorothalonil (>80% detections) and followed by herbicides metolachlor (>50%) and atrazine (>45%). Gas scavenging is the dominant contributor to wet deposition of pesticides for the Peninsula. Higher wind speed significantly influenced the amount present on the filters for hydrophobic pesticides (diazinon (OP) and α-endosulfan (OC)) which generally have high soil half lives. Analysis in chapter 7 reveals that washout is temperature dependent and physical properties alone are not enough to predict gas scavenging. The predicted WRs for more hydrophobic compounds (such as HCHs, α-endosulfan), under the temperature conditions in the region, fell below the level for which gas scavenging is the prominent process ($H/RT < 10^{-4}$) at higher temperatures. This suggests that during the cooler parts of the year, particle washout may be more important for more hydrophobic organochlorines.

Nature and duration of precipitation and proximity of agricultural areas also influences washouts. Chlorothalonil was the single biggest contributor to the wet flux (28-53%). Our analysis suggests that, the extent of wet deposition of herbicides depends on the timing of precipitation relative to herbicide application. Among the four years sampled, the year with the wettest (2001) and driest spring (2002) had the same number of precipitation events (25). Te events in 2002 were evenly spaced out while in 2001 no precipitation occurred in the 15 days when 60% of corn was planted. Consequently, the wet flux of herbicides in 2002 (54 μg/m^2) was higher than in 2001 (44 μg/m^2). The insecticide and fungicide fluxes were higher in wetter years (2000 and 2003) and were statistically correlated ($r = 0.15$-0.51; $\alpha=0.05$) with the amount of precipitation volume in individual events. This shows that insecticide and fungicide fluxes are dependent upon the total amount of rainfall received in a year, reflecting their environmental persistence.

While wet deposition is not the main source of pesticides to the water bodies of the region; our estimates suggest that it can account for up to 10-20% of the annual loadings of pesticides to the Bay (chapter 8), and those levels may be more important in remote areas. The concentrations of some pesticides in the precipitation are high enough to be a cause of concern for aquatic species.. The levels in precipitation were high and USEPA marine water quality criteria for endosulfan (8.7 ng/L) and chlorpyrifos (5.8 ng/L) were exceeded in more than 25% of the events sampled at DV. The high rise in levels of chlorothalonil at the remotest site (DV) (which is also the closest to wetlands) in the rainiest year suggests that water bodies and associated wetlands are at risk from wet deposition of these pesticides arising from short range atmospheric transport. Soluble herbicides are likely to be delivered to nearby wetlands in highest concentrations during a rain event shortly after application.

The levels of PBDEs in air were similar that those reported in the Great Lakes at two of the sites, yet they were higher than normal at a site in Delaware. Investigation for sources (chapter 9) revealed that disposal of treated wastewater effluent by spray irrigation onto soil is a potential new source for PBDEs to the atmosphere and can lead to elevated air concentrations in the vicinity.

Research needs

Our work has illustrated that large data sets are needed, both temporally and spatially, in order to be able to model and predict what are the trends and levels of pesticides in the atmosphere and their overall contribution to the budget of pesticides to water bodies. Through the completion of this study, a long – term dataset for the pesticides in Delmarva region is available for further research. It will enable risk assessment studies on the occurrence of these pesticides in the atmosphere.

The non- availability of realistic physical property datasets is another big hurdle to ensure realistic fate assessments. The vapor pressure and Henry's law constants of pesticides are highly dependent on temperature. Data for most pesticides is available only at 298 K, which can be quite high when compared to actual ambient temperatures, and is not available at all for most transformation products. For realistic risk assessments experimental determination of parameters that express temperature dependence of physical properties is required.

The research has shown that the behavior of pesticides in rural areas is different than would be expected in urban areas for other POPs. Agricultural cycle influenced their levels and meteorological parameters play an important role in chemical distribution. The omission of these factors results in under prediction of phase distribution (J-P model) and greater importance being accredited to temperature (Clausius Clapeyron equation) which results in incorrect environmental fate assessment and risk analysis. The most commonly used methods/models predicting environmental levels of pesticides need to be revised to include the influence of agricultural cycle and meteorological parameters which greatly impact environmental fate and more specific information on the composition of the particle phase.

Some pesticides are toxic mainly through the inhalation route. Lack of standards makes it hard to ascertain if the levels in air, especially for a few days after application, are high enough to be a risk for the farm operators. The knowledge of harmful levels for human and other aerial biota (such as birds) will enable us to evaluate if risk exists through their application and steps can be examined to reduce air levels of these compounds.

The identification and study of the most abundant pesticide transformation products must be linked to the risks they may represent to exposed organisms, which tend to be aquatic or aerial biota. The transformation products can be more toxic or more volatile than the parent compound and present a greater risk. This is more important for the more persistent (chlorothalonil) and newer pesticides (Fipronil).

APPINDIX A - Pesticide usage on crops in Delmarva Peninsula

Pesticide	Class	Target crop
Acetochlor	H	corn
Alachlor	H	corn, soybeans
Atrazine	H	corn
Metolachlor	H	corn, soybeans, greens, potatoes, tomatoes
Metribuzin	H	potatoes, peas, tomatoes
Pendimethalin	H	corn, soybeans, greens, potatoes, tomatoes
Simazine	H	corn, orchard fruits, strawberries
Trifluralin	H	greens, tomatoes
Chlorpyrifos	I	corn, orchard fruits, strawberries
endosulfan	I	vine crops, orchard fruits, tomatoes, potatoes
Diazinon	I	melons, greens, orchard fruits
Fipronil	I	corn
γ-HCH (lindane)	I	squash seed
Malathion	I	strawberries
Chlorothalonil	F	vine crops, orchard fruits, greens, tomatoes, potatoes

APPENDIX B - Target analytes for this study

Compound	CAS #	Type	Chemical class	Chemical formula
Current use pesticide (CUP)				
Acetochlor[b]	34256-82-1	H	chloroacetanilide	$C_{14}H_{20}ClNO_2$
Alachlor	15972-60-8	H	chloroacetanilide	$C_{14}H_{20}ClNO_2$
Atrazine	1912-24-9	H	triazine	$C_8H_{14}ClN_5$
CEAT	1007-28-9	TP	triazine	$C_5H_8ClN_5$
CIAT	6190-65-4	TP	triazine	$C_6\ H_{10}\ Cl\ N_5$
Metolachlor	51218-45-2	H	chloroacetanilide	$C_{15}H_{22}ClNO_2$
Metribuzin	21087-64-9	H	Triazinone	$C_8H_{14}N_4OS$
Pendimethalin	40487-42-1	H	2,6-Dinitroaniline	$C_{13}H_{19}N_3O_4$
Simazine	122-34-9	H	triazine	$C_7H_{12}ClN_5$
Trifluralin	1582-09-8	H	2,6-Dinitroaniline	$C_{13}H_{16}F_3N_3O_4$
Chlorpyrifos	2921-88-2	I	OP -heterocyclic derivatives	$C_9H_{11}Cl_3NO_3PS$
Chlorpyrifos oxon	5598-15-2	TP	OP	$C_9H_{11}Cl_3NO_4P$
α-endosulfan[a]	959-98-8	I	OC - Cyclodienes	$C_9H_6Cl_6O_3S$
β-endosulfan[a]	33213-65-9	I	OC - Cyclodienes	$C_9H_6Cl_6O_3S$
Endosulfan sulfate	1031-07-8	TP	OC	$C_9H_6Cl_6O_4S$
Diazinon	333-41-5	I	OP - Heterocyclic derivatives	$C_{12}H_{21}N_2O_3PS$
Fipronil	120068-37-3	I	phenylpyrazole	$C_{12}H_4C_{l2}F_6N_4OS$
γ-HCH	58-89-9	I	OC - Hexchlorocyclohexane	$C_6H_6Cl_6$
Malathion	121-75-5	I	OP -Aliphatics-	$C_{14}H_{19}PS_2$
Chlorothalonil	1897-45-6	F	Substituted Benzene, organonitrile	$C_8Cl_4N_2$

APPENDIX B (*contd.*) - Target analytes for this study

Compound	CAS #	Type	Chemical class	Chemical formula
Historical use pesticide (HUP)				
Cyanazine	21725-46-2	H	triazine	$C_9H_{13}ClN_6$
44'-DDT	50-29-3	I	OC -Diphenyl Aliphatics	$C_{14}H_9Cl_5$
44'-DDD	72-54-8	I, TP	OC	$C_{14}H_9Cl_5$
44'-DDE	72-55-9	TP	OC	$C_{14}H_8C_{l4}$
α-HCH	319-84-6	I	OC - Hexchlorocyclohexane	$C_6H_6Cl_6$
Aldrin	309-00-2	I	OC - Cyclodienes	$C_{12}H_8Cl_6$
Dieldrin	60-57-1	I, TP	OC - Cyclodienes	$C_{12}H_8Cl_6O$
cis (α) chlordane	5103-71-9	I	OC - Cyclodienes	$C_{10}H_6Cl_8$
trans (β) chlordane	5103-74-2	I	OC - Cyclodienes	$C_{10}H_6Cl_8$
cis-nonachlor	5103-73-1	I	OC - Cyclodienes	$C_{10}H_5Cl_9$
trans-nonachlor	39765-80-5	I	OC - Cyclodienes	$C_{10}H_5Cl_9$
Oxychlordane	27304-13-8	TP	OC	$C_{10}\ H_4\ Cl_8\ O$
Heptachlor	76-44-8	I	OC - Cyclodienes	$C_{10}H_5Cl_7$
Heptachlor epoxide	1024-57-3	TP	OC	$C_{10}H_5Cl_7O$
Mirex	2385-85-5	I	OC - Cyclodienes	$C_{10}Cl_{12}$
Penta Brominated diphenyl ethers (penta-BDEs)				
BDE 47	5436-43-1	FR	penta-BDE	$Cl_2Br_4OH_6$
BDE 99	60348-60-9	FR	penta-BDE	$Cl_2Br_5OH_5$
BDE 100	189084-64-8	FR	penta-BDE	$Cl_2Br_5OH_5$
BDE 154	111-84-2	FR	penta-BDE	$Cl_2Br_5OH_5$

H: herbicide; F: fungicide; I : inseccticide; TP: transformation product; FR : flame retardant
OC : organochlorine ; OP: organophosphate
[‡] CUPs : date of registration for use; HUPs: year of usga ban
* voluntary phase out by this year
[a] not registered for use separately but unsrr the mixture endosulfan
CIAT: 6-amino-2-chloro-4-isopropylamino-*s* -triazine
CEAT: 6-amino-2-chloro-4-ethylamino-*s* -triazine
HCH : hexachlorocyclohexane

APPENDIX C - Physicochemical properties at 25 °C (except as noted) of analytes

Compound	CAS #	Mol Wt. g/mol	Solubility[a] mg/L	Vapor Pressure[a] Pa	HLC Pa m^3/mol	log K_{ow}[a]
Current use pesticide (CUP)						
Acetochlor[b]	034256-82-1	269.8	2.23E+02	3.73E-03	2.26E-03	3.03
Alachlor	015972-60-8	269.8	2.42E+02	2.93E-03	8.43E-04	3.52
Atrazine	1912-24-9	215.7	3.47E+01 (26 °C)	3.85E-05	2.39E-04	2.61
CEAT[b]	1007-28-9	173.6	6.7E+02 (22 ˚C)	2.81E-02	1.18E-04	1.15
CIAT[b]	6190-65-4	187.6	3.2E+03 (22 ˚C)	1.24E-02	1.55E-04	1.51
Metolachlor	51218-45-2	283.8	5.30E+02 (20 °C)	4.19E-03	9.12E-04	3.13
Metribuzin	21087-64-9	214.3	1.05E+03 (20 ˚C)	5.79 E-05 (20 °C)	1.18 E-05 (20 °C)	1.6
Pendimethalin	40487-42-1	281.3	2.75E-01	4.00E-03	8.67E-02	5.18
Simazine	122-34-9	201.7	6.2E+00 (22 ˚C)	2.95E-06	9.54E-05	2.18
Trifluralin	1582-09-8	335.3	7.50E-01	6.11E-03	1.04E+01	5.34
Chlorpyrifos	2921-88-2	350.6	1.18E+00	2.71E-03	2.97 E-01 (20 °C)	4.96
Chlorpyrifos oxon	005598-15-2	333.0				
α-Endosulfan[b]	959-98-8	406.9	5.1E-01 (20 °C)	4.00E-04	7.18E-01	3.83
β-Endosulfan[b]	33213-65-9	406.9	4.5 E-01(20 °C)	8.00E-05	3.96E-02	3.83
Endosulfan sulfate[b]	1031-07-8	422.9	4.8E-01 (20 ^{0}C)	3.73E-05	3.29E-02	3.66
Diazinon	333-41-5	304.4	4.00E+01	1.20E-02	1.14 E-02 (23 °C)	3.81
Fipronil[b]	120068-37-3	437.2	1.9E+00 (20 °C)	3.71E-04	8.53E-05	4.0
γ-HCH[b]	000058-89-9	290.8	7.30E+00	5.60E-03	5.21E-01	3.72
Malathion	121-75-5	330.4	1.43E+02(20 °C)	4.51E-04	4.95E-04	2.36
Chlorothalonil	1897-45-6	265.9	6.00E-01	7.60E-05	2.03E-01	3.05

APPENDIX C (***contd.***) - Physicochemical properties at 25 °C (except as noted) of analytes

Compound	CAS #	Mol Wt. g/mol	Solubility[a] mg/L	Vapor Pressure[a] Pa	HLC Pa m^3/mol	log K_{ow}[a]
Historical use pesticide (HUP)						
Cyanazine	21725-46-2	240.7	1.70E+02	1.84E-05	2.60E-07	2.22
4,4'-DDD[b]	72-54-8	320.1	9.00E-02	1.80E-04	6.69E-01	6.02
4,4'-DDE[b]	72-55-9	318.0	4.00E-02	8.00E-04	4.22E+00	6.51
4,4'-DDT[b]	50-29-3	354.5	5.50E-03	2.1 E-05 (20 °C)	8.43E-01	6.91
α-HCH	319-84-6	290.8	2.00E+00	6.00E-03	1.24E+00	3.8
Aldrin[b]	309-00-2	364.9	1.70E-02	1.60E-02	4.46E+00	6.5
Dieldrin	60-57-1	380.9	1.95E-01	7.85E-04	1.01E+00	5.4
cis (α) chlordane	005103-71-9	409.8	5.60E-02	4.80E-03	3.52E+01	6.1
trans (β) chlordane	005103-74-2	409.8	5.60E-02	6.71E-03	4.90E+01	6.22
cis-nonachlor	5103-73-1	444.2	1.04E-02	1.20E-04	2.51E+00	6.08
trans-nonachlor	5103-74-2	440.0				
Oxychlordane	027304-13-8	423.77	2.30E-02	9.20E-04	8.71E-03	5.48
Heptachlor[b]	76-44-8	373.3	1.80E-01	5.33E-02	2.98E+01	6.1
Heptachlor epoxide	1024-57-3	389.3	2.00E-01	2.59 E-03 (30 °C)	2.13E+00	4.98
Mirex[b]	2385-85-5	545.6	8.50E-02	1.07E-04	8.22E+01	6.89
Brominated diphenyl ether [c,d]						
BDE 47	5436-43-1	485.8	1.5 E-02	1.86E-04	1.50E+00	6.19
BDE 99	60348-60-9	564.7	9.4 E-03	1.76E-05	2.30E-01	6.53
BDE 100	189084-64-8	564.7	4.0E-02	2.86E-05	6.90E-02	6.86
BDE 154	111-84-2	643.6	8.7E-04	3.80E-06	2.40E-01	7.39

HLC : Henry's Law Constant

[a] ARS database (http://www.arsusda.gov)

[b] Syracuse Research Corporation (SRC) (http://esc.syrres.com)

[c] Tittlemier et al. 2002 [d] Palm et al. 2002

APPENDIX D - Percentage breakthrough on the back PUF (back/total *100)

	Horn Point (HP)			**Lewes (LD)**			**Dover (DV)**			**Total***
Nunber of samples	98			95			47			
	n	Max	Min	n	Max	Min	n	Max	Min	
Current use pesticide (CUP)										
Acetochlor	5	63.0	39.9	5	93	15.7	2	68.0	28.9	5.0
Alachlor	26	93.3	6.6	3	92	15.0	1	29.1	29.1	12.5
Atrazine	5	37.6	3.1	16	86.2	2.9	1	35.7	35.7	9.2
CEAT	5	77.3	60.7	2	98.1	64.6	1	91.3	91.3	3.3
CIAT	0			1	25.0	25.0	0			0.4
Metolachlor	17	65.2	1.1	7	60.4	4.0	4	44.3	10.3	11.7
Metribuzin	23	76.1	2.0	1	56.5	56.5	3	74.5	48.9	11.3
Pendimethalin	2	58.9	57.5	0			2	20.1	14.6	1.7
Simazine	0			0			0			0
Trifluralin	26	96.6	11.4	52	92.05	3.2	17	76.3	2.0	39.0
Chlorpyrifos	9	39.6	0.7	4	51.7	1.1	0			5.4
Chlorpyrifos Oxon	0			0			0			0.0
a-endosulfan	15	96.1	2.0	13	63.0	0.4	13	6.4	0.8	17.1
b-endosulfan	3	73.3	5.1	1	46.5	46.5	0			1.7
endosulfan sulfate	8	78.3	19.9	0	0.0	128.4	0			3.3
Diazinon	6	24.6	7.5	24	42.0	2.7	4	24.6	8.7	14.2
Fipronil	0			2	67.9	27.7	1	95.0	95.0	1.3
g-HCH	55	93.1	2.4	49	74.9	1.9	22	76.4	0.8	52.5
Malathion	0			0			0			0
Chlorothalonil	60	96.8	2.1	78	98.0	2.6	1	13.9	13.9	57.9
Historical use pesticide (HUP)										
Cyanazine	4	54.3	24.1	0			0			1.7
44'-DDT	0			0			0			0
44'-DDD	0			0			0			0
44'-DDE	0			1	66.9	66.9	0			0.4
a-HCH	51	84.8	12.0	57	97.6	9.3	29	91.8	13.5	57.1
Aldrin	0			0			0			0
Dieldrin	5	48.1	1.4	2	40.2	4.4	0			2.9
Cis-nonachlor	0			0		122.7	0			0
a-chlordane	5	31.2	6.6	6	73.8	2.5	2	10.3	2.5	5.4
g-chlordane	6	37.3	5.5	6	73.4	2.5	2	9.4	2.9	5.8
Trans-nonachlor	6	40.7	5.9	6	74.4	24.9	4	68.7	2.1	6.7
Oxychlordane	4	34.3	25.2	0			3	20.2	15.5	2.9
Heptachlor	19	78.6	4.4	37	98.6	12.0	6	41.4	26.9	25.8
Heptachlor epoxide	7	51.4	38.9	0			11	65.2	12.5	7.5
Mirex	0			0			0			0
Brominated diphenyl ethers (BDEs)										
BDE 47	0			11	94	0.2	0			4.6
BDE 100	0			1	84.1	84.1	0			0.4
BDE 99	1	50.7	50.7	32	61.2	3.8	5	93.6	26.7	15.8
BDE 154	0			0			0			0

Notes:
n is the number of samples where breakthrough was observed
max and min is the maximum and minimum % of the analyte seen on the back PUF
* Total lists the % of total samples in this study where the analyte broke through the front PUF

APPENDIX E – Chromatographic details and method detection limit (MDL) of analytes

			Method Detection Limit (MDL)[c]		
	Pesticide class[a]	**MS ions monitored**	**Gas (PUF)**	**Particulate (Filter)**	**Precipitation (Cartridge)**
		m/z	pg/m^3	pg/m^3	ng/L
GC-EI					
Acetochlor	H	223, 162, 146	15	4.8	1.3
Alachlor	H	160, 188, 237	9.4	4.3	1.3
Atrazine	H	200, 215, 173	9.2	9.7	2.1
CEAT	TP	173, 158, 145	22	8.3	2.1
CIAT	TP	172, 187, 174	11	5.4	1.8
Cyanazine	H	212, 225, 240	113	19	1.5
Metolachlor	H	162, 238	13.4 (14)	5.1 (34[f]-69[c])[h]	1.3
Metribuzin	H	198, 199, 144	29	12	1.3
Pendimethalin	H	252, 181, 191	16	1.5	1.2
Simazine	H	201, 186, 173	32	11	2.0
atrazine-d_5[d]	I.S.	205, 220, 215			
GC-NCI					
Chlorothalonil	F	266, 264, 268	25 (45)	2.0 (20)	3.2-12
Chlorpyrifos	I	313, 315, 214	0.8	0.8 (2.8)	0.5 (2.3[f])
Chlorpyrifos Oxon	TP	298, 297, 299	17	0.7[f]	2.0
Diazinon	I	169, 303	4.2	4.3	2.0
α-endosulfan	I	406, 408, 410	1.3 (5.2)	1.6 (2.8)	0.2 (0.6)
β-endosulfan	I	406, 408, 404	1.3	0.9 (4.9)	0.2
Endosulfan sulfate	TP	386, 388, 384	1.3	1.0	0.5
Fipronil	I	384, 331, 400	0.7	0.9	0.3 (2.1[c]-2.8[g])
Malathion	I	172, 157	5.1	3.2	0.9
Trifluralin	H	335, 336, 305	7.9	1.3	0.4 (1.8[g])
diazinon-d_{10}[e]		179			
PCB-204[d]		430, 428, 394			

A

APPENDIX E (*contd.*) – Chromatographic details and method detection limit (MDL) of analytes

			Method Detection Limit (MDL)[c]		
	Pesticide class[a]	**MS ions monitored** m/z	**Gas (PUF)** pg/m^3	**Particulate (Filter)** pg/m^3	**Precipitation (Cartridge)** ng/L
GC-NCI					
Historical Organochlorines					
Aldrin	I	330, 237, 332	1.2	2.4	0.2
Dieldrin	I, TP	346, 380, 237	1.4	1.2	0.1
cis (α) chlordane	I	410, 408, 412	1.8	1.2	0.4
trans (β) chlordane	I	410, 412, 408	1.9	1.0 (1.3)	0.3
cis-nonachlor	I	444, 442, 446	1.0	1.0	0.3
trans-nonachlor	I	444, 442, 446	1.1	1.2	0.3
Oxychlordane	TP	352, 350, 424	1.8	1.0	0.4
44'-DDD	I	248, 250, 320	24	9.6	1.4
44'-DDE	TP	318, 316, 320	5.9	3.0	0.7
44'-DDT	I	248,71, 318	98	7.4	0.2
α-HCH	I	255, 257, 71	2.5	0.9	0.4
γ-HCH	I	255, 71, 257	0.9	0.9	0.5 (2.8[f])
Heptachlor	I	266, 300, 232	0.8	1.1	0.4[i]
Heptachlor epoxide	TP	318, 237, 388	1.5	1.2	0.4[i]
Mirex	I	370, 404, 334	1.5	1.1	0.1[i]
Brominated diphenyl ethers (BDEs)					
BDE 47	FR	161, 325, 79	6.0 (32[f])	1.0	
BDE 100	FR	161, 484, 79	2.6	1.1	
BDE 99	**FR**	161, 81	3.1	1.4	
BDE 154	FR	484, 564, 81	3.3	3.3	

[a] F: Fungicide; H: Herbicide; I: Insecticide; FR: Flame retardant

[c] values in parantheses are higher MDLs used for Horn Point, unless otherwise noted

[d] internal standard, [e] extraction surrogate (not used for precipitation samples)

[f] MDLs for Lewes, [g] MDLs for Dover

[h] MDLs for the years 2001-2002 [I] Instrument detection limit

CIAT: 6-amino-2-chloro-4-isopropylamino-s-triazine

CEAT: 6-amino-2-chloro-4-ethylamino-s-triazine

APPENDIX F - Percent recovery of analytes recovered in laboratory spikes

	Pesticide class[a]	Spike recoveries[b] Gas (PUF) n = 16	Particulate (Filter) n =16	Precip. (Cartridge) n =5
Current use pesticide (CUP)				
Acetochlor	H	100 (20)	100 (40)	94 (7)
Alachlor	H	100 (20)	100 (40)	93 (5)
Atrazine	H	100 (30)	100 (30)	82 (12)
CEAT	TP	90 (20)	100 (40)	83 (16)
CIAT	TP	110 (30)	110 (40)	85 (15)
Metolachlor	H	100 (30)	110 (40)	96 (5)
Metribuzin	H	110 (30)	170 (100)	
Pendimethalin	H	120 (40)	110 (40)	105 (11)
Simazine	H	120 (40)	100 (60)	82 (12)
Chlorothalonil	F	200 (40)	110 (40)	69 (5)
Chlorpyrifos	I	100 (20)	90 (20)	143 (18)
Chlorpyrifos Oxon	TP	70 (30)	50 (30)	62 (16)
Diazinon	I	80 (20)	100 (40)	95 (8)
α-endosulfan	I	71 (17)	90 (20)	73 (5)
β-endosulfan	I	82 (19)	100 (20)	82 (6)
Endosulfan sulfate	TP	75 (16)	110 (20)	101 (13)
Fipronil	I	80 (20)	90 (20)	73 (1)*
Malathion	I	35 (12)	110 (30)	82 (7)
Trifluralin	H	63 (19)	80 (20)	54 (4)
γ-HCH	I	75 (17)	90 (30)	85 (8)
Historical use pesticide (HUP)				
Cyanazine	H	55 (16)	110 (30)	75 (18)
Aldrin	I	90 (20)	90 (20)	40 (6)
Dieldrin	I, TP	120 (40)	90 (20)	70 (3)
cis (α) chlordane	I	86 (17)	100 (20)	62 (4)
trans (β) chlordane	I	82 (19)	100 (20)	55 (4)
cis-nonachlor	I	80 (16)	100 (20)	63 (7)
trans-nonachlor	I	84 (19)	110 (20)	57 95)
Oxychlordane	TP	84 (13)	100 (20)	58 (4)
44'-DDD	I	84 (19)	110 (30)	62 (3)
44'-DDE	TP	86 (19)	101 (18)	45 (4)
44'-DDT	I	90 (60)	140 (60)	79 (12)
α-HCH	I	81 (18)	90 (30)	85 (7)
Heptachlor	I	90 (20)	100 (30)	63 (2)
Heptachlor epoxide	TP	90 (20)	100 (30)	75 (2)
Mirex	I	77 (18)	100 (20)	30 (3)
Brominated diphenyl ethers (BDEs)				
BDE 47	FR	83 (17)	83 (22)	
BDE 100	FR	60 (15)	105 (31)	
BDE 99	FR	59 (13)	86 (29)	
BDE 154	FR	47 (11)	73 (28)	

[a] F: Fungicide; H: Herbicide; I: Insecticide
[b] values in parantheses are standard deviations

APPENDIX G - Percent recovery of extraction surrogate in air samples

PUF

	Avg.	**Std dev.**
HP	96	31
LD	66	21
DV	52	15
Total	**76**	**31**

Filter

	Avg.	**Std dev.**
HP	96	47
LD	116	58
DV	105	48
Total	**104**	**52**

APPENDIX H - Gaseous phase concentrations (pg/m3) summary for Horn Point (HP)

	2000		2001		2002		2003		Overall		
N	31		27		39		32		129		
	Median	Max	Median	Max	Median	Max	Median	Max	Median	GM	Average
Temp (K)	290.2	301.3	295.2	301.6	293.6	302.3	292.9	300.6	292.9		291.7
WS (mph)	7.0	15.5	5.2	10.4	6.2	14.0	5.2	11.2	5.6		
Acetochlor	12.9	472.1	7.7	127.5	7.7	168.3	7.8	674.0	7.7	14.4	42.7
Alachlor	8.1	447.5	50.0	1,974.0	66.5	390.0	4.7	110.0	33.5	26.9	89.5
Atrazine	358.6	2,032	118.1	870.1	47.4	2,752	21.3	152.8	101.5	76.3	254.8
CEAT	10.8	18.6	11.5	247.4	93.7	2,911	10.9	10.9	10.9	22.8	99.1
CIAT	9.0	616.9	6.0	105.2	5.4	309.7	5.4	32.1	5.4	9.5	28.1
Cyanazine	56.7	97.7	149.1	659.0	56.5	1,903	57.0	385.9	57.0	99.5	196.1
Metolachlor	853.0	13,117	291.8	5,840	256.3	7,501	87.9	1,549	277	276.0	718.2
Metribuzin	14.6	25.1	1,449.7	6,339	14.5	14.8	14.7	2,434	14.7	49.2	385.0
Pendimethalin	8.3	14.3	8.3	1,183.0	8.3	354.2	8.3	1,442	8.3	11.5	41.3
Simazine	26.7	728.8	15.9	128.9	15.9	525.6	16.1	16.2	16.0	20.3	35.6
Trifluralin	6.8	119.6	25.2	112.5	23.4	119.1	30.8	346.5	20.8	19.3	31.8
DDD	19.6	70.0	11.9	13.3	11.9	12.1	12.0	32.7	11.9	12.8	13.4
DDE	4.9	67.1	3.0	17.3	9.1	38.7	3.0	27.7	3.0	4.8	7.0
DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
a-chlordane	36.3	166.8	18.7	45.0	13.4	47.7	16.3	65.2	19.0	15.6	25.5
a-endosulfan	120.0	878.8	92.6	432.0	37.4	962.1	34.9	282.5	61.8	52.4	117.8
a-HCH	111.3	340.9	21.6	42.8	18.2	33.1	18.1	41.3	21.7	25.4	44.9
Aldrin	0.6	1.0	0.6	0.6	0.6	2.5	0.6	0.6	0.6	0.6	0.6
b-endosulfan	31.1	273.7	9.4	42.7	0.6	86.1	0.6	15.7	6.8	4.5	19.2
Chlorothalonil	482.5	8252.3	1118.7	7890.3	634.0	4503.6	541.3	4857.6	634.0	608.9	1351.2
Chlorpyrifos	117.7	840.3	39.6	1,028.6	41.2	448.9	20.7	240.6	45.5	32.9	109.3
Chlorpyrifos Oxon	8.3	14.4	8.3	9.3	8.3	129.4	8.4	8.4	8.3	9.2	10.6

APPENDIX H (*contd.*) - Gaseous phase concentrations (pg/m3) summary for Horn Point (HP)

	2000		**2001**		**2002**		**2003**		**Overall**		
N	31		27		39		32		129		
	Median	Max	Median	Max	Median	Max	Median	Max	Median	GM	Average
Temp (K)	290.2	301.3	295.2	301.6	293.6	302.3	292.9	300.6	292.9		291.7
WS (mph)	7.0	15.5	5.2	10.4	6.2	14.0	5.2	11.2	5.6		
Cis-nonachlor	0.5	0.9	1.5	3.1	0.5	2.9	0.5	0.5	0.5	0.7	0.9
Diazinon	3.6	515.5	55.2	253.8	57.0	163.1	46.2	650.6	50.8	23.2	70.0
Dieldrin	0.7	1.2	49.5	159.8	54.0	211.8	88.0	393.8	40.6	16.2	59.8
endosulfan sulfate	8.8	541.2	4.8	14.2	0.7	45.5	1.5	13.0	1.2	2.6	13.9
Fipronil	0.4	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
g-chlordane	38.3	178.7	21.0	96.6	16.5	44.0	14.9	58.5	19.7	15.7	26.9
g-HCH	66.0	226.1	25.0	89.0	18.6	104.4	20.3	85.6	29.4	24.8	42.2
Heptachlor	0.4	0.7	21.9	567.6	16.8	45.6	8.4	33.6	11.6	5.4	17.3
Heptachlor epoxide	0.8	1.3	6.6	30.7	1.9	18.5	0.8	13.2	1.3	1.9	3.8
Malathion	4.2	120.0	2.6	182.2	2.6	294.6	2.6	18.7	2.6	3.8	11.9
Mirex	0.6	1.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Oxychlordane	0.7	1.3	5.1	11.3	3.2	12.6	2.1	10.2	2.2	2.1	3.2
Trans-nonachlor	25.7	118.2	15.7	39.7	11.3	36.9	13.9	48.9	15.6	12.0	19.0
BDE 47	0.6	1.0	3.3	10.8	0.6	26.0	0.6	11.7	0.6	1.3	3.3
BDE 100	3.0	5.2	3.0	3.3	3.0	5.4	3.0	3.0	3.0	3.1	3.2
BDE 99	1.5	2.6	3.8	9.9	2.9	25.6	1.5	11.9	1.6	2.5	3.2
BDE 154	1.4	2.3	1.4	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Endosulfan	167	983	100	475	38	1,048	36	297	72	61	137
Σ HCH	177	459	52	110	42	122	37	117	54	59	88
Σ chlordane	109	466	63	195	45	141	50	183	62	59	81
Σ DDT	137	137	24	29	24	51	32	40	25	28	30

Σ HCH = (α + γ) HCH Endosulfan = (a + b) ensodulfan

Σ chlordane = (α + γ + cis +trans) chlordane ΣDDT = DDT + DDE + DDD

APPENDIX I - Gaseous phase concentrations (pg/m3) summary for Lewes (LD)

	2001		2002		2003		Overall		
N	29		42		24		95		
	Median	Max	Median	Max	Median	Max	Median	GM	Average
Temp (K)	293.0	302.1	291.7	302.0	294.5	302.0	292.5		
wnd spd	3.1	14.0	2.3	5.3	1.9	4.4	2.3		
Acetochlor	7.2	453.7	6.0	3,569	7.8	1,583.4	7.4	11.6	103.5
Alachlor	4.5	161.8	3.7	379.9	4.7	211.1	4.6	6.6	26.3
Atrazine	4.4	1,413	3.6	23,071	373.5	1,151	4.7	27.5	428.2
CEAT	10.2	517.4	8.4	1,792.1	10.7	11	10.4	14.6	71.9
CIAT	5.1	282.5	4.2	1,185.6	5.4	675.6	5.2	7.6	43.2
Cyanazine	53.1	67.3	43.5	72.5	56.3	59	53.6	49.8	50.5
Metolachlor	75.2	2,387	38.9	47,992	192.1	4,518	51.3	54	871
Metribuzin	13.9	1,294.5	11.8	63	14.5	15.2	14.2	18	65.8
Pendimethalin	7.8	9.8	6.4	251.2	8.3	4,264	7.8	10	96.3
Simazine	15.1	963.9	12.3	4,152.7	15.9	16.6	15.4	18.3	83.6
Trifluralin	103.8	2,825	81.5	1,592.2	403.9	12,384	180.9	140.9	436.6
DDD	11.1	14.1	9.1	15.2	11.8	12.4	11.2	10.5	10.6
DDE	12.8	72.7	16.3	108.6	23.0	1,533.1	17.6	15.2	38.7
DDT	ND	ND	ND	ND	ND	ND	ND	ND	ND
α-chlordane	23.2	91.1	13.4	127.1	33.2	68.4	20.3	17.3	26.2
α-endosulfan	34.0	969.0	15.8	272.1	62.6	809.8	43.6	29.1	95.4
α-HCH	25.2	46.8	14.6	32.9	28.3	61.4	19.4	19.1	22.6
Aldrin	0.5	0.7	0.4	0.7	0.6	0.6	0.6	0.5	0.5
b-endosulfan	3.5	81.3	1.4	25.8	4.1	68.9	2.9	2.8	8.2
Chlorothalonil	802.9	12,253	541.2	17,176	561.8	10,601	584.5	962.0	2,110
Chlorpyrifos	44.9	1511.0	34.0	2456.8	73.8	442.7	45.7	41.5	155.9
Chlorpyrifos Oxon	7.8	39.9	7.2	45.0	8.4	20.9	8.2	9.1	10.5

APPENDIX I (*contd.*) - Gaseous phase concentrations (pg/m^3) summary for Lewes (LD)

	2001		**2002**		**2003**		**Overall**		
N	29		42		24		95		
	Median	Max	Median	Max	Median	Max	Median	GM	Average
Temp (K)	293.0	302.1	291.7	302.0	294.5	302.0	292.5		
wnd spd	3.1	14.0	2.3	5.3	1.9	4.4	2.3		
Cis-nonachlor	1.7	6.9	1.8	10.1	3.0	5.9	2.1	1.9	2.5
Diazinon	89.6	1223.6	36.1	856.8	249.6	683.2	61.3	41.1	157.8
Dieldrin	53.5	290.4	19.3	257.6	68.4	313.7	31.8	29.7	58.6
endosulfan sulfate	2.9	23.8	3.9	12.4	2.5	15.7	3.3	3.2	4.7
Fipronil	0.3	38.8	0.3	4.0	0.4	1.8	0.3	0.4	1.3
g-chlordane	26.4	102.9	17.3	155.2	39.1	81.8	24.1	21.4	31.2
g-HCH	27.6	286.9	16.7	166.2	59.9	382.3	27.6	27.9	52.4
Heptachlor	21.4	59.6	16.1	63.9	25.2	50.0	18.3	15.5	21.6
Heptachlor epoxide	3.9	12.3	2.2	14.4	3.3	11.2	2.8	2.2	3.6
Malathion	2.6	2,860	2.0	36.1	2.6	91.7	2.5	4.1	45.5
Mirex	0.5	0.7	0.4	0.7	1.5	54.0	0.5	0.7	2.2
Oxychlordane	3.2	11.6	3.3	14.4	5.7	9.9	3.5	3.2	4.2
Trans-nonachlor	16.4	73.7	10.8	102.5	26.2	52.3	15.6	13.5	20.6
BDE 47	112.9	395.2	140.1	571.2	294.9	670.9	168.8	133.1	206.3
BDE 100	13.1	35.4	8.4	67.4	27.1	73.2	13.2	11.2	16.2
BDE 99	26.2	90.4	15.4	177.9	67.8	168.4	26.1	24.2	37.0
BDE 154	ND		ND		ND		ND		
Σ DDT	28.7	84.2	27.9	123.8	35.4	1,545.2	30.1	34.0	56.2
Σ chlordane	75.3	285.8	46.7	409.3	106.4	214.7	67.6	59.9	85.5
ΣHCH	52.5	312.1	32.8	183.6	89.7	405.3	51.9	52.1	75.0
Σ Hept	25	72	21	78	31	61	23	22	27

Σ HCH = ($\alpha + \gamma$) HCH

Endosulfan = (a + b) ensodulfan

Σ chlordane = ($\alpha + \gamma$ + cis +trans) chlordane

ΣDDT = DDT + DDE + DDD

APPENDIX J - Gaseous phase concentrations (pg/m^3) summary for Dover (DV)

	2002		2003		Overall		
N	22		25		47		
	Median	Max	Median	Max	Median	GM	Average
Temp. (K)	287	301	295	302	294		292
wind speed (mph)	3.6	11.0	3.7	7.6	3.7		
Acetochlor	8.6	516.4	8.8	1,015	8.6	17.9	97.3
Alachlor	36.7	235.6	4.4	6.0	5.3	10.2	27.2
Atrazine	5.2	7,015	5.5	816	5.3	30	317.5
CEAT	12.0	904.3	10.2	13.6	12.0	21	97.2
CIAT	5.9	1,008.2	6.2	407.7	6.0	12.7	61.3
Chlorothalonil	217.7	266.0	15.2	2,818.9	213.7	84	218.1
Chlorpyrifos	26.9	409	62.7	718	38.1	33	93.5
Chlorpyfs Oxon	8.9	14.4	7.9	11	8.5	8.6	8.7
Diazinon	14.6	257.3	46.7	551.9	35.0	28	74.2
α-chlordane	23.8	322.4	88.9	4,805.5	51.6	46.0	230.3
α-endosulfan	2.4	31	9.2	516.6	5.0	5	29.1
α-HCH	1.7	11.3	4.1	72.0	2.8	2.7	6.6
Fipronil	0.4	3.4	0.4	6.8	0.4	0.5	0.7
Metolachlr	208.8	9,797.0	313.7	4,863	303.2	184.1	889.4
Metribuzin	15.9	679.7	13.8	193.6	15.8	20.9	41.5
Pendimeth	9.3	21,841	9.3	2,779.5	9.3	33.2	722.3
Simazine	17.3	1,513.4	15.1	718.3	17.3	20.8	68.1
Trifluralin	65.9	1,466.2	557.1	5,686.1	312.9	266.7	787.5
Aldrin	0.6	1.0	0.5	0.7	0.6	0.6	0.6
Cyanazine	60.8	98	53.5	71.5	58.1	58	58.9

APPENDIX J (*contd.*) - Gaseous phase concentrations (pg/m^3) summary for Dover (DV)

	2002		2003		Overall		
N	22		25		47		
	Median	Max	Median	Max	Median	GM	Average
Temp. (K)	287	301	295	302	294		292
wind speed (mph)	3.6	11.0	3.7	7.6	3.7		
a-chlordane	11.2	57.3	27.3	119.7	18.7	16.1	24.4
g-chlordane	13.0	45.2	28.9	90.4	22.8	18.0	24.8
Cis-nonachlor	0.5	3.9	1.7	6.9	0.9	1.0	1.4
Trans-nonachlor	7.5	40.8	23.0	75.9	15.0	11.3	17.7
Oxy chlordane	0.8	8.9	6.0	20.4	2.7	2.5	4.4
p,p-DDD	12.8	20.5	11.2	15.0	12.2	12.2	12.4
p,p-DDE	22.1	162.7	92.2	230.4	61.1	41.6	72.1
p,p-DDT	ND	ND	ND	ND	ND	ND	ND
Dieldrin	8.3	150.5	56.7	262.7	38.3	31.0	52.2
a-HCH	18.7	40.0	27.8	53.1	23.2	22.0	24.5
g-HCH	17.7	238.4	56.5	342.5	36.4	23.5	67.7
Heptachlor	11.2	27.8	6.8	92.3	10.3	5.3	13.5
Hepta. epoxide	0.8	8.7	8.8	28.2	4.2	2.8	6.4
Malathion	2.8	4.4	2.4	38.8	2.6	2.7	3.9
Mirex	2.8	15.6	0.7	0.9	0.8	1.3	2.0
BDE 47	5.2	38	16.9	52.0	11.3	6.5	13.8
BDE 100	3.2	5.3	2.8	3.8	3.2	3.1	3.2
BDE 99	1.7	9.3	3.1	16.6	1.9	3.1	4.3
BDE 154	1.5	2.3	1.3	1.7	1.4	1.4	1.4
Σ Endosulfan	28.1	343.1	104.6	5,322	57.1	53.3	259.4
Σ DDT	37.1	174.2	103.8	241.6	80.1	70.7	90.7
Σ chlordane	41.1	152.8	93.4	280.1	61.8	52.6	74.1
Σ BDE	13.3	42.1	25.7	67.4	17.1	16.1	21.2

Σ HCH = $(\alpha + \gamma)$ HCH Endosulfan = (a + b) ensodulfan

Σ chlordane = $(\alpha + \gamma$ + cis +trans) chlordane ΣDDT = DDT + DDE + DDD

APPENDIX K - Precipitation concentrations (ng/L) summary for Horn Point (HP)

				Concentration (ng/L)			
	N	n	% detection	mean	median	max	min
Vol (L)	242			2.23	1.32	19.96	0.05
Acetochlor	242	36	14.9	86.8	66.6	356.5	11.4
Alachlor	242	52	21.5	76.2	39.6	486.0	5.3
Atrazine	242	94	38.8	135.9	77.3	895.6	4.7
CEAT	242	0	0.0				
CIAT	242	37	15.3	61.6	35.8	261.2	3.4
Cyanazine	174	6	3.4	2,112	2,029	3,920	456.0
Metolachlor	242	142	58.7	126.7	64.4	997.9	0.8
Metribuzin	174	1	0.6	8.8	8.8	8.8	8.8
Pendimethalin	242	28	11.6	44.0	30.2	147.4	2.8
Simazine	202	20	9.9	110.2	66.5	499.7	17.9
Trifluralin	242	46	19.0	3.8	1.6	23.8	0.2
DDD	134	0	0.0				
DDE	134	24	17.9	18.5	11.8	89.8	2.8
DDT	174	1	0.6	13.9	13.9	13.9	13.9
α-chlordane	174	5	2.9	1.4	1.3	3.3	0.4
α-endosulfan	242	39	16.1	2.0	1.2	30.6	0.0
α-HCH	242	6	2.5	0.9	0.5	2.1	0.3
Aldrin	134	0	0.0				
β-endosulfan	242	102	42.1	3.3	2.1	81.0	0.3
Chlorothalonil	242	197	81.4	129.4	65.9	2,011	2.5
Chlorpyrifos	242	102	42.1	6.2	2.2	176.8	0.4
Chlorpyrifos oxon	242	7	2.9	60.7	26.3	201.3	4.4
cis-nonachlor	174	0	0.0				
Diazinon	242	49	20.2	39.0	22.7	158.9	3.1
Dieldrin	134	9	6.7	1.4	1.3	3.1	0.1
Endosulfan sulfate	242	74	30.6	1.9	1.9	14.2	0.3
Fipronil	134	17	12.7	12.0	5.5	59.5	0.8
γ-chlordane	242	2	0.8	1.6	1.6	1.7	1.5
γ-HCH	242	33	13.6	3.2	2.0	22.4	0.5
Heptachlor	62	3	4.8	18.9	21.6	24.8	10.2
Heptachlor epoxide	134	1	0.7	56.4	56.4	56.4	56.4
Malathion	242	15	6.2	47.9	17.7	358.2	0.9
Mirex	134	0	0.0				
Oxychlordane	134	1	0.7	2.3	2.3	2.3	2.3
trans-nonachlor	134	0	0.0				
BDE-47	134	2	1.5	1.5	1.5	2.6	0.5
BDE-99	134	0	0.0				
BDE-100	134	0	0.0				
BDE-154	134	0	0.0				
Σ BDE	134	2	1.5	1.5	1.5	2.6	0.5
Σ DDT		25		18.3	12.2	89.8	2.8
Endosulfan	242	103	42.6	4.1	2.4	111.7	0.3

N: total number of samples analyzed in
n: total number of samples detected in
Endosulfan = (a + b) ensodulfan
Σ BDE = sum of the four penta-BDE congeners
ΣDDT = DDT + DDE + DDD

APPENDIX L - Precipitation concentrations (ng/L) summary for Lewes (LD)

				Concentration (ng/L)			
	N	n	% detection	mean	median	max	min
Vol (L)		176		1.66	0.93	21.85	0.05
Acetochlor	176	23	13.1	147.6	65.5	954.4	14.8
Alachlor	176	19	10.8	86.8	57.3	244.4	27.5
Atrazine	176	67	38.1	127.7	79.0	898.0	6.1
CEAT	176	1	0.6	210.1	210.1	210.1	210.1
CIAT	176	23	13.1	154.2	85.8	892.8	19.0
Cyanazine	176	0	0.0				
Metolachlor	176	86	48.9	159.2	57.7	1500.1	2.2
Metribuzin	176	3	1.7	569.3	397.8	1269.6	40.6
Pendimethalin	176	21	11.9	79.3	49.5	235.3	7.3
Simazine	131	7	5.3	98.6	68.3	292.0	44.0
Trifluralin	176	71	40.3	10.7	3.1	112.2	0.3
DDD	131	0	0.0				
DDE	176	3	1.7	32.6	25.7	65.9	6.2
DDT	176	0	0.0				
α-chlordane	176	6	3.4	0.9	0.6	2.4	0.4
α-endosulfan	176	44	25.0	5.5	2.0	46.6	0.5
α-HCH	176	5	2.8	2.9	1.1	11.0	0.2
Aldrin	131	1	0.8	2.7	2.7	2.7	2.7
β_ενδοσυλφαν	176	77	43.8	6.1	2.7	78.0	0.0
Chlorothalonil	176	111	63.1	243.5	86.5	5569.1	3.6
Chlorpyrifos	176	16	9.1	9.4	4.7	40.4	1.5
Chlorpyrifos_oxon	176	3	1.7				
cis_nonachlor	176	0	0.0				
Diazinon	176	56	31.8	112.4	46.9	1,266	2.4
Dieldrin	131	9	6.9	1.2	1.0	3.4	0.2
Endosulfan_sulfate	176	60	34.1	7.4	3.3	64.5	0.1
Fipronil	131	32	24.4	4.8	3.3	24.6	0.4
γ_χηλορδανε	176	1	0.6	3.3	3.3	3.3	3.3
γ_ΗΧΗ	176	1	0.6	35.5	35.5	35.5	35.5
Heptachlor	131	4	3.1	32.6	40.1	48.9	1.3
Heptachlor_epoxide	131	1	0.8	17.6	17.6	17.6	17.6
Malathion	176	16	9.1	15.2	10.0	52.8	4.0
Mirex	131	9	6.9	167.7	57.4	628.3	3.0
Oxychlordane	176	0	0.0				
trans-nonachlor	176	1	0.6	158.9	158.9	158.9	158.9
BDE-47	131	21	16.0	13.7	2.3	144.5	0.3
BDE-99	131	6	4.6	18.2	8.4	47.0	0.9
BDE-100	131	2	1.5	5.2	5.2	9.8	0.7
BDE-154	131	1	0.8	1.9	1.9	1.9	1.9
Σ BDE	131	21	16.0	19.5	2.3	144.5	0.3
Σ DDT		3		32.6	25.7	65.9	6.2
Endosulfan	176	78	44.3	9.1	3.8	124.6	0.04

N: total number of samples analyzed in
n: total number of samples detected in
Endosulfan = (a + b) ensodulfan   Σ BDE = sum of the four penta-BDE congeners
ΣDDT = DDT + DDE + DDD

APPENDIX M - Precipitation concentrations (ng/L) summary for Dover (DV)

				Concentration (ng/L)			
	N	n	% detection	mean	median	max	min
Vol (L)	71			3.58	2.35	21.30	0.13
Acetochlor	71	16	22.5	72.8	47.1	506.3	5.2
Alachlor	71	10	14.1	31.8	26.3	72.1	13.9
Atrazine	71	22	31.0	175.7	92.0	863.7	6.7
CEAT	71	1	1.4	295.3	295.3	295.3	295.3
CIAT	71	12	16.9	66.7	50.0	203.9	10.9
Cyanazine	71	0	0.0				
Metolachlor	71	40	56.3	127.2	55.2	995.3	1.6
Metribuzin	71	1	1.4	160.8	160.8	160.8	160.8
Pendimethalin	71	13	18.3	156.4	29.4	1,134	3.3
Simazine	71	10	14.1	52.6	40.7	134.5	11.6
Trifluralin	71	56	78.9	5.7	2.9	49.5	0.3
DDD	71	0	0.0				
DDE	71	24	33.8	12.6	7.5	62.9	2.3
DDT	71	0	0.0				
α-chlordane	71	16	22.5	1.5	1.0	6.1	0.5
α-endosulfan	71	52	73.2	8.0	3.6	53.9	0.2
α-HCH	71	12	16.9	1.3	1.0	3.3	0.3
Aldrin	71	0	0.0				
β-endosulfan	71	57	80.3	9.9	4.3	148.0	0.1
Chlorothalonil	71	70	98.6	549.2	257.6	3,313	5.4
Chlorpyrifos	71	48	67.6	8.4	4.1	135.5	0.6
Chlorpyrifos_oxon	71	16	22.5	132.7	25.0	1,753	8.8
cis_nonachlor	71	2	2.8	0.9	0.9	1.1	0.7
Diazinon	71	37	52.1	126.7	49.6	775.5	7.5
Dieldrin	71	35	49.3	2.0	1.5	9.8	0.5
Endosulfan_sulfate	71	43	60.6	7.7	5.1	41.0	0.3
Fipronil	71	8	11.3	21.2	16.3	43.9	2.1
γ_chlordane	71	24	33.8	1.7	1.3	5.8	0.5
γ_HCH	71	42	59.2	5.1	2.8	34.7	0.6
Heptachlor	71	0	0.0				
Heptachlor_epoxide	71	0	0.0				
Malathion	71	25	35.2	18.1	12.0	113.1	2.4
Mirex	71	0	0.0				
Oxychlordane	71	2	2.8	1.7	1.7	2.5	0.9
trans-nonachlor	71	7	9.9	1.3	1.0	2.2	0.6
BDE-47	71	4	5.6	1.3	1.2	2.3	0.3
BDE-99	71	4	5.6	5.5	2.3	17.0	0.4
BDE-100	71	0	0.0				
BDE-154	71	0	0.0				
Σ BDE	71	6	8.5	4.5	1.9	17.0	0.3
Σ DDT	71	24	33.8	12.6	7.5	62.9	2.3
Endosulfan	71	58	81.7	16.9	6.9	196.1	0.2

N: total number of samples analyzed in
n: total number of samples detected in
Endosulfan = (a + b) ensodulfan Σ BDE = sum of the four penta-BDE congeners
ΣDDT = DDT + DDE + DDD

APPENDIX N - Average pesticide concentrations (average ± 95% CI) in three phases at the two sites (HP, LD)

	Horn Point (HP, MD)			Lewes (LD, DE)		
Pesticide	Gas pg/m^3	Particulate pg/m^3	Precip. ng/L	Gas pg/m3	Particulate pg/m3	Precip. ng/L
Current use						
Acetochlor	43 ± 17	8.2 ± 4.7	13 ± 5.3	104 ± 85	17 ± 15	20 ± 13
Alachlor	90 ± 35	7.7 ± 3.6	17 ± 7.3	26 ± 14	3.5 ± 1.6	10 ± 5
Atrazine	255 ± 74	82 ± 23	53 ± 16	428 ± 477	98 ± 63	49 ± 18
CEAT	99 ± 54	18 ± 16	ND	72 ± 46	23 ± 17	2.2 ± 2.3
CIAT	28 ± 13	36 ± 16	10 ± 4.0	43 ± 31	26 ± 15	21 ± 12
Metolachlor	718 ± 261	175 ± 35	75 ± 17	871 ± 994	239 ± 167	78 ± 29
Metribuzin	385 ±144	8.8 ± 3.2	0.7 ± 0.1	66 ± 40	ND	10 ± 15
Pendimethalin	41 ± 29	11 ± 9.3	5.6 ± 2.6	96 ± 97	7.4 ± 8.0	10 ± 5
Simazine	W	31 ± 16	19 ± 7.0	84 ± 87	44 ± 30	6.2 ± 4.9
Trifluralin	32 ± 7	1.4 ± 0.3	0.9 ± 0.3	437 ± 263	1.3 ± 0.4	4.4 ± 2.2
α–endosulfan	118 ± 27	2.2 ± 0.3	0.7 ± 0.3	95 ± 31	0.72 ± 0.02	1.6 ± 0.7
β–endosulfan	19 ± 6.5	3.1 ± 0.3	1.5 ± 0.7	8.2 ± 2.8	0.51 ± 0.16	2.7 ± 1.1
Endosulfan sulfate	14 ± 9.5	2.2 ± 0.4	0.8 ± 0.2	4.7 ± 0.8	0.46 ± 0.02	2.7 ± 1.0
Chlorpyrifos	109 ± 29	2.2 ± 0.4	2.8 ± 1.5	156 ± 67	0.44 ± 0.07	1.9 ± 0.6
Chlorpyrifos oxon	11 ± 2	ND	4.1 ± 3.5	11 ± 1.5	7.6 ± 4.8	2.6 ± 2.3
Diazinon	70 ± 17	20 ± 6.3	8.7 ± 2.9	158 ± 43	6.5 ± 1.8	36 ± 19
Fipronil	0.38 ± 0.01	1.6 ± 2.0	3.6 ± 1.5	1.3 ± 1.0	0.46 ± 0.06	2 ± 0.5
Malathion	12 ± 6.6	6 ± 2.5	3.4 ± 3.1	45 ± 60	1.7 ± 0.4	1.8 ± 0.9
Chlorothalonil	1351 ± 290	50 ± 18	107 ± 24	2110 ± 660	62 ± 47	154 ± 71
Historical organochlorines						
Aldrin	0.64 ± 0.04	ND	ND	ND	ND	ND
Dieldrin	60 ± 13	ND	0.2 ± 0.1	59 ± 13	0.56 ± 0.3	0.1 ± 0.1
α chlordane	26 ± 4.6	1.2 ± 0.2	0.24 ± 0.04	26 ± 4.5	ND	0.2 ± 0.03
γ–chlordane	27 ± 5	1.3 ± 0.2	0.17 ± 0.02	31 ± 5.2	ND	ND
cis-nonachlor	0.87 ± 0.12	0.6 ± 0.08	ND	2.5 ± 0.4	ND	ND
trans-nonachlor	19 ± 3	0.65 ± 0.07	ND	21 ± 3.6	ND	1.4 ± 2.4
Oxychlordane	3.2 ± 0.5	ND	0.22 ± 0.02	4.2 ± 0.6	ND	ND
Cyanazine	196 ± 58	23 ± 14	95 ± 89	50 ± 1.6	9.0 ± 0.7	ND
DDD	13 ± 1.1	ND	ND	ND	ND	ND
DDE	7.0 ± 1.5	ND	2.9 ± 1.6	39 ± 32	ND	ND
DDT	ND	ND	14.0	ND	ND	ND
α–HCH	44 ± 11	0.45 ± 0.02	0.22 ± 0.02	23 ± 2.5	ND	0.3 ± 0.1
γ–HCH	42 ± 7	1.0 ± 0.5	0.7 ± 0.2	52 ± 14	0.46 ± 0.08	1.6 ± 0.4
Heptachlor	17 ± 9	ND	0.6 ± 0.5	22 ± 2.8	ND	1.2 ± 1.1
Heptachlor epoxide	3.8 ± 0.9	0.64 ± 0.09	0.6 ± 0.8	3.6 ± 0.7	ND	0.3
Mirex	3.2 ± 0.9	1.1 ± 0.2	ND	2.2 ± 1.5	0.54 ± 0.14	12 ± 12
Σ chlordane	81 ± 13	33 ± 8.2	0.72 ± 0.06	86 ± 14	ND	2.1 ± 1.8
Σ DDT	30 ± 3.3	ND	2.5 ± 1.3	39 ± 32	ND	1.8 ± 2.2
Σ HCH	88 ± 16	0.85 ± 0.3	0.9 ± 0.2	75 ± 15	ND	0.3 ± 1.6

APPENDIX O - Average pesticide concentrations (average ± 95% CI) in three phases at the remote site (DV) and observed maximum in the Peninsula

	Dover (DV, DE)			Maximum observed conc.		
Pesticide	Gas pg/m3	Particulate pg/m3	Precip. ng/L	Gas pg/m3	Particulate pg/m3	Precip. ng/L
Current use						
Acetochlor	97 ± 64	13 ± 9.1	17 ± 15	3,569	562	954
Alachlor	27 ± 14	5.1 ± 2.8	5.0 ± 3.0	1,974	132	486
Atrazine	318 ± 295	104 ± 58	55 ± 33	23,071	2,057	898
CEAT	97 ± 62	ND	5.2 ± 8.1	2,911	726	295
CIAT	61 ± 46	29 ± 22	12 ± 7.8	1,186	506	893
Metolachlor	889 ± 475	277 ± 153	72 ± 38	47,992	5,092	1,500
Metribuzin	42 ± 29	ND	2.9 ± 4.4	6,339	172	1,270
Pendimethalin	722 ± 916	31 ± 40	29 ± 34	21,841	927	1,134
Simazine	68 ± 69	31 ± 26	8.3 ± 5.2	4,153	1,124	500
Trifluralin	788 ± 348	0.7 ± 0.2	4.7 ± 1.7	12,384	17	112
α–endosulfan	230 ± 202	1.7 ± 1.5	6.0 ± 2.5	4,806	38	54
β–endosulfan	29 ± 25	6.3 ± 9.0	8.0 ± 4.5	517	214	148
Endosulfan sulfate	6.6 ± 3.6	1.3 ± 0.8	4.8 ± 1.8	541	18	64
Chlorpyrifos	94 ± 42	ND	6.0 ± 3.8	2,457	9.1	177
Chlorpyrifos oxon	8.7 ± 0.4	ND	31 ± 48	129	139	1,753
Diazinon	74 ± 33	ND	67 ± 34	1,224	210	1,266
Fipronil	0.7 ± 0.3	1.3 ± 0.8	3.6 ± 1.9	39	92	59
Malathion	3.9 ± 1.8	ND	6.7 ± 3.6	2,860	79	358
Chlorothalonil	218 ± 118	39 ± 20	542 ± 165	17,176	2,030	5,569
Historical organochlorines						
Aldrin	ND	ND	ND	2.5	ND	2.7
Dieldrin	52 ± 16	ND	1.0 ± 0.4	394	1.6	9.8
α chlordane	24 ± 6.5	ND	0.5 ± 0.2	167	3.7	6.1
γ–chlordane	25 ± 5	ND	0.7 ± 0.2	179	3.7	5.8
cis-nonachlor	1.4 ± 0.4	ND	0.17 ± 0.03	10	3.6	1.1
trans-nonachlor	18 ± 4	ND	0.27 ± 0.09	118	4.0	159
Oxychlordane	4.4 ± 1.3	ND	0.25 ± 0.06	20	7.3	2.5
Cyanazine	59 ± 2.6	ND	ND	1,903	706	3,920
DDD	ND	ND	ND	70	ND	
DDE	72 ± 17	ND	4.5 ± 2.4	1,533	ND	90
DDT	ND	ND	ND	ND	ND	14
α–HCH	25 ± 3	ND	0.39 ± 0.14	341	1.2	11
γ–HCH	68 ± 23	1.2 ± 1.1	3.6 ± 1.4	382	27.2	35
Heptachlor	14 ± 4.6	ND	ND	568	ND	49
Heptachlor epoxide	6.4 ± 2.0	ND	ND	31	4.8	56
Mirex	2.0 ± 0.7	ND	ND	54	3.7	628
Σ chlordane	74 ± 17	ND	1.9 ± 0.5	466	99	160
Σ DDT	72 ± 17	ND	5.2 ± 2.4	1,545	ND	91
Σ HCH	92 ± 24	1.2 ± 1.1	4.0 ± 1.4	459	27.2	36

APPENDIX P - Overall levels of pesticides in the Delmarva Peninsula (combined data from the three sites)

Pesticide	Gaseous air					Particle phase					Dissolved phase precipitation			
	MDL (pg/m^3)	$N_{analyzed}$	Detection (%)	Median (pg/m^3)	Maximum (pg/m^3)	MDL (pg/m^3)	$N_{analyzed}$	Detection (%)	Median (pg/m^3)	Maximum (pg/m^3)	MDL (ng/L)	$N_{analyzed}$	Detection (%)	Maximum (ng/L)
Current use														
Acetochlor	15	271	18	204	3,569	4.8	265	8	108	562	1.3	489	15	954
Alachlor	9.4	271	38	73	1,974	4.3	265	8	33	132	1.3	489	17	486
Atrazine	9.2	271	61	231	23,071	9.7	265	55	63	2,057	2.1	489	37	898
CEAT	22	271	18	250	2,911	8.3	265	5	202	726	2.1	489	0.4	295
CIAT	11	271	19	102	1,186	5.4	265	16	144	506	1.8	489	15	893
Metolachlor	13.4 (14)	271	78	314	47,992	5.1 (34[c]-69[b])[e]	265	62	125	5,092	1.3	489	55	1,500
Metribuzin	29	240	24	685	6,339	12	234	1	148	172	1.3	421	1.2	1,270
Pendimethalin	16	271	13	309	21,841	1.5	265	5	162	927	1.2	489	13	1,134
Simazine	32	271	8.1	218	4,153	11	265	12	186	1,124	2.0	404	9	500
Trifluralin	7.9	271	88	59	12,384	1.3	234	33	1.5	17	0.4 (1.8d)	489	35	112
α–endosulfan	1.3 (5.2)	271	95	58	4,806	1.6 (2.8)	234	13	1.5	38	0.2 (0.6)	489	28	54
β-endosulfan	1.3	271	63	10	517	0.9 (4.9)	234	12	0.9	214	0.2	489	48	148
Endosulfan sulfate	1.3	271	64	4.3	541	1.0	234	38	1.2	18	0.5	489	36	64
Chlorpyrifos	0.8	271	91	50	2,457	0.8 (2.8)	234	12	1.2	9.1	0.5 (2.3c)	489	34	177
Chlorpyrifos oxon	17	271	8	22	129	0.7[f]	234	8	16	139	2.0	489	6	1,753
Diazinon	4.2	271	73	74	1,224	4.3	234	28	27	210	2.0	489	29	1,266
Fipronil	0.7	240	7.5	3.0	39	0.9	234	6	2.9	92	0.3 (2.1b-2.8d)	336	17	59
Malathion	5.1	271	16	19	2,860	3.2	234	9	13	79	0.9	489	11	358
Chlorothalonil	25 (45)	271	89	566	17,176	2.0 (20[b])	234	49	28	2,030	3.2-12	489	77	5,569
Historical CUPs														
Cyanazine	113	271	12	366	1,903	19	265	1.9	193	706	1.5	421	1.4	3,920
Aldrin	1.2	240	0.4	2.5	2.5	2.4	234	ND			0.2	336	0.3	2.7
Dieldrin	1.4	240	93	53	394	1.2	234	0.4	1	1.6	0.1	336	16	9.8
α chlordane	1.8	271	93	21	167	1.2	234	13	2	4	0.4	421	6.4	6.1
γ chlordane	1.9	271	94	23	179	1.0 (1.3)	234	16	1	3.7	0.3	489	5.5	5.8
cis nonachlor	1.0	240	57	1.5	10	1.0	234	0.9	2	3.6	0.3	421	0.5	1.1
Trans nonachlor	1.1	271	93	16	118	1.2	234	0.4	4	4.0	0.3	381	2.1	159
Oxychlordane	1.8	240	77	4.0	20	1.0	234	ND			0.4	381	0.8	2.5
DDD	24	271	1	33	70	9.6	234	ND			1.4	336	ND	
DDE	5.9	271	58	22	1,533	3.0	234	ND			0.7	381	13	90
DDT	0	271	ND			7.4	234	ND				421	0.2	14
α-HCH	2.5	271	99	22	341	0.9	234	0.4	1	1.2	0.4	489	4.7	11
γ-HCH	0.9	271	94	32	382	0.9	234	4.3	7	27	0.5 (2.8c)	489	16	35
Heptachlor	0.8	240	89	17	568	1.1	234	ND			0.4	264	2.7	49
Heptachlor epoxide	1.5	240	59	5.0	31	1.2	234	0.4	5	4.8	0.4	336	0.6	56
Mirex	1.5	240	7	2.9	54	1.1	234	13	2	3.7	0.1	336	2.7	628

APPENDIX Q - Overall detections and levels of analytes in gas phase (pg/m^3) at the three sites (separately)

	semi -rural			rural			backgroun/ semi-urban			**Three sites together**	
	Horn Point			**Lewes**			**Dover**			**Concentration**	
	% detect	Median	Max	% detect	Median	Max	% detect	Median	Max	min - max	% detection
Current use											
Acetochlor	20	7.7	674	14	7.4	3,569	23	8.6	1,015	20 - 3,570	20
Alachlor	58	33	1,974	15	4.6	380	30	5.3	236	13 - 1,980	38
Atrazine	80	101	2,752	**44**	**4.7**	**23,071**	43	5.3	7,015	13 - 23,000	61
CEAT	24	10.9	2,911	12	10	1,792	17	12	904	29 - 2,900	19
CIAT	20	5.4	617	15	5.2	1,186	23	6.0	1,008	12 - 1,200	19
Metolachlor	95	277	13,117	57	51	47,992	74	303	9,797	13 - 48,000	78
Metribuzin	**29**	**14.7**	**6,339**	13	14	1,295	17	16	680	26 - 6,340	24
Pendimethalin	9	8.3	1,442	8	7.8	4,264	32	9.3	21,841	65 - 22,000	13
Simazine	9	16	729	8	15	4,153	6	17	1,513	32 - 41,50	8.1
Trifluralin	77	21	347	**97**	**181**	**12,384**	100	313	5,686	8 - 12,400	88
Chlorothalonil	91	634	8,252	**100**	**585**	**17,176**	62	214	2,819	90 - 17,200	90
a_endosulfan	**95**	**62**	**962**	96	44	969	96	52	4,806	1 - 4,800	95
b_endosulfan	**58**	**6.8**	**274**	63	2.9	81	77	5.0	517	1 - 520	63
Endosulfan_sulfate	**48**	**1.2**	**541**	84	3.3	24	66	2.8	72	1 - 540	64
TotEndo	95	78	1,048	96	48	1,050	96	62	5,322		
Chlorpyrifos	88	46	1,029	95	46	2,457	91	38	718	1 - 2,500	91
Chlorpyrifos_oxon	3	8.3	129	19	8.2	45	nd			11 - 130	8
Diazinon	64	51	651	**78**	**61**	**1,224**	85	35	552	4 - 1,200	73
Fipronil	nd			14	0.3	39	11	0.4	6.8	1 - 40	8
g_HCH	95	29	226	100	28	382	81	36	342	1 - 400	95
Malathion	15	2.6	295	23	2.5	2,860	6	2.6	39	4 - 2,900	16

bolded letters indicate that the levels were statistically higher ($p<0.05$) than at the other sites

APPENDIX Q (*contd.*) - Overall detections and levels of analytes in the gas phase (pg/m^3) at the three sites (separately)

	semi -rural			rural			backgroun/ semi-urban			**Three sites together**	
	Horn Point			**Lewes**			**Dover**			**Concentration**	
	% detect	Median	Max	% detect	Median	Max	% detect	Median	Max	min - max	% detection
Historical											
Aldrin	1	0.6	2.5	nd			nd			2.5	single sample
Dieldrin	**71**	**41**	**394**	98	32	314	81	38	263	2 - 400	95
Cyanazine	26	57	1,903	nd			nd			150 - 1,900	12
DDD	2.3	12	70	nd			nd			25 - 70	1
DDE	28	3.0	67	84	18	1,533	**89**	**61**	**230**	5 - 1,500	58
DDT	nd			nd			nd				nd
TotDDT	29	13	137	84	20	1,533	**89**	**74**	**230**		
a_chlordane	91	19	167	96	20	127	96	19	120	3 - 170	93
g_chlordane	89	20	179	99	24	155	98	23	90	2 - 180	94
cis_nonachlor	23	0.5	3.1	**88**	**2.1**	**10**	49	0.9	6.9	1 - 10	57
Oxychlordane	59	2.2	13	86	3.5	14	57	2.7	20	1 - 20	77
Trans_nonachlor	89	16	118	96	16	103	96	15	76	2 - 120	93
a_HCH	**98**	**22**	**341**	100	19	61	100	23	53	2 - 340	99
Heptachlor	70	12	568	95	18	64	72	10	92	3 - 570	90
Heptachlor epoxide	44	1.3	31	60	2.8	14	**57**	**4.2**	**28**	1 - 30	60
Mirex	nd			14	0.5	54	9	0.8	16	1 - 50	7
BDE-47	27	10	26	**99**	**169**	**671**	72	11	52		
BDE 99	35	5.3	26	**99**	**26**	**178**	49	3.2	17		
BDE 100	1	5.4	5.4	**81**	**15**	**73**	2	1.9	5		
BDE 154	nd			nd			nd				
TotBDE	39	12	57	**100**	**215**	**912**	77	20	64		

bolded letters indicate that the levels were statistically higher ($p<0.05$) than at the other sites

APPENDIX R - Yearly detection patterns and combined concentration levels (2000-2003) in precipitation in the Delmarva Peninsula

	% Detections						Concentrations in the Peninsula			
	2000	2001	2002	2003	Total		mean	median	max	min
N	68	85	176	180	n	%				
Current Use Pesticides (CUPs)										
Acetochlor	10.0	14.1	18.1	14.5	75	15.1	102.4	63.9	954.4	5.2
Alachlor	*24.3*	*21.2*	*19.2*	*6.9*	*81*	*16.3*	*73.2*	*41.0*	*486.0*	*5.3*
Atrazine	31.4	47.1	40.1	30.2	183	36.9	137.7	79.0	898.0	4.7
CEAT	0	0	0.6	0.6	2	0.4	252.7	252.7	295.3	210.1
CIAT	12.9	22.4	19.2	6.3	72	14.7	92.0	59.9	892.8	3.4
Chlorothalonil	88.6	81.2	79.7	95.0	378	86.2	240.6	80.7	5,569	2.5
Chlorpyrifos	14.3	41.2	62.1	47.2	166	46.8	7.1	3.0	176.8	0.4
Chlorpyrifos Oxon	0.0	4.7	4.0	10.1	27	5.5	122.2	26.3	1,753	4.4
Diazinon	1.4	5.9	43.5	39.6	142	29.7	90.8	41.7	1,266	2.4
a-endosulfan	12.9	48.2	18.1	56.0	135	34.8	5.5	2.0	53.9	0.0
b-endosulfan	28.6	56.5	32.8	71.7	236	48.9	5.8	2.4	148.0	0.0
endosulfan sulfate	8.6	20.0	35.0	62.3	177	37.5	5.2	2.5	64.5	0.1
Fipronil	0	0	32.8	34.0	57	22.8	9.3	4.7	59.5	0.4
g-HCH	15.7	12.9	26.6	32.7	76	24.6	4.7	2.3	35.5	0.5
Metolachlor	54.3	62.4	47.5	59.7	268	55.0	137.2	62.0	1,500	0.8
Metribuzin	0	2.4	1.7	0	5	1.0	375.5	160.8	1,270	8.8
Malathion	7.1	5.9	15.3	13.2	56	11.8	25.2	11.3	358.2	0.9
Pendimethalin	12.9	11.8	15.3	10.1	62	12.6	79.5	35.2	1,134	2.8
Simazine	17.1	0	12.4	1.9	37	7.5	92.4	64.7	499.7	11.6
Trifluralin	***0***	***15.3***	***41.8***	***69.8***	173	40.3	7.2	2.4	112.2	0.2

APPENDIX R (*contd.*)- Yearly detection patterns and combined concentration levels (2000-2003) in precipitation in the Delmarva Peninsula

	% Detections						Concentrations in the Peninsula			
	2000	2001	2002	2003	Total		mean	median	max	min
N	68	85	176	180	n	%				
Historical Use Pesticides (HUPs)										
Aldrin	0	0	0.6	0	1	0.2	2.7	2.7	2.7	2.7
Dieldrin	0	0	15.3	13.8	53	10.0	1.7	1.3	9.8	0.1
44'-DDD	0	0	0	0.0	0	0.0				
Cyanazine	0	0	0	3.8	6	1.2	2,112	2,029	3,920	456
a-chlordane	0	10.6	1.7	9.4	27	5.5	1.4	1.0	6.1	0.4
g-chlordane	0	2.4	0.0	16.4	27	5.7	1.7	1.5	5.8	0.5
Cis-nonachlor	0	0	0	0.0	2	0.0	0.9	0.9	1.1	0.7
Trans-nonachlor	0	0	0	4.4	8	1.4	21.0	1.3	158.9	0.6
Oxychlordane	0	0	3.4	1.3	3	1.6	1.9	2.3	2.5	0.9
44'-DDE	0	0	0.0	32.1	51	10.4	16.5	9.7	89.8	2.3
44'-DDT	0	0	0.6	0	1	0.2	13.9	13.9	13.9	13.9
a-HCH	1.4	0	11.9	4.4	23	5.9	1.6	0.9	11.0	0.2
Heptachlor	0.0	0	3.4	0.6	7	1.4	26.7	24.8	48.9	1.3
Heptachlor epoxide	0	0	1.1	0.6	2	0.6	37.0	37.0	56.4	17.6
Mirex	0	0	0.6	2.5	9	1.0	167.7	57.4	628.3	3.0
PBDEs										
BDE 47		0	12.4	4.4	27	5.9	11.0	2.1	144.5	0.3
BDE 100		0	1.1	0.0	10	0.4	13.1	4.4	47.0	0.4
BDE 99		0	2.8	3.1	2	2.0	5.2	5.2	9.8	0.7
BDE 154		0	0.6	0.0	1	0.2	1.9	1.9	1.9	1.9

APPENDIX S - Yearly summary of levels of CUPs in precipitation at semi rural site (HP)

			2000			2001		
Pesticide	**MDL**	**Percent detection**	**Concentration**		**Flux**	**Concentration**		**Flux**
			range	average		range	average	
	ng/L		ng/L	ng/L	$\mu g/m^2$	ng/L	ng/L	$\mu g/m^2$
a-endosulfan	0.23	31	1.3-30.7	0.8	0.5	0.4-5.2	1.2	0.6
b-endosulfan	0.22	47	0.3-81.0	2.4	1.5	0.4-7.7	1.6	0.8
chlorothalonil	1.60	92	12.4-2011.0	128.2	80.8	5.6-509.9	85.6	41.2
chlorpyrifos	0.45	39	1.0-28.8	1.0	0.6	0.5-8.9	1.2	0.7
chlorpyrifos oxon	2.03	3	1.3-651.23	4.6	2.9	2.7-74.6	8.1	3.7
diazinon	1.96	20	12.8	0.3	0.2	10.1-39.2	0.5	0.2
endosulfan sulfate	0.50	34	1.0-14.3	0.4	0.3	0.9-3.4	0.6	0.3
g-HCH	0.54	25	1.5-22.4	0.8	0.5	0.3-7.1	1.2	0.5
malathion	0.88	7.4	1.9-358.2	1.5	0.9	31.5	0.2	0.2
acetochlor	1.30	17	13.6-164.6	2.1	1.3	19.8-84.9	6.6	3.1
alachlor	1.30	25	9.5-448.9	15.7	9.9	7.7-486.0	13.7	6.3
atrazine	1.30	44	21.8-895.6	43.6	27.4	4.7-521.7	26.4	12.1
CEAT	2.10	0.0	ND	NA	NA	ND	NA	NA
CIAT	1.80	18	20.9-131.6	4.6	2.9	11.4-144.6	7.8	3.6
metolachlor	1.20	66	4.3-997.9	52.7	33.1	11-371	37.6	17.3
pendimethalin	1.20	12	20.4-82.7	4.8	3.0	11.7-95.8	3.7	2.2
simazine	2.00	24.0	18-499.7	16.2	10.2	‡	‡	‡
trifluralin	0.37	17	ND	NA	NA	0.2-7.4	0.1	0.1
Total					176			93

‡ data not available due to interfering ions

APPENDIX S (*contd.*)- Yearly summary of levels of CUPs in precipitation at semi rural site (HP)

	2002			2003		
Pesticide	**Concentration**		**Flux**	**Concentration**		**Flux**
	range ng/L	average ng/L	µg/m^2	range ng/L	average ng/L	µg/m^2
a-endosulfan	0.1-2.4	0.3	0.1	0.2-1.4	0.4	0.4
b-endosulfan	0.1-2.4	0.6	0.2	0.3-11.0	2.0	1.5
chlorothalonil	6.1-1086.5	78.2	30.1	2.0-381.2	91.2	61.7
chlorpyrifos	0.4-176.8	4.5	1.8	0.7-17.1	2.3	1.3
chlorpyrifos oxon	ND	NA	NA	4.4-48.3	1.5	1.3
diazinon	3.1-147.6	6.2	2.4	10.0-158.9	18.4	14.6
endosulfan sulfate	0.2-7.5	0.9	0.3	0.7-4.2	0.7	0.9
g-HCH	0.3-6.3	0.8	0.3	0.67-3.6	0.3	0.3
malathion	7.3	0.1	0.0	4.2-82.8	5.9	1.8
acetochlor	50.1-356.5	20.3	7.8	11.4-219.4	14.0	11.2
alachlor	6.2-150.8	15.1	5.8	5.3-73.4	3.4	2.7
atrazine	20.9-468.5	35.2	13.6	10.1-798.3	18.5	15.1
CEAT	ND	NA	NA	ND	NA	NA
CIAT	12.7-261.2	11.6	4.5	3.4-17.9	0.8	0.7
metolachlor	1.4-585.3	51.4	19.8	0.8-803.4	40.2	32.1
pendimethalin	14.4-147.4	4.5	1.7	2.8-75.8	4.3	3.5
simazine	19.2-156.7	4.0	1.6	55.0-130.9	6.0	4.8
trifluralin	0.1-12.1	0.3	0.1	0.2-23.8	1.2	0.8
Total			90			155

‡ data not available due to interfering ions

APPENDIX T - Yearly summary of levels of CUPs in precipitation at the rural site (LD)

Pesticide	MDL	2001			2002			2003		
		Concentration		Flux	Concentration		Flux	Concentration		Flux
		range	average		range	average		range	average	
	ng/L	ng/L	$\mu g/m^2$	$\mu g/m^2$	ng/L	ng/L	$\mu g/m^2$	ng/L	ng/L	$\mu g/m^2$
a-endosulfan	0.23	0.50-15	0.90	0.38	0.6-1.3	0.15	0.06	0.7-47	0.60	0.43
a-HCH	0.40	ND	NA	NA	0.2-1.8	0.21	0.09	0.2-11	0.10	0.04
b-endosulfan	0.22	0.42-21	2.2	0.88	0.04-10	1.1	0.46	0.04-78	1.10	0.80
chlorothalonil	1.60	3.7-995	101	41	3.6-396	65	26.66	2.5-5570	55	38.65
chlorpyrifos	0.45	0.52-45	1.7	0.7	0.4-12	2.3	0.96	2.3-40	1.3	0.90
chlorpyrifos oxon	2.03	14-273	64	26	ND	NA	NA	ND	NA	NA
diazinon	1.96	18-118	1.50	0.60	6-181	19	7.92	0.01-13	14.2	10.01
endosulfan sulfate	0.50	0.90-11	1.1	0.46	0.1-8	1.0	0.42	1.2-64	1.1	0.79
g-HCH	0.54	0.55-16	0.43	0.18	0.8-5.3	0.4	0.17	1.9-35	0.80	0.58
malathion	0.88	9.5	0.30	0.11	4.2-53	3.3	1.36	4.0-6.3	0.20	0.12
acetochlor	1.30	36-220	6.8	2.8	19-954	13	5.19	15-248	3.8	2.68
alachlor	1.30	30-96	3.3	1.4	27-244	13	5.29	99	0.20	0.15
atrazine	1.30	6.8-710	22	8.8	13-898	42	17.32	6.1-311	6.4	4.50
CEAT	2.10	ND	NA	NA	ND	NA	NA	210.00	1.8	1.24
CIAT	1.80	44-250	12	5.0	42-353	11	4.52	142-298	2.3	1.64
metolachlor	1.20	2.3-500	21	8.8	13-1500	58	23.53	9.6-1190	12.5	8.77
pendimethalin	1.20	87-235	10	4.2	24-163	8.4	3.42	7.3-182	1.3	0.92
simazine	2.00	‡	‡	‡	44-292	10.5	4.26	ND	NA	NA
trifluralin	0.37	0.30-17	0.7	0.31	0.4-25	0.7	0.27	0.6-112	1.9	1.31
Total				102			102			74

APPENDIX U - Yearly summary of levels of CUPs in precipitation at the background site (DV)

Pesticide	2002			2003		
	Concentration		Flux	Concentration		Flux
	range ng/L	average ng/L	$\mu g/m^2$	range ng/L	average ng/L	$\mu g/m^2$
Acetochlor	5.2-80.9	13.2	6.9	14.9-506.3	9.2	5.2
Alachlor	13.9-36.7	9.0	4.7	15.3-72.1	1.9	1.1
Atrazine	6.7-376.6	39.3	20.5	16.2-863.74	20.4	11.6
CEAT	295.31	4.0	2.1	ND	NA	NA
CIAT	13.3-151.6	19.0	9.9	10.9-203.9	3.3	1.9
Metolachlor	1.6-476.7	65.8	34.2	2.8-995.3	41.4	23.5
Pendimethalin	3.236-91.6	17.0	8.9	22.2-1134.4	104.1	59.1
Simazine	11.60-134.51	17.0	8.8	ND	NA	NA
Trifluralin	0.34-27.0	1.4	0.7	0.7-49.5	5.7	3.2
a-endosulfan	0.19-3.2	1.1	0.6	0.8-53.9	6.0	3.4
b-endosulfan	0.28-6.1	1.5	0.8	0.9-148.0	13.1	7.5
Chlorothalonil	9.1-765.9	90.6	47.1	35.2-135.5	749.6	425.2
Chlorpyrifos	0.72-22.8	3.1	1.6	1.0-135.5	9.7	5.5
Chlorpyrifos Oxon	9.23-45.1	7.8	4.1	8.8-1752.7	99.9	56.7
Diazinon	10.3-742.6	21.0	10.9	7.5-270.5	41.8	23.7
endosulfan sulfate	0.45-4.1	0.4	0.2	0.9-41.0	4.8	2.8
g-HCH	0.54-3.9	1.1	0.6	1.0-34.7	3.7	2.1
Malathion	2.4-44.3	7.5	3.9	6.3-46.7	5.3	3.0
Total			1,120			635

APPENDIX V - Results of multiple linear (and non-linear) regressions for pesticides in gas phase at HP

CUPs	Alachlor	Atrazine	CEAT	CIAT	Metolachlor	Metribuzin	Trifluralin	CHTHNL	CLPYFS	a-Endo	b-Endo	Endo sulfate	Diazinon	lindane (g-HCH)
			Eq. 4.2-1	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$										
r^2 (p value)	0.39 (<0.0001)	0.37 (<0.0001)	0.36 (0.0021)	0.39 (0.003)	0.38 (<0.0001)	0.69 (<0.0001)		0.34 (<0.0001)	0.47 (<0.0001)	0.50 (<0.0001)	0.21 (0.0002)	0.42 (<0.0001)	0.11 (0.01)	0.37 (<0.0001)
ΔH (kJ/mol)	29 ± 10	33 ± 10	13 ± 19	24 ± 24	29 ± 9	ns		61 ± 8.0	67 ± 9.0	70 ± 7.0	ns	(-23) ± 17	26 ± 8.4	30 ± 6.4
$t_{1/2}$ (yr)	1.2 ± 0.2	1.0 ± 0.1	(-0.5) ± 0.1	1 ± 0.3	0.9 ± 0.1	0.6 ± 0.1		15 ± 25	13 ± 1.2	1.6 ± 0.3	1.6 ± 0.4	1.1 ± 0.2	15 ± 25	1.5 ± 0.2
			Eq. 4.2-2	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$										
r^2 (p value)	0.43 (<0.0001)	0.43 (<0.0001)	0.36 (0.0039)	0.55 (0.004)	0.45 (<0.0001)	0.69 (<0.0001)		0.34 (<0.0001)	0.49 (<0.0001)	0.50 (<0.0001)	0.20 (0.0007)	0.44 (<0.0001)	0.13 (0.06)	0.39 (<0.0001)
ΔH (kJ/mol)	23 ± 11	29 ± 10	11 ± 22	33 ± 25	21 ± 10	ns		57 ± 9.0	70 ± 10	68 ± 8.0	ns	(-22) ± 20	21 ± 9	26 ± 6.8
$t_{1/2}$ (yr)	1.1 ± 0.2	1.0 ± 0.1	(-0.5) ± 0.1	1.2 ± 0.4	0.9 ± 0.1	0.6 ± 0.1		13 ± 20	14 ± 1.2	1.6 ± 0.3	1.8 ± 0.5	1.3 ± 0.3	17 ± 31	1.5 ± 2.1
cos (WD)	ns	-0.42	ns	ns	-0.57	ns		ns	ns	ns	ns	ns	ns	ns
sin(WD)	ns	ns	ns	ns	ns	ns		ns	ns	ns	ns	ns	ns	-0.28
WS	ns	ns		1.5	ns	ns		ns	ns	ns	ns	ns	ns	ns
			Eq. 4.2-3	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + \frac{a_3}{1+\left(\frac{t_a - a_5}{a_6}\right)}$										
r^2 (p value)	0.46 (<0.0001)	0.42 (<0.0001)	0.51 (0.0023)	0.73 (<0.0001)		0.73 (<0.0001)		0.36 (<0.0001)	0.51 (<0.0001)	0.56 (<0.0001)	0.55 (<0.0001)	0.50 (<0.0001)	0.14 (0.036)	0.51 (<0.0001)
ΔH (kJ/mol)	14 ± 12	28 ± 10	29 ± 19	66 ± 21		ns		45 ± 9.0	57 ± 10	37 ± 13	62 ± 15	41 ± 18	46 ± 16	24 ± 7
$t_{1/2}$ (yr)	1.3 ± 0.3	1.0 ± 0.1	(-0.5) ± 0.1	1.3 ± 0.4		0.7 ± 0.1		ns	ns	1.6 ± 0.3	1.5 ± 2.7	1.1 ± 0.2	ns	1.5 ± 11
a_3	1.0	1.0	1.6	2.3		ns		ns	1.4	1.6	3.1	-0.8	ns	1.1
a_5 (d)	175	142	120	121		174		211	201	215	315	135	194	139
a_6 (d)	ns	ns	ns	ns		ns		ns	ns	52	35	ns	ns	45

APPENDIX V (*contd.*) - Results of multiple linear (and non-linear) regressions for pesticides in gas phase at HP

HUPs	a-HCH	DDE	Dieldrin	a-chlordane	g-chlordane	cis-nonachlor	trans-nonachlor	oxychlor	HEPT	HEPTX
				Eq. 4.2-1	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$					
r^2 (p value)	0.47 (<0.0001)	0.24 (0.01)	0.51 (<0.0001)	0.38 (<0.0001)	0.39 (<0.0001)	0.70 (<0.0001)	0.4 (<0.0001)	0.57 (<0.0001)	0.39 (<0.0001)	0.56 (<0.0001)
ΔH (kJ/mol)	(-9.8)	26 ± 0.8	69 ± 8	37 ± 5.9	35 ± 5.8	59 ± 7.4	43 ± 6.6	43 ± 4.7	25 ± 7	58 ± 8.2
$t_{1/2}$ (yr)	1.2 ± 0.1	3.7 ± 2.4	(-1.5) ± 0.3	2.2 ± 0.4	2.0 ± 0.3	2.6 ± 0.8	2.8 ± 0.6	3.5 ± 1.0	1.7 ± 0.4	1.5 ± 0.3
				Eq. 4.2-2	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$					
r^2 (p value)	0.49 (<0.0001)	0.34 (0.02)	0.52 (<0.0001)	0.39 (<0.0001)	0.39 (<0.0001)	0.81 (<0.0001)	0.40 (<0.0001)	0.60 (<0.0001)	0.34 (<0.0001)	0.57 (<0.0001)
ΔH (kJ/mol)	(-9.8)	23 ± 8	67 ± 8	38 ± 6	35 ± 6	63 ± 7	43 ± 6	41 ± 5	21 ± 7	57 ± 9
$t_{1/2}$ (yr)	1.1 ± 0.1	3.1 ± 1.7	(-1.5) ± 0.3	2.1 ± 0.4	2.0 ±0.3	2.2 ± 0.5	2.8 ± 0.6	3.3 ± 0.9	1.6 ± 0.4	1.5 ± 0.3
cos (WD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
sin(WD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
WS	ns	ns	ns	ns	ns	0.3	ns	ns	ns	ns

APPENDIX W - Results of multiple linear (and non linear) regressions for pesticides in gas phase at LD

CUPs	Alachlor	Atrazine	CEAT	CIAT	Metolachlor	Metribuzin	Trifluralin	CHTHNL	CLPYFS	a-Endo	b-Endo	Endo sulfate	Diazinon	lindane (g-HCH)
			Eq. 4.2-1		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$									
r^2 (p value)		ns			ns		0.26 (<0.0001)	0.24 (<0.0001)	0.35 (<0.0001)	0.54 (<0.0001)	0.24 (0.0004)	0.37 (<0.0001)	0.424 (<0.0001)	0.29 (<0.0001)
ΔH (kJ/mol)							57 ± 12	47 ± 9	82 ± 12	103 ± 10	65 ± 13	38 ± 6	93 ± 13	51 ± 9
$t_{1/2}$ (yr)							(-1.5) ± 0.5	ns	ns	ns	ns	ns	ns	ns
			Eq. 4.2-2		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$									
r^2 (p value)		ns			ns		0.27 (0.0001)	0.27 (<0.0001)	0.43 (<0.0001)	0.54 (<0.0001)	0.34 (0.0009)	0.42 (<0.0001)	0.47 (<0.0001)	0.32 (<0.0001)
ΔH (kJ/mol)							51 ± 13	50 ± 10	76 ± 12	101 ± 11	54 ± 16	38 ± 6	88 ± 14	52 ± 9
$t_{1/2}$ (yr)							(-1.9) ± 1.1	ns	ns	ns	ns	ns	ns	ns
cos (WD)							ns	ns	ns	ns	ns	ns	-0.46	ns
sin(WD)							ns	ns	ns	ns	ns	ns	ns	ns
WS							ns	ns	-0.7	ns	ns	ns	ns	ns
			Eq. 4.2-3		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + \frac{a_3}{1 + \left(\frac{t_a - a_5}{a_6}\right)}$									
r^2 (p value)		0.36 (<0.0001)			0.42 (<0.0001)		0.52 (<0.0001)	0.31 (<0.0001)	0.42 (<0.0001)	0.66 (<0.0001)	0.48 (<0.0001)	0.44 (<0.0001)	0.52 (<0.0001)	0.59 (<0.0001)
ΔH (kJ/mol)		ns			ns		ns	38 ± 10	ns	36 ± 16	ns	ns	89 ± 19	33 ± 10
$t_{1/2}$ (yr)		ns			ns		(-1.9) ± 0.7	ns	ns	ns	ns	ns	ns	ns
a_3		2.8			4.0		3.7	1.1	2.5	3.9	3.4	0.9	ns	2.2
a_5 (d)		101			127		181	169	200	203	204	205	149	159
a_6 (d)		ns			ns		89	ns	63	76	71	ns	ns	61

ENDIX W (*contd.*) - Results of multiple linear (and non linear) regressions for pesticides in gas phase at LD

HUPs	a-HCH	DDE	Dieldrin	a-chlordane	g-chlordane	cis-nonachlor	trans-nonachlor	oxychlor	HEPT	HEPTX
		Eq. 4.2-1		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$						
r^2 (p value)	0.17 (<0.0001)	0.37 (<0.0001)	0.41 (<0.0001)	0.48 (<0.0001)	0.51 (<0.0001)	0.49 (<0.0001)	0.49 (<0.0001)	0.35 (<0.0001)	0.25 (<0.0001)	0.16 (0.01)
ΔH (kJ/mol)	21 ± 5	52 ± 7.8	69 ± 9	52 ± 6	56 ± 6	38 ± 4.5	55 ± 6	30 ± 5	27 ± 5	24 ± 8
$t_{1/2}$ (yr)	ns	ns	ns	ns	ns	(-5.2) ± 2.5	ns	ns	ns	ns
		Eq. 4.2-2		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$						
r^2 (p value)	0.17 (0.0063)	0.41 (<0.0001)	0.43 (<0.0001)	0.52 (<0.0001)	0.53 (<0.0001)	0.53 (<0.0001)	0.52 (<0.0001)	0.39 (<0.0001)	0.27 (<0.0001)	0.23 (0.03)
ΔH (kJ/mol)	19 ± 5	45 ± 7	65 ± 1	49 ± 6	53 ± 6	36 ± 5	52 ± 6	26 ± 5	25 ± 5	21 ± 8
$t_{1/2}$ (yr)	ns	ns	ns	ns	ns	ns	ns	ns	ns	1.5 ± 0.3
cos (WD)	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
sin(WD)	ns	ns	ns	ns	ns	ns	ns	ns	0.21	ns
WS	ns	ns	-0.42	-0.31	ns	-0.25	-0.29	-0.29	ns	ns

APPENDIX X - Results of multiple linear (and non-linear) regressions for pesticides in gas phase at DV

CUPs	Alachlor	Atrazine	CEAT	CIAT	Metolachlor	Metribuzin	Trifluralin	CHTHNL	CLPYFS	a-Endo	b-Endo	Endo sulfate	Diazinon	lindane (g-HCH)
			Eq. 4.2-1	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$										
r^2 (p value)		ns		ns	ns		0.62 (<0.0001)	0.24 (0.030)	0.23 (0.0057)	0.44 (<0.0001)	0.20 (0.0275)	0.22 (0.0316)	0.27 (0.0029)	ns
ΔH (kJ/mol)							99 ± 16	ns	64 ± 20	104 ± 22	ns	ns	37 ± 18	
$t_{1/2}$ (yr)							(-0.5) ± 0.1	(-1.2) ± 0.5	ns	ns	(-0.7) ± 0.3	(-0.9) ± 0.4	(-0.9) ± 0.4	
			Eq. 4.2-2	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$										
r^2 (p value)		ns		ns	ns		0.67 (0.0001)	ns	0.50 (<0.0001)	0.50 (<0.0001)	0.36 (0.0153)	ns	0.43 (0.0012)	ns
ΔH (kJ/mol)							102 ± 17		77 ± 19	114 ± 25	ns		ns	
$t_{1/2}$ (yr)							(-0.5) ± 0.1		ns	(-0.8) ± 0.4	(-0.5) ± 0.2		(-0.9) ± 0.4	
cos (WD)							ns		ns	ns	-0.783		ns	
sin(WD)							ns		-0.582	-0.579	ns		-0.6026	
WS							ns		1.38	ns	ns		ns	
			Eq. 4.2-3	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + \frac{a_3}{1+\left(\frac{t_a - a_5}{a_6}\right)}$										
r^2 (p value)		0.52 (0.0457)			ns		0.75 (<0.0001)		0.31 (0.0137)	0.68 (<0.0001)	0.62 (<0.0001)	0.59 (0.0003)		0.42 (0.0025)
ΔH (kJ/mol)		102 ± 28					ns		ns	107 ± 17	55 ± 22	ns		ns
$t_{1/2}$ (yr)		ns					(-0.6) ± 0.2		ns	ns	ns	(-2.8) ± 3.0		ns
a_3		ns					ns		1.5	4.5	4.4	2.9		ns
a_5 (d)		204					179		209	239	241	241		175
a_6 (d)		ns					ns		ns	10	-14	8.4		ns

APPENDIX X (*contd.*) - Results of multiple linear (and non-linear) regressions for pesticides in gas phase at DV

HUPs	a-HCH	DDE	Dieldrin	a-chlordane	g-chlordane	cis-nonachlor	trans-nonachlor	oxychlor	HEPT	HEPTX
	Eq. 4.2-1		$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t$							
r^2 (p value)	0.32 (0.0002)	0.61 (<0.0001)	0.35 (0.0006)	0.53 (<0.0001)	0.59 (<0.0001)	ns	0.59 (<0.0001)	0.23 (0.0430)	ns	0.49 (0.0003)
ΔH (kJ/mol)	14 ± 6	69 ± 10	67 ± 17	52 ± 10	52 ± 8		64 ± 10	ns		33 ± 13
$t_{1/2}$ (yr)	(-1.9) ± 0.6	ns	ns	(-1.3) ± 0.5	(-1.3) ± 0.4		(-1.2) ± 0.4	ns		(-0.8) ± 0.2
	Eq. 4.2-2	$\ln P = a_0 + a_1\left(\frac{1}{T}\right) + a_2 t + b_1(\cos WD) + b_2(\sin WD) + b_3(LnWS)$								
r^2 (p value)	0.36 (0.0019)	0.67 (<0.0001)	0.42 (0.0029)	0.62 (<0.0001)	0.66 (<0.0001)	ns	0.67 (<0.0001)	0.39 (0.0483)	ns	0.50 (0.0082)
ΔH (kJ/mol)	18 ± 7	76 ± 11	60 ± 21	54 ± 10	57 ± 9		69 ± 11	ns		36 ± 16
$t_{1/2}$ (yr)	(-1.9) ± 0.6	(-1.7) ± 0.8	ns	(-1.2) ± 0.4	(-1.2) ± 0.3		(-1.1) ± 0.3	ns		(-0.7) ± 0.2
cos (WD)	ns	ns	ns	ns	ns		ns	ns		ns
sin(WD)	ns	-0.258	ns	-0.338	-0.304		-0.375	ns		ns
WS	ns	ns	ns	ns	ns		ns	ns		ns

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.
4/18/00	109	109	785.5	282.1	11.39	54.26	7.05	4.30	224.31	9.85	186.68	51.66	687.56	13.29	7.55
4/25/00	116	116	776.7	281.5	8.26	63.42	7.14	4.35	117.36	9.97	4.97	52.25	450.36	13.44	7.63
5/2/00	123	123	772.8	288.3	4.79	136.1	7.17	4.37	296.39	10.02	5.00	52.51	853.01	13.51	7.67
5/9/00	130	130	776.8	299.6	7.26	234.7	7.13	4.35	2032.00	9.96	616.93	52.24	13117.50	13.44	7.63
5/16/00	137	137	1054.3	291.6	5.48	202.07	472.11	177.17	669.91	7.34	258.49	38.49	4497.07	9.90	5.62
5/23/00	144	144	793.7	293.2	8.64	229.58	102.49	298.24	1074.72	9.75	339.23	51.13	2900.29	13.15	7.47
5/30/00	151	151	773.9	287.5	7.16	85.01	7.16	4.36	403.72	10.00	4.99	52.44	858.57	13.49	7.66
6/6/00	158	158	767.2	290.2	12.97	74.12	7.22	4.40	103.46	10.09	5.03	52.90	135.81	13.61	7.73
6/13/00	165	165	775.2	292.3	5.99	128.57	7.15	169.98	425.77	9.99	4.98	52.35	1203.07	13.47	7.65
6/20/00	172	172	789.1	296.2	4.83	198.5	7.02	382.04	477.48	9.81	4.89	51.43	886.55	13.23	7.51
6/27/00	179	179	781.7	298.7	4.79	239.48	7.09	447.50	533.05	9.90	4.94	51.92	1130.02	13.36	7.58
7/4/00	186	186	876.4	300.2	5.21	245.05	6.32	315.38	286.45	8.83	4.41	46.31	498.61	11.91	6.76
7/11/00	193	193	856.9	295.1	4.52	134.94	6.47	226.75	205.45	9.03	4.51	47.36	363.43	12.18	6.92
7/18/00	200	200	777.1	299.9			7.13	4.35	203.85	9.96	4.97	52.23	460.91	13.43	7.63
7/25/00	207	207	720.8	294.8	6.96	101.38	7.69	229.75	241.78	10.74	5.36	56.30	725.87	14.48	8.22
8/1/00	214	214	716.3	301.3	7.02	240.22	7.74	4.71	4.60	10.81	5.39	56.65	87.75	14.57	8.28
9/12/00	256	256	429.6	299.3	5.97	226.21	12.90	7.86	1319.92	18.02	8.99	94.46	3008.97	24.30	13.80
9/19/00	263	263	418.2	296.0	6.15	238.8	13.25	8.07	1126.86	18.51	9.24	97.04	1936.12	24.96	14.18
9/26/00	270	270	416.5	287.2	8.76	64.89	237.40	333.94	445.24	18.58	9.27	97.43	696.53	25.06	14.23
10/3/00	277	277	422.9	296.4	5.36	237.48	13.10	7.98	1462.87	18.30	9.13	95.95	1888.57	24.68	14.02
10/10/00	284	284	416.5	285.5	8.23	283.07	13.30	8.11	345.99	18.58	9.27	97.43	947.54	25.06	14.23
10/17/00	291	291	415.7	291.1	5.37	104.14	13.33	8.12	1140.05	18.62	9.29	97.63	1625.29	25.12	14.26
10/24/00	298	298	417.1	286.1	2.14	174.48	13.29	8.10	972.03	18.56	9.26	97.29	1423.89	25.03	14.21
10/31/00	305	305	434.3	284.5	8.69	99.37	12.76	7.78	440.55	17.82	8.89	93.45	520.71	24.04	13.65
11/7/00	312	312	416.3	283.7	2.3	171.3	13.31	8.11	7.91	18.60	9.28	97.49	1701.17	25.08	14.24
11/14/00	319	319	427.2	281.6	12.09	326.13	12.97	7.90	249.39	18.12	9.04	95.00	644.42	24.44	13.88
11/21/00	326	326	415.2	273.8	15.45	324.06	13.35	8.13	210.82	18.64	9.30	97.73	174.13	25.14	14.28
11/28/00	333	333	427.4	280.6	4.98	219.11	12.97	7.90	433.10	18.11	9.04	94.96	668.00	24.43	13.87
12/5/00	340	340	415.9	276.9	10.48	249.68	13.32	8.12	132.60	18.61	9.29	97.57	209.25	25.10	14.25
12/12/00	347	347	417.9	275.0	14.05	210.91	13.26	8.08	271.27	18.52	9.24	97.10	394.60	24.98	14.18
12/19/00	354	354	415.4	274.6	12.75	301.14	13.34	8.13	358.59	18.63	9.30	97.69	1300.15	25.13	14.27
5/15/01	135	501	725.9	289.2	6.15	216.29	7.63	125.41	870.15	10.66	105.20	209.87	532.52	1059.05	8.17
5/22/01	142	508	717.9	292.5	7.21	178.78	46.82	102.25	267.03	56.63	64.76	294.22	252.00	1533.69	8.26
5/29/01	149	515	718.2	292.1	6.26	255.96	7.72	72.76	91.90	28.60	5.38	347.35	187.56	1705.66	8.25
6/5/01	156	522	717.6	295.2	4.58	228.32	7.72	309.02	319.26	247.42	66.99	340.63	398.27	6338.93	8.26
6/12/01	163	529	717.9	299.6	4.88	241.69	31.58	497.20	261.25	10.78	49.79	636.58	290.52	2620.95	8.26
6/19/01	170	536	719.1	298.3	5.21	230.33	59.77	668.39	270.29	81.82	55.30	658.98	1454.17	2260.80	8.24
6/26/01	177	543	717.6	297.6	3.87	258.05	7.72	1974.01	111.45	10.79	5.38	56.56	847.45	1181.38	8.26
7/3/01	184	550	717.6	296.3	5.52	220.32	7.72	426.02	139.01	10.79	5.38	514.11	791.94	2062.88	1183.03
7/10/01	191	557	717.9	298.8	6.62	240.33	7.72	254.81	143.37	99.87	5.38	495.78	494.67	1644.79	8.26
7/17/01	198	564	717.6	299.8	5.03	209.38	7.72	155.68	102.71	119.31	5.38	56.56	5840.23	1789.32	8.26
7/24/01	205	571	717.6	301.0	8.45	244.97	7.72	4.71	77.86	10.79	5.38	56.56	152.07	1337.69	8.26
7/31/01	212	578	717.6	294.7	2.92	178.35	7.72	40.65	79.78	10.79	5.38	535.54	194.52	2001.96	8.26
8/7/01	219	585	717.6	301.6	6.12	285.83	7.72	66.34	118.07	10.79	5.38	172.17	291.80	2246.01	8.26
8/14/01	226	592	730.1	296.9	4.3	94.04	7.59	27.29	56.03	10.60	5.29	55.58	107.95	740.67	8.12

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.
8/21/01	233	599	725.9	296.0	4.88	269.23	7.63	87.89	243.05	46.30	5.32	55.90	446.85	1840.80	8.17
8/28/01	240	606	717.9	298.7	5.03	209.95	7.72	35.42	297.09	10.78	43.91	56.53	588.00	1911.23	8.26
9/4/01	247	613	717.9	297.4	7.03	173.35	7.72	74.17	266.40	10.78	41.75	56.53	537.64	1539.68	8.26
9/11/01	254	620	721.7	297.5	5.4	139.15	7.68	4.68	151.05	10.72	28.94	56.23	237.95	1449.67	8.21
9/18/01	261	627	784.8	291.8	3.21	168.56	7.06	4.30	120.02	44.24	44.05	51.71	245.13	1064.41	7.55
9/25/01	268	634	721.8	288.8	8.46	212.88	7.68	29.55	44.49	10.72	5.35	196.38	84.46	1020.77	8.21
10/2/01	275	641	675.6	291.7	4.08	249.83	127.50	42.72	66.50	11.46	11.62	60.07	217.34	1188.32	8.77
10/9/01	282	648	671.1	284.0	4.09	197.01	8.26	5.03	67.72	11.53	5.75	149.10	276.55	829.24	8.83
10/16/01	289	655	696.2	287.3	10.35	264.95	7.96	50.03	97.71	58.56	5.55	58.29	331.58	586.14	8.51
10/23/01	296	662	642.2	294.5	6.66	210.93	8.63	29.99	33.71	12.05	6.01	63.19	117.69	650.48	9.23
10/30/01	303	669	642.5	284.1	4.37	125.87	8.63	33.48	139.15	12.05	6.01	179.09	555.28	1157.27	9.23
11/6/01	310	676	642.0	283.5	9.2	322.51	8.63	30.22	53.59	12.06	6.02	204.53	194.58	1341.85	9.23
11/13/01	317	683	646.2	280.1	3.82	176.57	8.58	5.23	116.52	11.98	5.98	62.80	404.67	764.77	9.17
3/5/02	64	795	949.6	283.5	13.15	327.66	5.84	3.56	3.47	93.69	4.07	42.74	58.70	10.99	6.24
3/12/02	71	802	922.9	281.9	3.42	144.12	6.00	48.86	54.61	85.13	4.18	1084.67	208.46	11.31	121.99
3/19/02	78	809	718.1	280.6	6.87	140.23	7.72	4.70	14.79	165.04	5.38	642.01	77.41	14.54	8.25
3/26/02	85	816	717.5	278.9	7.68	181.73	7.72	4.71	767.45	10.79	5.38	784.66	2182.42	14.55	8.26
4/2/02	92	823	718.1	289.7	11.24	201.89	7.72	66.52	1571.84	226.75	5.38	765.07	2505.86	14.54	8.25
4/9/02	99	830	718.1	290.3	7.81	198.73	7.72	67.41	222.94	169.79	85.18	935.94	403.06	14.54	8.25
4/16/02	106	837	718.1	297.3	4.13	203.62	120.92	390.03	303.56	893.18	103.49	1902.91	1061.99	14.54	8.25
4/23/02	113	844	703.8	283.6	8.88	246.18	7.87	57.04	4.68	11.00	55.16	57.67	90.06	14.83	8.42
4/30/02	120	851	773.9	287.3	5.96	230.64	66.82	80.40	20.83	545.15	4.99	52.44	200.50	13.49	7.66
5/7/02	127	858	773.3	294.0	5.26	245.92	7.17	103.55	270.46	1275.39	4.99	52.48	719.70	13.50	182.05
5/14/02	134	865	718.1	287.5	14	303.92	7.72	20.30	4.59	95.18	5.38	56.51	37.15	14.54	8.25
5/21/02	141	872	713.9	285.4	6.69	233.03	7.76	91.03	4.61	873.86	5.41	56.84	130.01	14.62	8.30
5/28/02	148	879	718.1	295.2	4.65	178.15	168.27	286.53	2752.44	833.05	309.69	56.51	7501.19	14.54	65.21
6/4/02	155	886	718.1	297.4	9.4	201.31	53.99	59.56	1394.44	687.44	177.38	724.66	1210.71	14.54	354.24
6/11/02	162	893	739.5	300.5	8.34	237.9	7.49	163.99	1358.93	228.91	193.02	54.88	2274.71	14.12	8.02
6/18/02	169	900	704.0	295.6	4.2	150.2	7.87	103.89	26.01	92.04	5.49	1896.08	472.23	14.83	8.42
6/25/02	176	907	722.6	302.3	5.54	174.45	7.67	4.67	4.56	10.71	5.34	1134.36	18.68	14.45	8.20
7/2/02	183	914	739.8	301.6	4.49	187.28	7.49	105.12	318.27	238.44	59.34	54.85	816.60	14.11	8.01
7/9/02	190	921	725.0	301.2	6.43	278.68	7.64	93.54	247.84	10.68	43.09	55.97	686.46	14.40	8.18
7/16/02	197	928	718.4	298.3	4.7	186.37	7.71	4.70	62.40	10.77	5.38	56.49	199.23	14.53	8.25

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.
7/23/02	204	935	718.1	300.0	6.61	142.71	7.72	107.18	115.19	343.24	5.38	56.51	426.24	14.54	8.25
7/30/02	211	942	718.1	302.0	7.35	268.64	7.72	43.47	4.59	114.95	5.38	56.51	6.74	14.54	8.25
8/6/02	218	949	719.0	295.9	10.27	31.17	7.71	73.01	36.19	2910.57	5.37	56.44	146.91	14.52	8.24
8/13/02	225	956	718.1	301.8	4.84	170.27	7.72	49.29	262.33	189.05	5.38	56.51	736.01	14.54	8.25
8/20/02	232	963	718.1	300.1	7.44	167.1	7.72	69.89	71.17	288.29	5.38	56.51	258.03	14.54	8.25
8/27/02	239	970	718.1	297.2	4.45	119.74	7.72	56.35	4.59	10.78	5.38	1578.22	6.74	14.54	8.25
9/3/02	246	977	718.1	298.1	5.06	233.82	7.72	122.62	153.73	197.44	5.38	1068.79	491.50	14.54	8.25
9/10/02	253	984	718.1	298.6	6.19	179.45	7.72	44.48	4.59	10.78	5.38	56.51	6.74	14.54	8.25
9/17/02	260	991	718.1	293.6	3.15	223.26	7.72	132.76	71.69	10.78	5.38	56.51	286.70	14.54	8.25
9/24/02	267	998	718.1	292.7	4.93	167.97	7.72	81.46	60.94	10.78	5.38	56.51	313.84	14.54	8.25
10/1/02	274	1005	718.1	295.4	4.26	235.36	7.72	73.93	231.22	10.78	5.38	56.51	640.79	14.54	8.25
10/8/02	281	1012	718.4	287.4	3.92	93.63	7.71	91.82	24.43	10.77	5.38	56.49	256.29	14.53	8.25
10/15/02	288	1019	718.1	288.0	9.38	79.37	7.72	39.80	41.06	296.87	5.38	56.51	220.17	14.54	8.25
10/22/02	295	1026	718.1	282.8	2.94	213.35	7.72	49.75	23.28	10.78	5.38	56.51	147.86	14.54	8.25
10/29/02	302	1033	718.1	278.8	8.45	65.28	7.72	55.98	20.01	10.78	5.38	56.51	139.42	14.54	8.25
11/5/02	309	1040	718.1	281.9	5.49	188.49	7.72	4.70	28.80	10.78	5.38	56.51	222.48	14.54	8.25
11/12/02	316	1047	718.1	283.9	9.29	34.32	7.72	42.15	47.39	10.78	5.38	56.51	272.11	14.54	8.25
11/19/02	323	1054	719.0	279.6	3.77	206.02	7.71	57.52	4.58	10.77	5.37	56.44	143.97	14.52	8.24
11/26/02	330	1061	719.0	279.4	6.82	191.35	7.71	113.00	29.19	10.77	5.37	56.44	172.25	14.52	8.24
3/31/03	90	1186	711.9	276.9	8.7	284.17	7.78	4.74	4.63	10.87	5.42	57.00	14.90	14.66	8.33
4/1/03	91	1187	804.1	286.1	7.41	250.5	6.89	4.20	4.10	9.63	4.80	50.47	18.58	193.79	7.37
4/2/03	92	1188	847.2	292.2	6.17	210.74	6.54	3.99	3.89	9.14	4.56	47.90	48.82	416.00	7.00
4/3/03	93	1189	711.9	287.1	6.21	117.01	7.78	4.74	4.63	10.87	5.42	57.00	96.05	2433.73	8.33
4/8/03	98	1194	759.0	277.0	7.6	79.15	7.30	4.45	4.34	10.20	5.09	53.46	6.38	13.75	7.81
4/15/03	105	1201	711.9	293.0	6.2	218.05	7.78	4.74	12.70	10.87	5.42	57.00	103.13	14.66	8.33
4/22/03	112	1208	711.9	286.0	10.68	325.08	7.78	4.74	4.63	10.87	5.42	57.00	19.17	14.66	8.33
4/29/03	119	1215	711.9	290.0	4.36	217.04	42.31	4.74	4.63	10.87	5.42	57.00	31.98	14.66	8.33
5/6/03	126	1222	711.9	287.3	3.03	212.54	194.81	24.37	117.90	10.87	5.42	57.00	347.42	14.66	8.33
5/13/03	133	1229	711.9	288.2	11.24	288.96	159.73	13.61	4.63	10.87	5.42	57.00	68.22	14.66	8.33
5/20/03	140	1236	711.9	291.0	4.54	193.86	417.34	4.74	113.13	10.87	5.42	57.00	125.33	14.66	8.33
5/27/03	147	1243	712.2	287.4	2.68	179.26	7.78	4.74	29.98	10.87	5.42	56.98	91.66	14.66	8.32
6/3/03	154	1250	711.9	290.8	5.16	182.63	135.04	21.00	129.83	10.87	14.50	57.00	333.12	14.66	8.33
6/10/03	161	1257	711.9	296.6	5.23	187.98	84.08	4.74	99.91	10.87	22.99	57.00	245.71	14.66	8.33
6/17/03	168	1264	710.2	290.1	4.88	119.03	7.80	4.76	97.58	10.90	13.38	57.15	277.28	14.70	8.35
6/23/03	174	1270	714.9	297.8	6.1	321.31	7.75	12.91	38.15	10.83	5.40	56.77	46.41	40.02	8.29
6/24/03	175	1271	711.9	297.8	4.64	293.33	7.78	4.74	88.63	10.87	5.42	169.03	89.18	151.47	8.33
6/25/03	176	1272	711.9	299.5	4.91	300.27	7.78	4.74	91.92	10.87	32.14	385.15	124.73	14.66	8.33
6/26/03	177	1273	711.9	300.6	4.41	276.69	674.02	43.44	101.46	10.87	5.42	385.93	161.57	14.66	8.33
7/1/03	182	1278	712.2	296.6	3.15	174.22	7.78	68.43	152.84	10.87	5.42	56.98	1548.71	14.66	1441.94
7/8/03	189	1285	711.9	299.7	5.19	280.31	7.78	4.74	57.36	10.87	5.42	57.00	123.69	14.66	8.33
7/15/03	196	1292	711.9	298.3	5.5	177.86	191.38	4.74	64.99	10.87	5.42	57.00	333.34	316.97	8.33
7/22/03	203	1299	711.9	297.6	5.87	230.65	125.78	4.74	58.98	10.87	5.42	150.22	151.97	52.93	8.33
7/29/03	210	1306	711.9	295.8	4.12	123.47	7.78	4.74	4.63	10.87	5.42	146.32	6.80	14.66	8.33
8/5/03	217	1313	711.9	296.5	4.08	209.83	310.87	47.08	4.63	10.87	5.42	57.00	55.51	402.33	8.33
8/12/03	224	1320	711.9	298.9	2.97	152.78	57.88	58.35	4.63	10.87	5.42	316.76	95.81	14.66	322.43
8/19/03	231	1327	711.9	296.9	2.52	189.98	229.92	28.11	43.71	10.87	5.42	167.64	72.03	85.51	129.62
8/26/03	238	1334	711.9	297.8	4.77	272.45	7.78	109.97	4.63	10.87	5.42	203.14	53.70	209.16	192.50
9/2/03	245	1341	707.2	297.0	4.86	137.06	244.93	4.77	37.27	10.95	5.46	57.39	86.53	51.50	8.38
9/9/03	252	1348	711.9	291.9	8.22	76.13	178.32	4.74	4.63	10.87	5.42	57.00	29.03	14.66	103.52
9/16/03	259	1355	711.9	292.9	5.67	101.72	119.43	59.43	4.63	10.87	5.42	57.00	6.80	14.66	8.33
9/29/03	272	1368	711.9	288.8	9.67	330.75	7.78	4.74	4.63	10.87	5.42	57.00	14.83	14.66	181.70

for pesticides, conc. < mdl have been replaced by 0.5*mdl

Metlchlr : metolachlor

Merbzn : metribuzin

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan
4/18/00	109	109	785.5	282.1	11.39	54.26	14.55	119.62	10.84	2.71	0.00	29.46	37.73	89.34	0.53	6.79
4/25/00	116	116	776.7	281.5	8.26	63.42	14.72	14.52	69.96	67.09	0.00	37.00	189.32	69.89	0.54	33.22
5/2/00	123	123	772.8	288.3	4.79	136.1	14.79	3.66	11.02	2.76	0.00	27.54	120.01	69.22	0.54	14.17
5/9/00	130	130	776.8	299.6	7.26	234.7	334.66	3.64	10.96	2.74	0.00	36.27	147.98	42.46	0.54	18.53
5/16/00	137	137	1054.3	291.6	5.48	202.07	10.84	2.68	8.08	2.02	0.00	10.66	53.28	33.96	0.40	6.27
5/23/00	144	144	793.7	293.2	8.64	229.58	14.40	3.57	10.73	2.68	0.00	44.41	143.06	44.70	0.53	18.86
5/30/00	151	151	773.9	287.5	7.16	85.01	14.77	3.66	11.01	2.75	0.00	13.91	39.42	83.36	0.54	6.80
6/6/00	158	158	767.2	290.2	12.97	74.12	14.90	25.32	11.10	2.78	0.00	14.61	32.50	67.76	0.54	7.12
6/13/00	165	165	775.2	292.3	5.99	128.57	14.75	7.97	10.99	2.75	0.00	24.56	43.60	73.17	0.54	10.52
6/20/00	172	172	789.1	296.2	4.83	198.5	14.49	3.59	10.79	2.70	0.00	21.35	100.11	22.08	0.53	13.54
6/27/00	179	179	781.7	298.7	4.79	239.48	14.62	7.51	10.90	2.72	0.00	42.93	247.58	35.65	0.53	33.81
7/4/00	186	186	876.4	300.2	5.21	245.05	153.69	3.23	9.72	2.43	0.00	33.89	344.87	44.20	0.48	41.04
7/11/00	193	193	856.9	295.1	4.52	134.94	13.34	3.30	9.94	2.49	0.00	34.90	174.37	53.86	0.49	25.74
7/18/00	200	200	777.1	299.9			14.71	11.94	10.96	2.74	0.00	65.60	878.76	81.43	0.54	104.73
7/25/00	207	207	720.8	294.8	6.96	101.38	15.86	25.89	11.82	2.95	0.00	36.70	171.39	118.37	0.58	31.08
8/1/00	214	214	716.3	301.3	7.02	240.22	15.96	3.95	11.89	2.97	0.00	0.92	21.03	1.24	0.58	0.64
9/12/00	256	256	429.6	299.3	5.97	226.21	728.80	6.59	19.83	4.96	0.00	117.95	665.24	166.72	0.97	128.79
9/19/00	263	263	418.2	296.0	6.15	238.8	27.34	27.22	20.37	5.09	0.00	145.42	364.83	255.90	1.00	59.93
9/26/00	270	270	416.5	287.2	8.76	64.89	27.44	35.10	20.45	5.11	0.00	98.90	163.28	340.86	1.00	166.74
10/3/00	277	277	422.9	296.4	5.36	237.48	27.03	6.69	20.14	5.04	0.00	166.76	644.51	232.89	0.99	273.70
10/10/00	284	284	416.5	285.5	8.23	283.07	27.44	6.80	20.45	5.11	0.00	32.05	113.83	242.71	1.00	95.39
10/17/00	291	291	415.7	291.1	5.37	104.14	27.50	6.81	20.49	5.12	0.00	41.15	103.37	182.89	1.00	79.52
10/24/00	298	298	417.1	286.1	2.14	174.48	27.40	6.79	20.42	5.11	0.00	41.03	83.79	199.53	1.00	76.32
10/31/00	305	305	434.3	284.5	8.69	99.37	26.32	6.52	19.61	4.90	0.00	62.09	244.16	310.17	0.96	81.28
11/7/00	312	312	416.3	283.7	2.3	171.3	27.46	6.80	20.46	5.12	0.00	67.69	140.46	167.18	1.00	141.38
11/14/00	319	319	427.2	281.6	12.09	326.13	26.76	6.63	19.94	4.99	0.00	108.50	425.78	176.40	0.98	130.26
11/21/00	326	326	415.2	273.8	15.45	324.06	27.53	6.82	20.51	5.13	0.00	1.59	31.26	166.86	1.00	62.64
11/28/00	333	333	427.4	280.6	4.98	219.11	26.75	6.62	19.93	4.98	0.00	27.81	61.82	118.49	0.98	23.54
12/5/00	340	340	415.9	276.9	10.48	249.68	27.48	6.81	20.48	5.12	0.00	1.59	25.67	142.89	1.00	1.10
12/12/00	347	347	417.9	275.0	14.05	210.91	27.35	6.77	20.38	5.10	0.00	1.58	29.09	147.20	1.00	1.10
12/19/00	354	354	415.4	274.6	12.75	301.14	27.52	6.81	20.50	5.13	0.00	97.59	33.84	111.32	1.00	1.10
5/15/01	135	501	725.9	289.2	6.15	216.29	85.58	29.82	11.73	12.51	0.00	8.61	41.64	20.26	0.57	6.41
5/22/01	142	508	717.9	292.5	7.21	178.78	92.00	89.66	11.87	2.97	0.00	16.94	57.11	22.85	0.58	4.85
5/29/01	149	515	718.2	292.1	6.26	255.96	15.92	38.43	11.86	2.97	0.00	13.56	39.80	19.72	0.58	0.64
6/5/01	156	522	717.6	295.2	4.58	228.32	128.88	25.17	11.87	2.97	0.00	14.05	67.51	27.01	0.58	12.65
6/12/01	163	529	717.9	299.6	4.88	241.69	53.37	41.60	11.87	2.97	0.00	44.95	92.62	21.69	0.58	7.65
6/19/01	170	536	719.1	298.3	5.21	230.33	32.11	20.32	11.85	2.96	0.00	25.37	95.99	20.99	0.58	9.28
6/26/01	177	543	717.6	297.6	3.87	258.05	15.93	51.98	11.87	2.97	0.00	28.90	153.88	16.42	0.58	10.87
7/3/01	184	550	717.6	296.3	5.52	220.32	15.93	34.05	11.87	2.97	0.00	22.09	143.43	18.95	0.58	9.95
7/10/01	191	557	717.9	298.8	6.62	240.33	15.92	30.94	11.87	2.97	0.00	29.52	277.76	31.72	0.58	26.87
7/17/01	198	564	717.6	299.8	5.03	209.38	15.93	112.49	11.87	2.97	0.00	36.32	431.97	27.76	0.58	42.70
7/24/01	205	571	717.6	301.0	8.45	244.97	15.93	21.66	11.87	2.97	0.00	25.03	123.98	11.85	0.58	12.85
7/31/01	212	578	717.6	294.7	2.92	178.35	15.93	9.21	11.87	2.97	0.00	18.42	123.75	19.75	0.58	10.08
8/7/01	219	585	717.6	301.6	6.12	285.83	15.93	64.48	11.87	2.97	0.00	42.23	380.30	28.99	0.58	39.62
8/14/01	226	592	730.1	296.9	4.3	94.04	15.66	28.67	11.67	2.92	0.00	24.59	147.31	15.84	0.57	14.02

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan
8/21/01	233	599	725.9	296.0	4.88	269.23	15.75	39.34	11.73	2.93	0.00	23.09	255.65	21.64	0.57	17.76
8/28/01	240	606	717.9	298.7	5.03	209.95	15.92	38.02	11.87	2.97	0.00	31.45	194.08	21.61	0.58	28.06
9/4/01	247	613	717.9	297.4	7.03	173.35	15.92	56.49	11.87	17.32	0.00	27.15	211.67	30.59	0.58	27.02
9/11/01	254	620	721.7	297.5	5.4	139.15	15.84	16.90	11.80	10.88	0.00	20.66	86.69	22.33	0.58	9.39
9/18/01	261	627	784.8	291.8	3.21	168.56	14.57	21.28	10.85	2.71	0.00	12.40	103.87	21.07	0.53	13.03
9/25/01	268	634	721.8	288.8	8.46	212.88	15.84	3.92	11.80	2.95	0.00	15.41	25.69	38.29	0.58	0.63
10/2/01	275	641	675.6	291.7	4.08	249.83	16.92	4.19	12.61	8.20	0.00	18.68	44.05	31.10	0.62	4.43
10/9/01	282	648	671.1	284.0	4.09	197.01	17.03	4.22	12.69	3.17	0.00	7.79	28.40	42.83	0.62	0.68
10/16/01	289	655	696.2	287.3	10.35	264.95	16.42	4.07	12.23	3.06	0.00	0.95	0.65	5.30	0.60	0.66
10/23/01	296	662	642.2	294.5	6.66	210.93	17.80	11.51	13.26	3.32	0.00	1.03	7.57	10.98	0.65	0.71
10/30/01	303	669	642.5	284.1	4.37	125.87	17.79	4.41	13.26	11.41	0.00	8.36	20.61	28.69	0.65	0.71
11/6/01	310	676	642.0	283.5	9.2	322.51	17.81	10.08	13.27	3.32	0.00	6.08	12.42	21.26	0.65	0.71
11/13/01	317	683	646.2	280.1	3.82	176.57	17.69	4.38	13.18	3.30	0.00	5.54	15.01	18.32	0.65	0.71
3/5/02	64	795	949.6	283.5	13.15	327.66	12.04	18.09	8.97	2.24	0.00	3.90	10.07	17.40	0.44	0.48
3/12/02	71	802	922.9	281.9	3.42	144.12	12.39	51.23	9.23	2.31	0.00	10.58	29.79	16.39	0.45	0.50
3/19/02	78	809	718.1	280.6	6.87	140.23	15.92	32.03	11.86	12.02	0.00	10.05	19.83	20.33	0.58	0.64
3/26/02	85	816	717.5	278.9	7.68	181.73	15.93	119.07	11.87	13.00	0.00	14.03	43.48	21.70	0.58	0.64
4/2/02	92	823	718.1	289.7	11.24	201.89	15.92	54.70	11.86	10.92	0.00	13.41	38.08	18.67	0.58	0.64
4/9/02	99	830	718.1	290.3	7.81	198.73	15.92	84.08	11.86	12.16	0.00	17.64	37.39	19.90	0.58	0.64
4/16/02	106	837	718.1	297.3	4.13	203.62	15.92	16.36	11.86	29.97	0.00	31.90	107.84	14.37	0.58	8.20
4/23/02	113	844	703.8	283.6	8.88	246.18	16.24	22.83	12.10	3.03	0.00	4.01	11.42	15.47	0.59	0.65
4/30/02	120	851	773.9	287.3	5.96	230.64	14.77	19.30	11.01	2.75	0.00	8.73	27.73	14.82	0.54	0.59
5/7/02	127	858	773.3	294.0	5.26	245.92	14.78	66.04	11.01	2.75	0.00	22.76	129.18	17.37	0.54	9.62
5/14/02	134	865	718.1	287.5	14	303.92	15.92	24.26	11.86	6.95	0.00	5.10	14.58	33.11	0.58	0.64
5/21/02	141	872	713.9	285.4	6.69	233.03	16.01	23.83	11.93	9.06	0.00	6.77	27.57	21.43	0.58	0.64
5/28/02	148	879	718.1	295.2	4.65	178.15	249.37	55.37	11.86	13.91	0.00	16.68	74.47	13.15	2.48	0.64
6/4/02	155	886	718.1	297.4	9.4	201.31	197.82	15.87	11.86	11.03	0.00	12.44	31.69	17.71	0.58	0.64
6/11/02	162	893	739.5	300.5	8.34	237.9	525.62	23.37	11.52	27.14	0.00	41.74	176.28	21.28	0.56	20.55
6/18/02	169	900	704.0	295.6	4.2	150.2	16.24	19.27	12.10	3.02	0.00	11.31	104.07	9.43	0.59	0.65
6/25/02	176	907	722.6	302.3	5.54	174.45	15.82	11.64	11.79	38.72	0.00	42.68	181.93	9.66	0.58	19.83
7/2/02	183	914	739.8	301.6	4.49	187.28	15.45	10.11	11.51	2.88	0.00	34.64	209.12	26.10	0.56	18.30
7/9/02	190	921	725.0	301.2	6.43	278.68	15.77	51.74	11.75	2.94	0.00	37.83	330.11	27.05	0.58	35.35
7/16/02	197	928	718.4	298.3	4.7	186.37	15.91	13.92	11.86	15.59	0.00	27.85	214.97	27.07	0.58	14.43

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan
7/23/02	204	935	718.1	300.0	6.61	142.71	15.92	94.23	11.86	23.16	0.00	34.00	279.22	17.21	0.58	21.68
7/30/02	211	942	718.1	302.0	7.35	268.64	15.92	25.33	11.86	2.97	0.00	0.92	5.40	10.53	0.58	0.64
8/6/02	218	949	719.0	295.9	10.27	31.17	15.90	20.58	11.85	7.55	0.00	9.26	160.26	25.60	0.58	13.94
8/13/02	225	956	718.1	301.8	4.84	170.27	15.92	23.76	11.86	2.97	0.00	40.19	962.12	18.19	0.58	86.11
8/20/02	232	963	718.1	300.1	7.44	167.1	15.92	32.21	11.86	29.35	0.00	47.71	229.25	25.84	0.58	24.76
8/27/02	239	970	718.1	297.2	4.45	119.74	15.92	13.92	11.86	2.97	0.00	0.92	0.63	10.92	0.58	0.64
9/3/02	246	977	718.1	298.1	5.06	233.82	15.92	12.76	11.86	19.20	0.00	34.78	181.29	26.21	0.58	16.00
9/10/02	253	984	718.1	298.6	6.19	179.45	15.92	25.19	11.86	2.97	0.00	0.92	0.63	8.29	0.58	0.64
9/17/02	260	991	718.1	293.6	3.15	223.26	15.92	12.76	11.86	2.97	0.00	21.33	83.48	18.90	0.58	9.73
9/24/02	267	998	718.1	292.7	4.93	167.97	15.92	15.19	11.86	13.30	0.00	19.02	66.48	25.98	0.58	9.72
10/1/02	274	1005	718.1	295.4	4.26	235.36	15.92	10.76	11.86	2.97	0.00	20.46	57.66	13.97	0.58	9.46
10/8/02	281	1012	718.4	287.4	3.92	93.63	15.91	20.78	11.86	9.77	0.00	10.23	25.22	25.63	0.58	0.64
10/15/02	288	1019	718.1	288.0	9.38	79.37	15.92	45.69	11.86	12.85	0.00	15.08	25.90	30.40	0.58	0.64
10/22/02	295	1026	718.1	282.8	2.94	213.35	15.92	9.22	11.86	9.48	0.00	9.26	18.35	13.94	0.58	0.64
10/29/02	302	1033	718.1	278.8	8.45	65.28	15.92	35.70	11.86	7.53	0.00	8.29	11.52	16.43	0.58	0.64
11/5/02	309	1040	718.1	281.9	5.49	188.49	15.92	32.50	11.86	13.12	0.00	12.96	20.64	24.73	0.58	0.64
11/12/02	316	1047	718.1	283.9	9.29	34.32	15.92	36.11	11.86	11.74	0.00	14.37	20.76	20.37	0.58	0.64
11/19/02	323	1054	719.0	279.6	3.77	206.02	15.90	10.61	11.85	8.12	0.00	9.61	14.49	14.17	0.58	0.64
11/26/02	330	1061	719.0	279.4	6.82	191.35	15.90	13.14	11.85	8.78	0.00	6.86	10.22	15.06	0.58	0.64
3/31/03	90	1186	711.9	276.9	8.7	284.17	16.06	22.00	11.96	2.99	0.00	8.86	15.11	12.94	0.59	0.64
4/1/03	91	1187	804.1	286.1	7.41	250.5	14.22	12.35	10.59	2.65	0.00	3.49	0.57	6.62	0.52	0.57
4/2/03	92	1188	847.2	292.2	6.17	210.74	13.49	19.29	10.05	2.51	0.00	13.22	24.26	5.75	0.49	0.54
4/3/03	93	1189	711.9	287.1	6.21	117.01	16.06	99.69	11.96	22.67	0.00	20.24	22.33	19.03	0.59	0.64
4/8/03	98	1194	759.0	277.0	7.6	79.15	15.06	18.34	11.22	2.81	0.00	10.30	26.11	7.15	0.55	0.60
4/15/03	105	1201	711.9	293.0	6.2	218.05	16.06	30.44	11.96	2.99	0.00	6.24	15.56	6.00	0.59	0.64
4/22/03	112	1208	711.9	286.0	10.68	325.08	16.06	20.62	11.96	2.99	0.00	7.35	16.22	6.18	0.59	0.64
4/29/03	119	1215	711.9	290.0	4.36	217.04	16.06	17.40	11.96	2.99	0.00	5.62	8.85	4.61	0.59	0.64
5/6/03	126	1222	711.9	287.3	3.03	212.54	16.06	27.25	11.96	2.99	0.00	7.95	12.57	11.70	0.59	0.64
5/13/03	133	1229	711.9	288.2	11.24	288.96	16.06	3.98	11.96	2.99	0.00	0.93	0.64	1.25	0.59	0.64
5/20/03	140	1236	711.9	291.0	4.54	193.86	16.06	30.85	11.96	2.99	0.00	15.46	32.83	18.37	0.59	0.64
5/27/03	147	1243	712.2	287.4	2.68	179.26	16.05	75.21	11.96	2.99	0.00	10.91	63.43	7.72	0.59	0.64
6/3/03	154	1250	711.9	290.8	5.16	182.63	16.06	16.24	32.67	2.99	0.00	15.87	34.05	10.39	0.59	0.64
6/10/03	161	1257	711.9	296.6	5.23	187.98	16.06	346.55	11.96	2.99	0.00	20.84	24.16	25.26	0.59	0.64
6/17/03	168	1264	710.2	290.1	4.88	119.03	16.10	86.66	11.99	3.00	0.00	29.54	164.75	21.49	0.59	5.75
6/23/03	174	1270	714.9	297.8	6.1	321.31	15.99	55.42	11.91	2.98	0.00	27.51	180.37	22.03	0.58	10.45
6/24/03	175	1271	711.9	297.8	4.64	293.33	16.06	96.29	11.96	2.99	0.00	65.23	282.50	31.34	0.59	14.62
6/25/03	176	1272	711.9	299.5	4.91	300.27	16.06	47.69	11.96	2.99	0.00	42.35	104.71	11.17	0.59	8.17
6/26/03	177	1273	711.9	300.6	4.41	276.69	16.06	46.94	11.96	2.99	0.00	22.98	43.25	22.15	0.59	4.31
7/1/03	182	1278	712.2	296.6	3.15	174.22	16.05	38.02	11.96	2.99	0.00	20.56	68.04	17.78	0.59	4.23
7/8/03	189	1285	711.9	299.7	5.19	280.31	16.06	28.42	11.96	2.99	0.00	19.86	73.73	14.24	0.59	2.51
7/15/03	196	1292	711.9	298.3	5.5	177.86	16.06	28.53	24.97	2.99	0.00	22.59	178.44	18.89	0.59	15.73
7/22/03	203	1299	711.9	297.6	5.87	230.65	16.06	160.08	11.96	2.99	0.00	54.99	217.94	41.25	0.59	14.05
7/29/03	210	1306	711.9	295.8	4.12	123.47	16.06	54.81	11.96	2.99	0.00	22.43	128.65	24.33	0.59	13.18
8/5/03	217	1313	711.9	296.5	4.08	209.83	16.06	30.71	11.96	12.28	0.00	16.77	104.38	27.60	0.59	8.12
8/12/03	224	1320	711.9	298.9	2.97	152.78	16.06	60.29	11.96	20.06	0.00	29.02	156.42	23.09	0.59	12.84
8/19/03	231	1327	711.9	296.9	2.52	189.98	16.06	62.04	11.96	2.99	0.00	23.13	52.31	28.99	0.59	5.45
8/26/03	238	1334	711.9	297.8	4.77	272.45	16.06	58.43	11.96	2.99	0.00	11.42	43.14	35.00	0.59	2.64
9/2/03	245	1341	707.2	297.0	4.86	137.06	16.16	41.23	12.04	11.43	0.00	17.25	35.73	19.16	0.59	0.65
9/9/03	252	1348	711.9	291.9	8.22	76.13	16.06	17.95	11.96	27.73	0.00	10.03	11.95	24.96	0.59	0.64
9/16/03	259	1355	711.9	292.9	5.67	101.72	16.06	9.06	11.96	2.99	0.00	0.93	0.64	5.13	0.59	0.64
9/29/03	272	1368	711.9	288.8	9.67	330.75	16.06	3.98	11.96	2.99	0.00	0.93	0.64	3.57	0.59	0.64

for pesticides, conc. < mdl have been replaced by 0.5*mdl

Cyanzn.: cyanazin

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	CHTHNL	CLRPS	Chlorp. Oxon	Cis-nonachlor	Diazinon	Dieldrin	endo. sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Mlthn	Mirex
4/18/00	109	109	785.5	282.1	11.39	54.26	11.42	88.37	7.60	0.45	1.93	0.65	0.62	0.32	32.80	23.68	0.36	0.70	2.35	0.51
4/25/00	116	116	776.7	281.5	8.26	63.42	111.92	49.30	7.68	0.46	29.21	0.65	158.70	0.33	32.34	20.94	0.36	0.71	2.37	0.52
5/2/00	123	123	772.8	288.3	4.79	136.1	296.36	426.43	7.72	0.46	1.96	0.66	7.22	0.33	29.12	194.67	0.36	0.71	2.38	0.52
5/9/00	130	130	776.8	299.6	7.26	234.7	508.45	115.50	7.68	0.46	146.79	0.65	18.99	0.33	42.16	150.00	0.36	0.71	2.37	0.52
5/16/00	137	137	1054.3	291.6	5.48	202.07	109.44	221.22	5.66	0.34	15.33	0.48	0.46	0.24	11.07	85.57	0.27	0.52	1.75	0.38
5/23/00	144	144	793.7	293.2	8.64	229.58	199.29	840.27	7.52	0.45	93.19	0.64	8.02	0.32	48.63	110.52	0.35	0.70	120.04	0.51
5/30/00	151	151	773.9	287.5	7.16	85.01	214.64	49.97	7.71	0.46	1.96	0.66	0.63	0.33	13.86	54.48	0.36	0.71	2.38	0.52
6/6/00	158	158	767.2	290.2	12.97	74.12	11.69	149.69	7.78	0.46	51.31	0.66	0.63	0.33	15.53	55.85	0.37	0.72	2.40	0.52
6/13/00	165	165	775.2	292.3	5.99	128.57	1855.88	147.38	7.70	0.46	95.05	0.66	0.63	0.33	26.08	65.05	0.36	0.71	2.38	0.52
6/20/00	172	172	789.1	296.2	4.83	198.5	531.09	117.69	7.56	0.45	61.96	0.64	8.77	0.32	20.19	83.74	0.36	0.70	2.33	0.51
6/27/00	179	179	781.7	298.7	4.79	239.48	292.36	165.86	7.63	0.45	63.93	0.65	12.01	0.33	48.02	83.37	0.36	0.71	2.36	0.51
7/4/00	186	186	876.4	300.2	5.21	245.05	591.33	117.64	6.81	0.40	114.84	0.58	22.16	0.29	35.23	93.86	0.32	0.63	2.10	0.46
7/11/00	193	193	856.9	295.1	4.52	134.94	1275.86	115.24	6.96	0.41	133.78	0.59	22.51	0.30	38.26	65.91	0.33	0.64	2.15	0.47
7/18/00	200	200	777.1	299.9			2496.50	390.26	7.68	0.45	139.66	0.65	47.28	0.33	67.17	133.70	0.36	0.71	2.37	0.52
7/25/00	207	207	720.8	294.8	6.96	101.38	1182.02	152.13	8.28	0.49	46.48	0.70	19.67	0.35	38.44	52.00	0.39	0.77	2.56	0.56
8/1/00	214	214	716.3	301.3	7.02	240.22	12.52	0.42	8.33	0.49	2.12	0.71	9.43	0.36	0.98	10.10	0.39	0.77	2.57	0.56
9/12/00	256	256	429.6	299.3	5.97	226.21	8252.28	508.01	13.89	0.82	377.97	1.18	59.06	0.59	126.68	166.77	0.66	1.29	4.29	0.93
9/19/00	263	263	418.2	296.0	6.15	238.8	2506.35	788.96	14.27	0.85	515.51	1.21	37.74	0.61	169.15	187.39	0.67	1.32	4.40	0.96
9/26/00	270	270	416.5	287.2	8.76	64.89	384.61	271.52	14.33	0.85	118.33	1.22	23.28	0.61	89.28	78.62	0.68	1.33	4.42	0.96
10/3/00	277	277	422.9	296.4	5.36	237.48	3384.88	372.43	14.11	0.84	3.58	1.20	52.10	0.60	178.67	226.13	0.67	1.31	4.36	0.95
10/10/00	284	284	416.5	285.5	8.23	283.07	482.47	48.99	14.33	0.85	3.64	1.22	1.16	0.61	30.60	128.47	0.68	1.33	4.42	0.96
10/17/00	291	291	415.7	291.1	5.37	104.14	936.27	542.88	14.36	0.85	3.65	1.22	1.17	0.61	47.40	92.72	0.68	1.33	4.43	0.97
10/24/00	298	298	417.1	286.1	2.14	174.48	1472.06	46.55	14.31	0.85	3.63	1.22	28.04	0.61	44.71	39.42	0.68	1.32	4.42	0.96
10/31/00	305	305	434.3	284.5	8.69	99.37	945.90	118.29	13.74	0.81	3.49	1.17	276.77	0.59	68.93	54.88	0.65	1.27	4.24	0.92
11/7/00	312	312	416.3	283.7	2.3	171.3	1005.62	541.30	14.34	0.85	3.64	1.22	1.17	0.61	47.26	92.45	0.68	1.33	4.43	0.96
11/14/00	319	319	427.2	281.6	12.09	326.13	1246.93	67.51	13.97	0.83	3.55	1.19	541.19	0.60	100.39	37.59	0.66	1.29	4.31	0.94
11/21/00	326	326	415.2	273.8	15.45	324.06	257.80	0.73	14.37	0.85	3.65	1.22	1.17	0.61	1.68	31.09	0.68	1.33	4.44	0.97
11/28/00	333	333	427.4	280.6	4.98	219.11	358.75	35.86	13.96	0.83	3.55	1.19	1.14	0.60	32.69	0.79	0.66	1.29	4.31	0.94
12/5/00	340	340	415.9	276.9	10.48	249.68	21.57	0.73	14.35	0.85	3.64	1.22	1.17	0.61	1.68	22.92	0.68	1.33	4.43	0.96
12/12/00	347	347	417.9	275.0	14.05	210.91	21.46	0.72	14.28	0.85	3.63	1.22	1.16	0.61	1.67	49.64	0.67	1.32	4.41	0.96
12/19/00	354	354	415.4	274.6	12.75	301.14	225.13	38.65	14.37	0.85	3.65	1.22	1.17	0.61	111.38	66.00	0.68	1.33	4.43	0.97
5/15/01	135	501	725.9	289.2	6.15	216.29	1118.74	11.32	8.22	0.49	53.49	9.06	7.92	0.35	9.81	61.79	11.18	10.42	2.54	0.55
5/22/01	142	508	717.9	292.5	7.21	178.78	794.51	104.90	8.31	1.78	57.00	56.72	10.14	0.35	19.34	70.38	12.54	30.70	2.57	0.56
5/29/01	149	515	718.2	292.1	6.26	255.96	1656.64	45.53	8.31	1.50	41.36	55.78	10.89	0.35	14.45	55.61	12.11	17.85	2.57	0.56
6/5/01	156	522	717.6	295.2	4.58	228.32	2568.44	174.06	8.32	1.78	67.92	93.54	12.32	0.36	13.85	50.50	16.61	4.46	2.57	0.56
6/12/01	163	529	717.9	299.6	4.88	241.69	3291.56	232.62	8.31	2.67	94.60	146.41	8.65	0.35	96.55	65.17	567.58	21.05	12.93	0.56
6/19/01	170	536	719.1	298.3	5.21	230.33	3363.66	173.70	8.30	2.53	44.48	133.91	9.46	0.35	27.27	88.96	38.61	14.41	2.56	0.56
6/26/01	177	543	717.6	297.6	3.87	258.05	7890.28	61.57	8.32	2.54	247.01	62.55	14.21	0.36	43.17	53.35	108.93	8.45	2.57	0.56
7/3/01	184	550	717.6	296.3	5.52	220.32	3737.37	418.07	8.32	1.80	163.82	112.99	0.68	0.36	23.71	29.38	35.01	0.77	19.54	0.56
7/10/01	191	557	717.9	298.8	6.62	240.33	5230.85	167.94	8.31	2.55	87.86	159.82	7.66	0.35	32.39	62.16	27.72	12.41	7.90	0.56
7/17/01	198	564	717.6	299.8	5.03	209.38	7576.16	1028.57	8.32	3.07	253.81	127.96	10.01	0.36	39.91	48.97	39.80	30.46	182.20	0.56
7/24/01	205	571	717.6	301.0	8.45	244.97	5246.20	170.27	8.32	2.40	223.12	47.61	7.00	0.36	31.22	24.81	31.05	5.46	2.57	0.56
7/31/01	212	578	717.6	294.7	2.92	178.35	2852.19	38.70	8.32	1.52	39.87	51.94	0.68	0.36	18.49	17.50	22.94	5.92	2.57	0.56
8/7/01	219	585	717.6	301.6	6.12	285.83	4214.74	62.71	8.32	3.11	148.43	97.92	11.41	0.36	43.13	37.68	48.89	13.70	2.57	0.56
8/14/01	226	592	730.1	296.9	4.3	94.04	2192.63	39.56	8.17	1.64	83.30	49.47	4.39	0.35	25.27	19.45	14.32	5.18	0.76	0.55

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	CHTHNL	CLRPS	Chlorp. Oxon	Cis-nonachlor	Diazinon	Dieldrin	endo. sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Mlthn	Mirex
8/21/01	233	599	725.9	296.0	4.88	269.23	817.51	28.35	8.22	1.50	55.17	42.03	4.78	0.35	24.55	25.04	26.86	9.02	2.54	0.55
8/28/01	240	606	717.9	298.7	5.03	209.95	1349.77	129.36	8.31	2.27	172.88	87.72	9.47	0.35	33.99	32.10	33.13	12.38	2.57	0.56
9/4/01	247	613	717.9	297.4	7.03	173.35	1045.60	95.16	8.31	1.99	147.73	50.02	6.66	0.35	30.01	29.87	22.86	10.60	2.57	0.56
9/11/01	254	620	721.7	297.5	5.4	139.15	915.44	21.34	8.27	1.33	50.84	45.54	0.67	0.35	22.35	22.00	21.86	6.62	2.55	0.5558946
9/18/01	261	627	784.8	291.8	3.21	168.56	603.32	18.93	7.60	0.90	25.87	26.07	4.32	0.32	12.88	13.99	14.18	8.45	2.35	0.5112036
9/25/01	268	634	721.8	288.8	8.46	212.88	346.91	16.86	8.27	1.00	2.10	25.64	0.67	0.35	17.90	13.77	18.51	4.60	2.55	0.56
10/2/01	275	641	675.6	291.7	4.08	249.83	503.72	18.15	8.83	1.15	88.02	33.91	0.72	0.38	20.96	19.66	27.07	6.41	2.73	0.59
10/9/01	282	648	671.1	284.0	4.09	197.01	325.51	7.52	8.89	0.53	2.26	12.81	0.72	0.38	9.03	11.68	12.13	2.07	2.74	0.60
10/16/01	289	655	696.2	287.3	10.35	264.95	156.35	0.44	8.57	0.51	2.18	0.73	0.70	0.37	1.00	0.49	0.40	0.79	2.65	0.58
10/23/01	296	662	642.2	294.5	6.66	210.93	337.44	4.67	9.29	0.55	2.36	2.06	0.76	0.40	1.09	6.21	9.87	0.86	2.87	0.62
10/30/01	303	669	642.5	284.1	4.37	125.87	324.52	8.45	9.29	0.55	53.03	16.50	0.76	0.40	9.88	11.92	16.00	3.10	2.87	0.62
11/6/01	310	676	642.0	283.5	9.2	322.51	185.09	0.47	9.30	0.55	2.36	2.68	0.76	0.40	7.54	8.24	14.08	2.87	2.87	0.62
11/13/01	317	683	646.2	280.1	3.82	176.57	120.81	0.47	9.23	0.55	2.35	3.64	0.75	0.39	7.24	6.17	12.33	0.85	2.85	0.62
3/5/02	64	795	949.6	283.5	13.15	327.66	357.17	0.32	6.28	0.37	48.15	8.57	0.54	0.27	4.55	8.35	10.74	0.58	1.94	0.42
3/12/02	71	802	922.9	281.9	3.42	144.12	686.67	20.10	6.47	0.38	67.68	44.45	0.53	0.28	13.59	13.65	0.31	1.87	2.00	0.43
3/19/02	78	809	718.1	280.6	6.87	140.23	256.92	18.87	8.31	0.49	69.39	40.59	0.71	0.35	11.95	10.62	16.75	0.77	2.57	0.56
3/26/02	85	816	717.5	278.9	7.68	181.73	507.13	22.54	8.32	0.49	107.23	60.51	0.71	0.36	17.85	14.15	25.17	2.10	2.57	0.56
4/2/02	92	823	718.1	289.7	11.24	201.89	396.31	27.21	8.31	1.35	69.54	56.88	0.68	0.35	15.18	18.60	12.62	2.84	2.57	0.56
4/9/02	99	830	718.1	290.3	7.81	198.73	492.33	53.97	8.31	0.49	93.28	54.03	0.68	0.35	21.03	74.74	16.07	2.97	2.57	0.56
4/16/02	106	837	718.1	297.3	4.13	203.62	1479.18	50.70	8.31	1.78	2.11	135.95	11.47	0.35	39.42	96.25	28.24	0.77	2.57	0.56
4/23/02	113	844	703.8	283.6	8.88	246.18	638.92	10.97	8.48	0.50	60.38	9.93	0.72	0.36	0.99	54.11	7.37	0.78	2.62	0.57
4/30/02	120	851	773.9	287.3	5.96	230.64	633.97	20.29	7.71	0.46	60.10	62.80	0.66	0.33	9.41	51.74	8.76	1.93	2.38	0.52
5/7/02	127	858	773.3	294.0	5.26	245.92	1364.40	73.07	7.72	0.46	137.78	97.56	6.56	0.33	27.93	104.44	29.65	4.15	2.38	0.52
5/14/02	134	865	718.1	287.5	14	303.92	372.97	8.23	8.31	0.49	2.11	27.92	0.71	0.35	4.90	42.11	11.56	0.77	2.57	0.56
5/21/02	141	872	713.9	285.4	6.69	233.03	560.95	16.04	8.36	0.50	2.12	21.40	0.71	0.36	7.10	81.72	11.25	0.77	2.58	0.56
5/28/02	148	879	718.1	295.2	4.65	178.15	1177.87	98.51	8.31	0.49	99.38	71.42	0.68	0.35	17.18	55.00	20.39	3.05	7.02	0.56
6/4/02	155	886	718.1	297.4	9.4	201.31	3544.94	142.70	8.31	0.49	81.92	68.98	0.68	0.35	11.68	40.79	8.27	4.58	46.30	0.56
6/11/02	162	893	739.5	300.5	8.34	237.9	3928.28	160.78	129.44	2.93	159.59	211.76	23.11	0.34	43.62	65.57	19.46	18.46	294.62	0.54
6/18/02	169	900	704.0	295.6	4.2	150.2	577.58	92.01	8.48	0.50	84.77	62.23	0.72	0.36	11.14	15.27	6.05	0.78	2.62	0.57
6/25/02	176	907	722.6	302.3	5.54	174.45	4410.33	204.56	8.26	2.50	163.09	179.28	15.29	0.35	43.95	41.71	0.39	10.07	125.64	0.56
7/2/02	183	914	739.8	301.6	4.49	187.28	4139.95	204.31	47.73	1.81	132.11	175.90	17.10	0.34	33.43	64.08	26.99	8.79	112.39	0.54
7/9/02	190	921	725.0	301.2	6.43	278.68	3858.83	105.32	8.23	1.94	144.96	128.02	22.07	0.35	39.34	52.85	32.62	9.49	39.74	0.55
7/16/02	197	928	718.4	298.3	4.7	186.37	1178.86	174.76	8.31	0.49	70.08	56.19	0.68	0.35	28.23	39.81	33.52	6.53	2.56	0.56

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	CHTHNL	CLRPS	Chlorp. Oxon	Cis-nonachlor	Diazinon	Dieldrin	endo. sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Mlthn	Mirex
7/23/02	204	935	718.1	300.0	6.61	142.71	933.77	448.90	8.31	1.98	105.83	114.73	5.38	0.35	37.18	35.23	25.13	6.21	8.73	0.56
7/30/02	211	942	718.1	302.0	7.35	268.64	262.75	0.42	8.31	0.49	60.30	0.71	0.71	0.35	0.97	10.99	45.63	0.77	2.57	0.56
8/6/02	218	949	719.0	295.9	10.27	31.17	3404.36	41.21	8.30	0.49	21.35	24.19	9.65	0.35	8.61	18.39	7.45	0.77	2.56	0.56
8/13/02	225	956	718.1	301.8	4.84	170.27	4503.62	252.85	31.40	2.01	53.47	85.39	45.45	0.35	41.83	36.11	28.52	5.21	187.65	0.56
8/20/02	232	963	718.1	300.1	7.44	167.1	3957.09	438.26	49.03	2.19	95.00	133.55	19.62	0.35	43.72	32.01	17.38	15.23	7.32	0.56
8/27/02	239	970	718.1	297.2	4.45	119.74	219.74	8.23	8.31	0.49	2.11	0.71	0.68	0.35	0.97	6.78	3.05	0.77	2.57	0.56
9/3/02	246	977	718.1	298.1	5.06	233.82	1231.93	188.56	8.31	1.21	57.00	84.72	11.52	0.35	38.28	24.77	22.47	3.27	2.57	0.56
9/10/02	253	984	718.1	298.6	6.19	179.45	152.90	0.42	8.31	0.49	2.11	0.71	0.68	0.35	0.97	4.60	2.84	0.77	2.57	0.56
9/17/02	260	991	718.1	293.6	3.15	223.26	1180.92	55.83	8.31	0.49	2.11	62.58	0.68	0.35	22.60	21.26	21.31	4.96	2.57	0.56
9/24/02	267	998	718.1	292.7	4.93	167.97	1001.50	45.65	8.31	0.49	2.11	48.15	0.68	0.35	19.70	16.18	22.92	3.77	2.57	0.56
10/1/02	274	1005	718.1	295.4	4.26	235.36	690.26	40.08	8.31	0.49	2.11	53.15	0.68	0.35	21.97	13.37	19.70	3.48	2.57	0.56
10/8/02	281	1012	718.4	287.4	3.92	93.63	591.96	14.87	8.31	0.49	2.11	19.99	0.71	0.35	10.33	10.94	11.85	0.77	2.56	0.56
10/15/02	288	1019	718.1	288.0	9.38	79.37	383.40	67.09	8.31	0.49	27.71	26.76	0.71	0.35	16.77	9.40	12.56	0.77	2.57	0.56
10/22/02	295	1026	718.1	282.8	2.94	213.35	529.02	11.03	8.31	0.49	2.11	17.80	0.71	0.35	10.37	7.52	13.69	0.77	2.57	0.56
10/29/02	302	1033	718.1	278.8	8.45	65.28	238.93	17.31	8.31	0.49	2.11	8.65	0.71	0.35	9.36	5.00	13.05	0.77	2.57	0.56
11/5/02	309	1040	718.1	281.9	5.49	188.49	346.19	43.47	8.31	0.49	2.11	39.62	0.71	0.35	16.49	9.19	18.92	1.73	2.57	0.56
11/12/02	316	1047	718.1	283.9	9.29	34.32	264.00	34.46	8.31	0.49	2.11	59.61	0.71	0.35	17.55	10.95	21.88	1.94	2.57	0.56
11/19/02	323	1054	719.0	279.6	3.77	206.02	354.20	16.70	8.30	0.49	2.11	28.86	0.71	0.35	11.49	6.38	20.10	0.77	2.56	0.56
11/26/02	330	1061	719.0	279.4	6.82	191.35	301.54	9.87	8.30	0.49	2.11	10.83	0.71	0.35	7.87	6.75	14.76	0.77	2.56	0.56
3/31/03	90	1186	711.9	276.9	8.7	284.17	877.35	7.26	8.38	0.50	103.21	32.95	0.71	0.36	8.27	15.06	11.55	0.40	2.59	0.56
4/1/03	91	1187	804.1	286.1	7.41	250.5	647.98	0.38	7.42	0.44	1.88	11.07	0.63	0.32	0.87	0.42	4.92	0.35	2.29	0.50
4/2/03	92	1188	847.2	292.2	6.17	210.74	10.59	15.49	7.04	0.42	1.79	81.04	0.60	0.30	15.62	25.21	12.37	0.65	2.17	0.47
4/3/03	93	1189	711.9	287.1	6.21	117.01	852.51	63.52	8.38	0.50	100.09	98.11	0.71	0.36	20.27	22.64	14.96	0.40	2.59	0.56
4/8/03	98	1194	759.0	277.0	7.6	79.15	434.85	9.02	7.86	0.47	67.85	66.66	0.67	0.34	8.30	15.51	5.85	0.37	2.43	0.53
4/15/03	105	1201	711.9	293.0	6.2	218.05	191.10	5.63	8.38	0.50	69.98	51.20	0.71	0.36	3.96	5.69	4.92	0.40	2.59	0.56
4/22/03	112	1208	711.9	286.0	10.68	325.08	241.09	6.57	8.38	0.50	71.06	37.12	0.71	0.36	5.14	29.64	7.58	0.40	2.59	0.56
4/29/03	119	1215	711.9	290.0	4.36	217.04	12.60	20.49	8.38	0.50	25.04	41.46	0.71	0.36	6.25	44.40	5.10	2.09	2.59	0.56
5/6/03	126	1222	711.9	287.3	3.03	212.54	585.33	8.84	8.38	0.50	72.17	52.24	1.39	0.36	5.44	25.96	7.70	0.78	2.59	0.56
5/13/03	133	1229	711.9	288.2	11.24	288.96	12.60	0.43	8.38	0.50	2.13	0.71	0.71	0.36	0.36	0.48	0.40	0.78	2.59	0.56
5/20/03	140	1236	711.9	291.0	4.54	193.86	693.64	20.84	8.38	0.50	85.30	122.68	2.04	0.36	12.94	26.22	4.00	0.40	15.51	0.56
5/27/03	147	1243	712.2	287.4	2.68	179.26	12.59	25.13	8.38	0.50	38.02	95.04	5.34	0.36	11.60	19.91	11.26	0.78	2.59	0.56
6/3/03	154	1250	711.9	290.8	5.16	182.63	190.55	17.63	8.38	0.50	29.88	217.17	0.71	0.36	13.82	22.64	7.63	4.47	18.68	0.56
6/10/03	161	1257	711.9	296.6	5.23	187.98	1199.45	53.99	8.38	0.50	90.05	132.33	0.68	0.36	19.09	40.41	13.25	0.40	2.59	0.56
6/17/03	168	1264	710.2	290.1	4.88	119.03	2740.99	43.68	8.40	0.50	117.50	184.89	0.68	0.36	25.95	50.31	27.99	5.66	7.31	0.56
6/23/03	174	1270	714.9	297.8	6.1	321.31	405.27	21.84	8.35	0.49	49.34	120.28	0.68	0.36	28.55	38.22	0.39	4.92	6.62	0.56
6/24/03	175	1271	711.9	297.8	4.64	293.33	4857.60	41.94	8.38	0.50	84.52	393.77	8.53	0.36	58.50	85.58	33.63	7.53	2.59	0.56
6/25/03	176	1272	711.9	299.5	4.91	300.27	822.52	21.77	8.38	0.50	650.58	237.96	1.64	0.36	37.85	47.52	20.70	13.18	11.32	0.56
6/26/03	177	1273	711.9	300.6	4.41	276.69	636.94	17.32	8.38	0.50	31.80	222.23	1.71	0.36	21.80	67.25	14.24	6.14	2.59	0.56
7/1/03	182	1278	712.2	296.6	3.15	174.22	322.79	18.32	8.38	0.50	35.28	159.13	1.87	0.36	20.32	19.43	14.73	2.65	2.59	0.56
7/8/03	189	1285	711.9	299.7	5.19	280.31	403.06	104.78	8.38	0.50	43.05	193.18	3.24	0.36	18.51	16.39	13.70	2.50	2.59	0.56
7/15/03	196	1292	711.9	298.3	5.5	177.86	330.54	71.20	8.38	0.50	33.50	193.50	2.28	0.36	22.33	15.97	8.43	2.43	2.59	0.56
7/22/03	203	1299	711.9	297.6	5.87	230.65	4468.49	131.99	8.38	0.50	127.95	356.77	1.56	0.36	48.88	35.17	22.95	10.58	2.59	0.56
7/29/03	210	1306	711.9	295.8	4.12	123.47	319.58	127.02	8.38	0.50	2.13	166.42	4.07	0.36	22.60	3.99	8.09	2.47	2.59	0.56
8/5/03	217	1313	711.9	296.5	4.08	209.83	2868.36	240.57	8.38	0.50	2.13	70.78	13.03	0.36	14.13	15.24	0.40	0.78	2.59	0.56
8/12/03	224	1320	711.9	298.9	2.97	152.78	3541.23	61.93	8.38	0.50	76.51	191.46	10.55	0.36	27.67	21.57	13.85	0.78	2.59	0.56
8/19/03	231	1327	711.9	296.9	2.52	189.98	2192.87	52.14	8.38	0.50	546.19	75.09	6.01	0.36	23.25	20.72	12.15	0.78	2.59	0.56
8/26/03	238	1334	711.9	297.8	4.77	272.45	1803.98	24.99	8.38	0.50	86.64	33.51	2.28	0.36	9.57	11.42	7.82	0.40	2.59	0.56
9/2/03	245	1341	707.2	297.0	4.86	137.06	1031.66	13.73	8.44	0.50	2.14	67.89	1.73	0.36	16.13	17.04	15.60	0.78	2.60	0.57
9/9/03	252	1348	711.9	291.9	8.22	76.13	497.26	0.43	8.38	0.50	2.13	31.70	1.74	0.36	8.02	5.46	8.43	0.40	2.59	0.56
9/16/03	259	1355	711.9	292.9	5.67	101.72	12.60	0.43	8.38	0.50	2.13	0.71	0.68	0.36	0.98	0.48	0.40	0.78	2.59	0.56
9/29/03	272	1368	711.9	288.8	9.67	330.75	12.60	0.43	8.38	0.50	2.13	0.71	0.68	0.36	0.98	0.48	0.40	0.78	2.59	0.56

for pesticides, conc. < mdl have been replaced by 0.5*mdl

HEPTX - heptaclor epoxide

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
4/18/00	109	109	785.5	282.1	11.39	54.26	0.66	17.68	0.51	2.73	1.40	1.24
4/25/00	116	116	776.7	281.5	8.26	63.42	0.67	10.51	0.52	2.76	1.41	1.25
5/2/00	123	123	772.8	288.3	4.79	136.1	0.68	20.81	0.52	2.77	1.42	1.26
5/9/00	130	130	776.8	299.6	7.26	234.7	0.67	29.50	0.52	2.76	1.41	1.25
5/16/00	137	137	1054.3	291.6	5.48	202.07	0.50	9.19	0.38	2.03	1.04	0.92
5/23/00	144	144	793.7	293.2	8.64	229.58	0.66	37.33	0.51	2.70	1.38	1.22
5/30/00	151	151	773.9	287.5	7.16	85.01	0.67	10.89	0.52	2.77	1.42	1.26
6/6/00	158	158	767.2	290.2	12.97	74.12	0.68	12.01	0.52	2.79	1.43	1.27
6/13/00	165	165	775.2	292.3	5.99	128.57	0.67	18.67	0.52	2.76	1.42	1.25
6/20/00	172	172	789.1	296.2	4.83	198.5	0.66	19.10	0.51	2.72	1.39	1.23
6/27/00	179	179	781.7	298.7	4.79	239.48	0.67	37.74	0.51	2.74	1.40	1.24
7/4/00	186	186	876.4	300.2	5.21	245.05	0.60	29.40	0.46	2.45	1.25	1.11
7/11/00	193	193	856.9	295.1	4.52	134.94	0.61	25.40	0.47	2.50	1.28	1.13
7/18/00	200	200	777.1	299.9			0.67	47.41	0.52	2.76	1.41	1.25
7/25/00	207	207	720.8	294.8	6.96	101.38	0.72	26.87	0.56	2.97	1.52	1.35
8/1/00	214	214	716.3	301.3	7.02	240.22	0.73	0.89	0.56	2.99	1.53	1.36
9/12/00	256	256	429.6	299.3	5.97	226.21	1.22	96.44	0.93	4.99	2.55	2.26
9/19/00	263	263	418.2	296.0	6.15	238.8	1.25	99.04	0.96	5.12	2.62	2.32
9/26/00	270	270	416.5	287.2	8.76	64.89	1.25	51.64	0.96	5.15	2.63	2.33
10/3/00	277	277	422.9	296.4	5.36	237.48	1.23	118.18	0.95	5.07	2.59	2.30
10/10/00	284	284	416.5	285.5	8.23	283.07	1.25	18.67	0.96	5.15	2.63	2.33
10/17/00	291	291	415.7	291.1	5.37	104.14	1.26	25.75	0.97	5.16	2.64	2.34
10/24/00	298	298	417.1	286.1	2.14	174.48	1.25	25.98	0.96	5.14	2.63	2.33
10/31/00	305	305	434.3	284.5	8.69	99.37	1.20	32.56	0.92	4.93	2.53	2.24
11/7/00	312	312	416.3	283.7	2.3	171.3	1.25	25.68	0.96	5.15	2.64	2.33
11/14/00	319	319	427.2	281.6	12.09	326.13	1.22	27.84	0.94	5.02	2.57	2.28
11/21/00	326	326	415.2	273.8	15.45	324.06	1.26	1.53	0.97	5.16	2.64	2.34
11/28/00	333	333	427.4	280.6	4.98	219.11	1.22	1.49	0.94	5.01	2.57	2.27
12/5/00	340	340	415.9	276.9	10.48	249.68	1.26	1.53	0.96	5.15	2.64	2.34
12/12/00	347	347	417.9	275.0	14.05	210.91	1.25	1.52	0.96	5.13	2.63	2.33
12/19/00	354	354	415.4	274.6	12.75	301.14	1.26	59.75	0.97	5.16	2.64	2.34
5/15/01	135	501	725.9	289.2	6.15	216.29	2.03	6.10	8.72	2.95	8.53	1.34
5/22/01	142	508	717.9	292.5	7.21	178.78	4.71	15.71	10.84	2.99	7.33	1.35
5/29/01	149	515	718.2	292.1	6.26	255.96	4.87	12.62	8.41	2.98	6.18	1.35
6/5/01	156	522	717.6	295.2	4.58	228.32	4.88	14.27	10.26	2.99	6.88	1.35
6/12/01	163	529	717.9	299.6	4.88	241.69	10.77	39.74	10.38	2.99	6.14	1.35
6/19/01	170	536	719.1	298.3	5.21	230.33	7.41	24.74	10.33	2.98	9.94	1.35
6/26/01	177	543	717.6	297.6	3.87	258.05	6.49	24.36	9.95	2.99	8.53	1.35
7/3/01	184	550	717.6	296.3	5.52	220.32	6.06	20.60	6.40	2.99	7.62	1.35
7/10/01	191	557	717.9	298.8	6.62	240.33	10.16	30.63	10.39	2.99	5.88	1.35
7/17/01	198	564	717.6	299.8	5.03	209.38	6.66	33.06	10.09	2.99	8.45	1.35
7/24/01	205	571	717.6	301.0	8.45	244.97	5.83	21.49	7.80	2.99	7.05	1.35
7/31/01	212	578	717.6	294.7	2.92	178.35	4.38	15.04	0.56	2.99	3.58	1.35
8/7/01	219	585	717.6	301.6	6.12	285.83	11.29	34.23	7.50	2.99	1.53	1.35
8/14/01	226	592	730.1	296.9	4.3	94.04	6.10	18.20	3.26	2.94	1.50	1.33

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
8/21/01	233	599	725.9	296.0	4.88	269.23	7.66	20.33	0.55	2.95	2.88	1.34
8/28/01	240	606	717.9	298.7	5.03	209.95	7.16	26.41	7.02	2.99	1.53	1.35
9/4/01	247	613	717.9	297.4	7.03	173.35	6.76	21.94	0.56	2.99	2.73	1.35
9/11/01	254	620	721.7	297.5	5.4	139.15	5.21	15.91	0.56	2.97	1.52	1.35
9/18/01	261	627	784.8	291.8	3.21	168.56	3.43	9.87	0.51	2.73	1.40	1.24
9/25/01	268	634	721.8	288.8	8.46	212.88	4.05	11.51	0.56	2.97	4.23	1.35
10/2/01	275	641	675.6	291.7	4.08	249.83	5.11	15.65	0.59	3.17	1.62	1.44
10/9/01	282	648	671.1	284.0	4.09	197.01	2.77	5.98	0.60	3.19	1.64	1.45
10/16/01	289	655	696.2	287.3	10.35	264.95	0.75	0.92	0.58	3.08	1.58	1.40
10/23/01	296	662	642.2	294.5	6.66	210.93	0.81	2.46	0.62	3.34	3.61	1.51
10/30/01	303	669	642.5	284.1	4.37	125.87	2.10	6.38	0.62	3.34	3.78	1.51
11/6/01	310	676	642.0	283.5	9.2	322.51	1.81	4.46	0.62	3.34	3.24	1.51
11/13/01	317	683	646.2	280.1	3.82	176.57	0.81	4.01	0.62	3.32	7.92	1.50
3/5/02	64	795	949.6	283.5	13.15	327.66	0.55	3.83	0.42	2.26	1.16	1.02
3/12/02	71	802	922.9	281.9	3.42	144.12	2.51	9.50	7.11	2.32	3.23	1.05
3/19/02	78	809	718.1	280.6	6.87	140.23	2.01	8.59	0.56	2.98	1.53	1.35
3/26/02	85	816	717.5	278.9	7.68	181.73	3.02	12.97	0.56	2.99	3.46	1.35
4/2/02	92	823	718.1	289.7	11.24	201.89	3.17	15.41	6.02	2.98	8.13	1.35
4/9/02	99	830	718.1	290.3	7.81	198.73	4.05	15.76	19.86	2.98	3.94	1.35
4/16/02	106	837	718.1	297.3	4.13	203.62	5.22	29.10	20.87	2.98	14.72	1.35
4/23/02	113	844	703.8	283.6	8.88	246.18	0.74	4.42	0.57	3.05	1.56	1.38
4/30/02	120	851	773.9	287.3	5.96	230.64	3.19	9.28	0.52	2.77	3.14	1.26
5/7/02	127	858	773.3	294.0	5.26	245.92	4.40	19.86	11.79	2.77	4.50	1.26
5/14/02	134	865	718.1	287.5	14	303.92	1.85	5.76	0.56	2.98	2.87	1.35
5/21/02	141	872	713.9	285.4	6.69	233.03	1.89	6.65	0.56	3.00	3.19	1.36
5/28/02	148	879	718.1	295.2	4.65	178.15	3.80	16.36	26.03	5.38	25.62	1.35
6/4/02	155	886	718.1	297.4	9.4	201.31	2.90	12.55	0.56	2.98	1.53	1.35
6/11/02	162	893	739.5	300.5	8.34	237.9	6.64	36.80	19.92	2.90	8.05	1.31
6/18/02	169	900	704.0	295.6	4.2	150.2	3.00	11.11	6.73	3.04	5.44	1.38
6/25/02	176	907	722.6	302.3	5.54	174.45	12.59	36.40	19.93	2.97	8.98	1.34
7/2/02	183	914	739.8	301.6	4.49	187.28	6.87	30.62	10.23	2.90	4.77	1.31
7/9/02	190	921	725.0	301.2	6.43	278.68	7.68	31.46	12.94	2.96	5.30	1.34
7/16/02	197	928	718.4	298.3	4.7	186.37	6.70	24.01	0.56	2.98	3.02	1.35

APPENDIX Y - Analyte concentrations in gas phase (pg/m^3) at HP (2000-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
7/23/02	204	935	718.1	300.0	6.61	142.71	5.50	29.40	7.53	2.98	3.43	1.35
7/30/02	211	942	718.1	302.0	7.35	268.64	0.73	0.89	0.56	2.98	1.53	1.35
8/6/02	218	949	719.0	295.9	10.27	31.17	3.53	9.57	0.56	2.98	1.53	1.35
8/13/02	225	956	718.1	301.8	4.84	170.27	5.49	32.29	11.07	2.98	4.55	1.35
8/20/02	232	963	718.1	300.1	7.44	167.1	10.03	36.89	8.91	2.98	3.65	1.35
8/27/02	239	970	718.1	297.2	4.45	119.74	0.73	0.89	0.56	2.98	1.53	1.35
9/3/02	246	977	718.1	298.1	5.06	233.82	6.66	18.14	7.67	2.98	2.74	1.35
9/10/02	253	984	718.1	298.6	6.19	179.45	0.73	0.89	0.56	2.98	1.53	1.35
9/17/02	260	991	718.1	293.6	3.15	223.26	4.65	17.16	8.49	2.98	2.95	1.35
9/24/02	267	998	718.1	292.7	4.93	167.97	2.66	8.42	0.56	2.98	1.53	1.35
10/1/02	274	1005	718.1	295.4	4.26	235.36	3.79	12.00	0.56	2.98	1.53	1.35
10/8/02	281	1012	718.4	287.4	3.92	93.63	3.08	8.23	0.56	2.98	1.53	1.35
10/15/02	288	1019	718.1	288.0	9.38	79.37	2.37	6.67	0.56	2.98	1.53	1.35
10/22/02	295	1026	718.1	282.8	2.94	213.35	3.77	11.33	0.56	2.98	1.53	1.35
10/29/02	302	1033	718.1	278.8	8.45	65.28	4.68	12.50	0.56	2.98	1.53	1.35
11/5/02	309	1040	718.1	281.9	5.49	188.49	2.56	7.98	0.56	2.98	1.53	1.35
11/12/02	316	1047	718.1	283.9	9.29	34.32	2.19	5.86	0.56	2.98	1.53	1.35
11/19/02	323	1054	719.0	279.6	3.77	206.02	0.73	0.89	0.56	2.98	1.53	1.35
11/26/02	330	1061	719.0	279.4	6.82	191.35	0.73	0.89	0.56	2.98	1.53	1.35
3/31/03	90	1186	711.9	276.9	8.7	284.17	0.73	7.50	0.56	3.01	1.54	1.37
4/1/03	91	1187	804.1	286.1	7.41	250.5	0.65	2.89	0.50	2.67	1.36	1.21
4/2/03	92	1188	847.2	292.2	6.17	210.74	2.24	12.37	0.47	2.53	1.30	1.15
4/3/03	93	1189	711.9	287.1	6.21	117.01	2.19	16.00	0.56	3.01	1.54	1.37
4/8/03	98	1194	759.0	277.0	7.6	79.15	0.69	9.05	0.53	2.82	1.45	1.28
4/15/03	105	1201	711.9	293.0	6.2	218.05	0.73	5.55	0.56	3.01	1.54	1.37
4/22/03	112	1208	711.9	286.0	10.68	325.08	0.73	6.04	0.56	3.01	1.54	1.37
4/29/03	119	1215	711.9	290.0	4.36	217.04	0.73	5.28	0.56	3.01	1.54	1.37
5/6/03	126	1222	711.9	287.3	3.03	212.54	0.73	6.50	0.56	3.01	1.54	1.37
5/13/03	133	1229	711.9	288.2	11.24	288.96	0.73	0.90	0.56	3.01	1.54	1.37
5/20/03	140	1236	711.9	291.0	4.54	193.86	1.49	13.36	0.56	3.01	1.54	1.37
5/27/03	147	1243	712.2	287.4	2.68	179.26	2.04	10.28	0.56	3.01	1.54	1.36
6/3/03	154	1250	711.9	290.8	5.16	182.63	4.00	15.62	0.56	3.01	1.54	1.37
6/10/03	161	1257	711.9	296.6	5.23	187.98	1.88	14.37	0.56	3.01	1.54	1.37
6/17/03	168	1264	710.2	290.1	4.88	119.03	4.62	23.18	0.56	3.02	1.55	1.37
6/23/03	174	1270	714.9	297.8	6.1	321.31	6.77	23.63	0.56	3.00	5.54	1.36
6/24/03	175	1271	711.9	297.8	4.64	293.33	10.21	48.92	0.56	3.01	1.54	1.37
6/25/03	176	1272	711.9	299.5	4.91	300.27	9.47	37.33	0.56	3.01	1.54	1.37
6/26/03	177	1273	711.9	300.6	4.41	276.69	5.41	22.16	11.71	3.01	5.58	1.37
7/1/03	182	1278	712.2	296.6	3.15	174.22	3.72	17.54	0.56	3.01	3.51	1.36
7/8/03	189	1285	711.9	299.7	5.19	280.31	3.47	17.43	7.32	3.01	1.54	1.37
7/15/03	196	1292	711.9	298.3	5.5	177.86	3.02	20.63	8.60	3.01	7.57	1.37
7/22/03	203	1299	711.9	297.6	5.87	230.65	5.35	37.41	0.56	3.01	1.54	1.37
7/29/03	210	1306	711.9	295.8	4.12	123.47	3.19	19.55	6.64	3.01	1.54	1.37
8/5/03	217	1313	711.9	296.5	4.08	209.83	4.06	15.00	10.27	3.01	11.85	1.37
8/12/03	224	1320	711.9	298.9	2.97	152.78	0.73	28.95	0.56	3.01	1.54	1.37
8/19/03	231	1327	711.9	296.9	2.52	189.98	3.02	17.56	0.56	3.01	1.54	1.37
8/26/03	238	1334	711.9	297.8	4.77	272.45	0.73	8.30	0.56	3.01	1.54	1.37
9/2/03	245	1341	707.2	297.0	4.86	137.06	3.08	13.35	0.57	3.03	1.55	1.37
9/9/03	252	1348	711.9	291.9	8.22	76.13	2.01	7.82	0.56	3.01	1.54	1.37
9/16/03	259	1355	711.9	292.9	5.67	101.72	0.73	0.90	0.56	3.01	1.54	1.37
9/29/03	272	1368	711.9	288.8	9.67	330.75	0.73	0.90	0.56	3.01	1.54	1.37

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.	Simazine	Trifluralin	DDD	DDE	DDT
4/11/01	101	467	702	284.8	1.5	86.25	7.89	4.81	4.69	11.03	5.50	57.81	108.60	615.99	8.44	16.28	366.37	12.13	10.58	0
4/18/01	108	474	619.2	277.8	3.2	287.9	8.95	5.45	5.32	12.50	6.24	65.54	7.82	16.86	9.57	18.46	21.09	13.76	9.03	0
4/25/01	115	481	626.4	280.6	2	281.9	8.85	5.39	5.26	12.36	6.17	64.79	7.73	595.37	9.46	18.25	103.75	13.60	14.75	0
5/16/01	136	502	914.8	286.3	1.7	277.8	6.06	3.69	104.11	8.46	75.66	44.36	154.87	247.91	6.48	12.50	178.48	9.31	2.33	0
5/23/01	143	509	789.5	291	1.5	276.2	7.02	4.28	220.19	9.80	4.89	51.40	925.54	13.22	7.51	14.48	548.65	10.79	27.57	0
5/30/01	150	516	782.4	288	3.1	294	7.08	161.77	136.48	9.89	4.94	51.87	212.25	13.34	7.58	14.61	225.00	10.89	17.95	0
6/6/01	157	523	777.5	293.8	1.5	280.9	7.13	4.34	314.37	449.64	4.97	52.20	1340.37	689.70	7.62	186.31	386.92	10.95	40.14	0
6/13/01	164	530	713.1	297.5	1.6	286	453.71	4.74	1413.43	517.37	282.54	56.91	2386.95	1294.54	8.31	963.93	2825.29	11.94	49.21	0
6/20/02	171	537	713.7	297.2	2	286.8	7.77	4.73	4.62	10.85	5.41	56.86	6.78	14.63	8.31	16.02	10.90	11.93	2.98	0
6/27/01	178	544	756.2	299.6	1.6	286.5	7.33	4.47	332.89	10.24	46.73	53.66	907.29	887.35	7.84	186.66	989.24	11.26	62.89	0
7/11/01	192	558	749.4	295.6	2.1	285	7.39	4.51	4.40	10.33	5.15	54.15	447.83	13.93	7.91	15.25	774.94	11.37	49.80	0
7/17/01	198	564	750.4	294.6	2.7	287.2	7.39	4.50	4.39	10.32	5.15	54.08	98.30	667.49	7.90	15.23	306.48	11.35	23.80	0
7/25/01	206	572	742	300.8	4.2	275.3	7.47	4.55	42.40	10.43	5.20	54.69	424.88	14.07	7.99	15.41	81.59	11.48	37.81	0
8/8/01	220	586	740.8	302.1	1.8	282.3	7.48	4.56	4.45	10.45	5.21	54.78	453.72	14.09	8.00	15.43	186.92	11.50	72.75	0
8/15/01	227	593	715.5	294.5	1.2	277.9	7.75	4.72	4.60	10.82	5.40	56.72	6.76	14.59	8.28	15.98	283.53	11.90	16.73	0
8/22/01	234	600	902.4	296.6	1	280.5	6.14	3.74	3.65	8.58	4.28	44.97	5.36	11.57	6.57	12.67	62.34	9.44	2.36	0
8/29/01	241	607	602.9	296.6	1.1	278.9	9.19	5.60	5.46	12.84	6.41	67.31	201.01	17.31	9.83	18.96	395.43	14.13	42.19	0
9/5/01	248	614	764.6	292.1	4.1	74.97	7.25	4.42	4.31	10.12	5.05	53.08	6.33	13.65	7.75	14.95	308.79	11.14	46.48	0
9/12/01	255	621	743	293	4.2	218.3	7.46	4.55	4.43	10.42	5.20	54.62	153.79	14.05	7.98	15.39	83.31	11.46	12.76	0
9/19/01	262	628	981.8	293.8	5.9	93.88	5.64	3.44	3.36	7.88	3.93	41.33	4.93	10.63	6.04	11.64	182.08	8.68	7.41	0
9/26/01	269	635	980.2	287.2	5.6	200.7	5.65	3.45	3.36	7.90	3.94	41.40	4.94	10.65	6.05	11.66	43.82	8.69	10.05	0
10/3/01	276	642	1116	294	4.5	217.3	4.97	3.03	2.95	6.94	3.46	36.37	75.24	9.36	5.31	10.24	41.73	7.63	1.91	0
10/10/01	283	649	1156	290.3	5.8	230.3	4.79	2.92	2.85	6.69	3.34	35.10	4.19	9.03	5.13	9.89	44.40	7.37	5.65	0
10/17/01	290	656	757.8	284.9	14	301.6	7.31	4.46	4.35	10.22	5.10	53.56	6.39	13.78	7.82	15.09	20.34	11.24	2.81	0
10/24/01	296	662	983.1	296.2	6.7	239.5	5.64	3.44	3.35	7.87	3.93	41.28	79.95	10.62	6.03	11.63	69.67	8.66	18.92	0
10/31/01	304	670	982.2	286.2	4.7	239.9	5.64	3.44	3.35	7.88	3.93	41.32	4.93	10.63	6.04	11.64	23.49	8.67	2.17	0
11/7/01	311	677	981.8	284.2	4.8	331.7	5.64	3.44	3.36	7.88	3.93	41.33	4.93	10.63	6.04	11.64	15.16	8.68	5.95	0
11/14/01	318	684	982.2	283.5	4.2	219.5	5.64	3.44	3.35	7.88	3.93	41.32	4.93	10.63	6.04	11.64	25.88	8.67	4.53	0

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.	Simazine	Trifluralin	DDD	DDE	DDT
11/21/01	325	691	982.6	288	3.5	230.7	5.64	3.44	3.35	7.88	3.93	41.30	4.92	10.62	6.03	11.63	9.98	8.67	2.17	0
1/3/02	3	734	977.8	270.6	3.4	279.4	5.67	3.45	35.16	7.92	3.95	41.51	75.89	62.71	6.06	11.69	2.89	8.71	2.18	0
2/22/02	53	784	840.5	279.5	2.9	288.5	6.59	4.02	3.92	9.21	4.60	48.29	31.02	26.10	7.05	13.60	42.07	10.13	19.07	0
3/6/02	65	796	922	282.9	4.4	204.9	6.01	3.66	164.73	8.40	4.19	44.01	768.60	28.76	6.43	12.40	24.38	9.24	7.27	0
3/13/02	72	803	972.1	282.3	3.3	63.76	5.70	3.47	3.39	7.96	3.97	41.75	4.98	10.74	6.10	11.76	342.69	8.76	21.53	0
3/19/02	78	809	1011	280.2	2.5	159.4	5.48	49.30	3.26	75.95	16.81	40.15	4.79	10.33	5.87	11.31	23.48	8.43	2.11	0
3/28/02	87	818	708	280	1.9	230.9	7.83	57.89	4.65	10.93	5.45	57.32	6.84	14.74	8.37	16.15	30.55	12.03	3.01	0
4/2/02	92	823	704.2	284.4	5.3	233.5	7.87	4.80	4.68	10.99	5.48	57.63	6.87	14.82	91.52	16.23	220.24	12.10	12.21	0
4/8/02	98	829	640.1	289.1	5.2	225.3	57.01	34.61	5.15	12.09	6.03	63.40	104.74	16.31	9.26	17.86	193.84	13.31	23.94	0
4/16/02	106	837	560	297.2	1.4	200.9	3568.93	379.95	23071.02	626.34	1185.64	72.47	47991.72	18.64	10.59	4152.73	266.73	15.21	108.60	0
4/23/02	113	844	698.9	280.8	2.3	293.8	7.93	4.83	1363.97	11.08	5.53	58.07	3157.71	14.94	8.48	16.36	4.05	12.19	3.05	0
4/30/02	120	851	717.5	286.1	2.7	197.2	7.72	4.71	4.59	10.79	5.38	56.56	98.06	14.55	8.26	15.93	67.89	11.87	2.97	0
5/7/02	127	858	716	294.6	2.4	326.7	7.74	359.17	1956.70	10.81	204.37	56.68	2162.47	14.58	8.28	726.30	159.76	11.90	67.51	0
5/14/02	134	865	711.5	289	4.5	326.1	7.79	4.75	4.63	10.88	5.43	57.04	6.80	14.67	8.33	16.07	43.82	11.97	10.98	0
5/21/02	141	872	814.9	285.8	1.8	292	6.80	4.14	4.04	1792.11	4.74	49.80	5.94	12.81	7.27	14.03	92.03	10.45	11.20	0
5/28/02	148	879	820.9	294.5	1.9	97.2	237.44	234.82	254.95	9.43	61.37	49.43	476.30	12.72	7.22	83.14	377.41	10.38	23.63	0
6/4/02	155	886	710.1	299.3	3.7	250.2	37.05	23.60	112.37	560.06	13.00	57.15	207.72	14.70	129.46	16.10	281.52	12.00	19.18	0
6/11/02	162	893	878.3	298.6	3.6	205.4	263.29	294.49	703.09	599.46	141.81	46.20	971.55	11.89	6.75	353.02	180.93	9.70	49.95	0
6/18/02	169	900	814.5	294.6	1.4	117.7	6.80	4.15	577.66	674.20	4.74	49.82	2437.91	12.82	251.21	14.03	898.62	10.46	16.21	0
6/25/02	176	907	1281	301.2	1.9	226.5	112.50	2.64	106.93	6.04	34.46	31.68	454.72	8.15	4.63	53.99	503.49	6.65	59.22	0
7/2/02	183	914	705.2	300.6	1.4	209.7	7.86	101.28	54.96	10.98	5.48	57.55	285.36	14.80	8.41	16.21	281.28	12.08	35.35	0
7/9/02	190	921	734.5	296.5	2.4	357.1	7.54	4.60	4.49	400.75	5.26	55.25	202.32	14.21	8.07	15.56	746.62	11.60	38.53	0
7/16/02	197	928	722.4	301.4	2.3	288.6	7.67	57.46	4.56	113.85	5.35	56.17	6.70	14.45	8.21	15.82	54.62	11.79	2.95	0
7/23/02	204	935	1187	294.8	3	183.7	4.67	2.84	2.78	212.55	3.25	34.19	132.60	8.80	4.99	9.63	1592.16	7.18	42.28	0
7/30/02	211	942	942	302	2.6	307.1	5.88	3.58	3.50	8.22	4.10	43.08	175.06	11.08	6.29	12.14	1193.31	9.04	48.02	0
8/6/02	218	949	939.6	292.3	3.6	62.89	5.90	3.59	3.51	8.24	4.11	43.19	5.15	11.11	6.31	12.17	58.78	9.06	24.03	0
8/13/02	225	956	924.2	300.4	2.3	221.8	6.00	3.65	3.56	8.38	4.18	43.91	51.78	11.30	6.41	12.37	77.52	9.22	16.42	0
8/20/02	232	963	940.4	295.2	2.1	25.75	5.89	3.59	3.50	8.23	4.11	43.15	51.31	11.10	6.30	12.16	85.52	9.06	37.25	0
8/27/02	239	970	957.8	292.6	1.4	178.3	5.79	3.53	3.44	8.08	4.03	42.37	5.05	10.90	6.19	11.94	203.93	8.89	21.98	0
9/3/02	246	977	930.5	296.9	1.9	200.9	5.96	3.63	3.54	8.32	4.15	43.61	53.79	11.22	6.37	12.28	54.10	9.15	17.39	0

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.	Simazine	Trifluralin	DDD	DDE	DDT
9/10/02	253	984	933.7	293.2	2.6	54.97	5.94	3.62	3.53	8.29	4.14	43.46	5.18	11.18	6.35	12.24	218.07	9.12	20.76	0
9/17/02	260	991	951	292.5	1.3	283.3	5.83	3.55	3.46	8.14	4.06	42.67	5.09	10.98	6.23	12.02	123.20	8.96	17.58	0
9/24/02	267	998	938.8	293.1	1.5	75.79	5.90	3.60	3.51	8.25	4.11	43.23	5.15	11.12	6.31	12.18	201.95	9.07	26.79	0
10/1/02	274	1005	934.5	296.5	1.8	206.9	5.93	3.61	3.53	8.28	4.13	43.43	46.75	11.17	6.34	12.23	57.03	9.11	9.14	0
10/8/02	281	1012	895.8	291.1	1.6	57.34	6.19	3.77	3.68	8.64	4.31	45.30	5.40	11.65	6.62	12.76	30.06	9.51	9.49	0
10/15/02	288	1019	996.4	285.4	2.9	1.92	5.56	3.39	3.31	7.77	3.88	40.73	4.86	10.48	5.95	11.47	259.95	8.55	8.10	0
10/22/03	295	1026	942	285	0.7	242.9	5.88	3.58	3.50	8.22	4.10	43.08	5.14	11.08	6.29	12.14	33.39	9.04	4.67	0
10/29/02	302	1033	945.5	280.1	3.9	26.1	5.86	3.57	3.48	8.19	4.08	42.92	5.12	11.04	6.27	12.09	42.33	9.01	5.06	0
11/5/02	309	1040	946.7	282.1	1.2	322.7	5.85	3.57	3.48	8.18	4.08	42.87	23.07	11.03	6.26	12.07	67.75	9.00	9.64	0
11/12/02	316	1047	946.7	279.1	3.5	59.22	5.85	3.57	3.48	8.18	4.08	42.87	92.10	11.03	6.26	12.07	57.22	9.00	10.47	0
11/19/02	323	1054	943.6	280.4	1.7	216.3	5.87	42.01	3.49	8.20	41.69	43.01	24.80	26.26	6.28	12.12	23.05	9.03	8.54	0
11/26/02	330	1061	961.3	273.6	2.3	64.62	5.76	3.51	3.43	8.05	4.02	42.22	12.86	29.80	6.17	11.89	39.59	8.86	6.10	0
12/19/02	352	1083	952.6	281	0.7	156.3	5.82	3.54	3.46	8.13	4.05	42.60	5.08	10.96	6.22	12.00	25.82	8.94	4.79	0
1/21/03	21	1117	942.4	266.1	2.2	291.1	5.88	3.58	210.20	8.21	4.10	43.06	5.14	11.08	6.29	12.13	3.00	9.04	2.26	0
4/15/03	105	1201	970.5	282.9	3.9	207.3	5.71	158.01	535.64	7.98	3.98	41.82	510.37	10.76	6.11	11.78	170.60	8.78	17.80	0
4/22/03	112	1208	726.5	282.3	3.2	284.1	7.63	211.06	715.49	10.65	5.32	55.86	681.72	14.37	8.16	15.73	227.88	11.72	23.77	0
4/29/03	120	1216	741.9	280.2	1.9	129.6	504.68	4.55	368.23	10.43	5.21	54.70	6.52	14.07	7.99	15.41	136.91	11.48	22.66	0
5/6/03	127	1223	709.4	280	2	200.6	917.1	4.8	392.8	10.9	5.4	57.2	1486.8	14.72	8.36	16.11	277.89	12.01	27.42	0

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanzn.	Metlchlr	Merbzn	Pndmthnl.	Simazine	Trifluralin	DDD	DDE	DDT
5/13/03	133	1229	735	284.4	4.4	317.1	280.67	4.59	702.28	10.53	5.25	55.22	1127.81	14.20	8.07	15.55	355.23	11.59	18.29	0
5/22/03	142	1238	725	297.2	1.7	18.82	1583.36	4.66	143.37	10.68	5.33	55.97	252.28	14.40	8.18	15.77	67.76	11.75	11.60	0
5/27/03	147	1243	708.5	280.8	1.2	159.2	350.14	4.77	258.49	10.93	5.45	57.28	33.13	14.74	8.37	16.14	204.9	12.02	15.57	0
6/3/03	154	1250	708.5	286.1	1.9	255.6	908.69	4.77	458.40	10.93	5.45	57.28	6.83	14.74	8.37	16.14	172.8	12.02	11.28	0
6/12/03	163	1259	722.3	294.6	2.7	215.2	7.67	4.67	391.44	10.72	5.35	56.18	890.44	14.45	787.46	15.83	795.4	11.79	14.20	0
6/18/03	169	1265	720.5	289	1	137.3	7.69	4.69	1151.13	10.74	675.58	56.32	4518.15	14.49	885.71	15.87	447.3	11.82	73.12	0
6/22/03	172	1268	686.8	285.8	2.2	291.1	8.07	4.92	378.80	11.27	489.55	59.09	214.9	15.20	1636.81	16.64	1077.0	12.40	36.46	0
7/1/03	182	1278	724.1	294.5	1.3	268.8	7.65	4.66	396.90	10.69	448.14	56.04	1194.0	14.42	8.19	15.79	1401.3	11.76	53.89	0
7/8/03	189	1285	706.7	299.3	1.9	349.3	7.84	4.78	431.22	10.95	5.47	57.43	1082.3	14.77	465.48	16.18	721.3	12.05	17.59	0
7/15/03	196	1292	731.6	298.6	2.3	255.7	7.57	4.62	270.99	10.58	5.28	55.47	2072.9	14.27	8.10	15.62	12383.6	11.64	101.32	0
7/22/03	203	1299	730.1	294.6			7.59	4.62	153.70	10.60	5.29	55.58	171.4	14.30	8.12	15.66	676.9	11.67	2.92	0
7/29/03	210	1306	701.5	301.2			7.90	4.81	422.99	11.03	5.51	57.85	212.93	14.88	4263.85	16.29	1331.9	12.14	40.40	0
8/5/03	217	1313	707.3	300.6			7.84	4.77	259.83	10.94	5.46	57.38	6.84	14.76	8.38	16.16	607.8	12.04	1533.14	0
8/12/03	224	1320	706.7	296.5			7.84	4.78	391.93	10.95	5.47	57.43	6.85	14.77	8.39	16.18	459.0	12.05	23.31	0
8/19/03	231	1327	719.9	301.4	0.9	113	7.70	4.69	351.02	10.75	5.36	56.37	6.72	14.50	8.23	15.88	733.3	11.83	26.66	0
8/26/03	238	1334	712.1	294.8			7.78	4.74	308.67	10.87	5.42	56.99	6.80	14.66	8.32	16.05	311.2	11.96	22.31	0
9/2/03	245	1341	730.4	302	1.8	25.88	7.59	4.62	322.33	10.60	5.29	55.56	6.63	14.29	8.12	15.65	594.9	11.66	46.63	0
9/9/03	252	1348	707	292.3			7.84	4.78	191.49	10.95	5.46	57.40	6.85	14.77	8.39	16.17	360.5	12.05	26.47	0
9/16/03	259	1355	716.6	300.4	0.9	72.79	7.73	4.71	298.43	10.80	5.39	56.63	6.75	14.57	8.27	15.95	63.8	11.89	15.20	0

for pesticides, conc. < mdl have been replaced by 0.5*mdl

Metlchlr : metolachlor

Merbzn : metribuzin

Cyanzn.: cyanazin

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	α-chlordane	α-endosulfan	α-HCH	Aldrin	β-endosulfan	chthnl	clrps	Chlorp. Oxon	Cis-nonachlor	Diazinon
4/11/01	101	467	702	284.8	1.5	86.25	20.00	7.91	18.30	0.59	2.15	494.02	36.31	8.50	1.70	27.74
4/18/01	108	474	619.2	277.8	3.2	287.9	3.20	2.73	17.43	0.67	0.74	528.44	5.56	9.64	0.57	2.45
4/25/01	115	481	626.4	280.6	2	281.9	21.39	8.32	28.03	0.67	0.73	585.09	16.54	9.53	1.31	2.42
5/16/01	136	502	914.8	286.3	1.7	277.8	11.99	30.16	28.72	0.46	1.50	409.42	36.57	6.52	1.11	154.89
5/23/01	143	509	789.5	291	1.5	276.2	40.62	60.48	34.20	0.53	6.66	844.20	139.65	7.56	3.72	89.63
5/30/01	150	516	782.4	288	3.1	294	8.91	29.51	32.12	0.53	3.46	629.61	20.27	7.63	0.96	18.35
6/6/01	157	523	777.5	293.8	1.5	280.9	32.73	209.44	29.20	0.54	14.61	986.84	98.03	7.68	2.64	123.90
6/13/01	164	530	713.1	297.5	1.6	286	91.08	242.90	38.31	0.58	20.60	1729.71	340.62	8.37	6.94	1223.61
6/20/02	171	537	713.7	297.2	2	286.8	6.01	3.28	3.31	0.58	0.64	538.17	15.09	8.36	0.50	2.12
6/27/01	178	544	756.2	299.6	1.6	286.5	51.47	149.06	25.22	0.55	12.84	2687.04	417.31	31.82	4.50	282.01
7/11/01	192	558	749.4	295.6	2.1	285	23.44	263.62	32.28	0.56	20.08	1272.88	578.39	22.28	2.34	68.24
7/17/01	198	564	750.4	294.6	2.7	287.2	64.65	232.13	42.91	0.56	26.08	1251.57	176.62	7.95	4.86	165.47
7/25/01	206	572	742	300.8	4.2	275.3	36.18	969.04	9.74	0.56	81.26	3449.57	1221.56	26.21	3.80	412.34
8/8/01	220	586	740.8	302.1	1.8	282.3	52.79	369.99	19.07	0.56	38.98	9114.77	255.94	28.01	4.89	182.45
8/15/01	227	593	715.5	294.5	1.2	277.9	41.84	102.95	46.79	0.58	6.29	1321.05	1510.96	39.93	3.34	41.54
8/22/01	234	600	902.4	296.6	1	280.5	0.73	0.50	9.90	0.46	0.51	519.71	0.34	6.61	0.39	1.68
8/29/01	241	607	602.9	296.6	1.1	278.9	82.00	264.67	37.67	0.69	22.12	1862.21	297.16	9.90	5.82	597.45
9/5/01	248	614	764.6	292.1	4.1	74.97	31.95	387.42	40.95	0.55	22.07	1107.06	69.98	7.81	2.22	134.42
9/12/01	255	621	743	293	4.2	218.3	23.24	33.97	25.80	0.56	4.29	802.90	44.89	8.03	1.87	122.63
9/19/01	262	628	981.8	293.8	5.9	93.88	30.59	44.63	33.31	0.42	3.21	838.20	146.01	6.08	2.29	242.25
9/26/01	269	635	980.2	287.2	5.6	200.7	11.40	27.99	23.16	0.43	2.14	567.14	22.46	6.09	1.02	6.46
10/3/01	276	642	1116	294	4.5	217.3	25.67	47.50	22.44	0.37	4.06	12252.81	52.17	5.35	1.70	227.94
10/10/01	283	649	1156	290.3	5.8	230.3	15.11	8.91	24.29	0.36	0.40	643.32	10.39	5.16	0.82	112.14
10/17/01	290	656	757.8	284.9	14	301.6	4.82	5.24	24.40	0.55	0.60	503.65	7.22	7.88	0.47	8.95
10/24/01	296	662	983.1	296.2	6.7	239.5	26.98	48.44	19.41	0.42	3.49	995.99	76.50	6.07	2.13	448.59
10/31/01	304	670	982.2	286.2	4.7	239.9	7.55	3.78	16.98	0.42	0.47	432.99	14.31	6.08	0.80	21.70
11/7/01	311	677	981.8	284.2	4.8	331.7	8.26	10.65	27.60	0.42	0.47	634.65	8.21	6.08	0.82	1.54
11/14/01	318	684	982.2	283.5	4.2	219.5	7.66	8.26	24.37	0.42	0.47	448.34	12.45	6.08	0.86	17.18

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	α-chlordane	α-endosulfan	α-HCH	Aldrin	β-endosulfan	chthnl	clrps	Chlorp. Oxon	Cis-nonachlor	Diazinon
11/21/01	325	691	982.6	288	3.5	230.7	4.07	1.09	16.76	0.42	0.47	305.20	6.13	6.07	0.36	1.54
1/3/02	3	734	977.8	270.6	3.4	279.4	3.35	1.98	8.48	0.43	0.47	394.98	1.03	6.10	0.36	1.55
2/22/02	53	784	840.5	279.5	2.9	288.5	12.30	10.95	13.71	0.50	0.55	637.62	14.34	7.10	1.65	14.25
3/6/02	65	796	922	282.9	4.4	204.9	4.43	5.48	9.35	0.45	0.50	564.93	10.42	6.47	0.89	1.64
3/13/02	72	803	972.1	282.3	3.3	63.76	16.00	14.31	19.37	0.43	1.43	1144.26	36.91	6.14	1.37	36.17
3/19/02	78	809	1011	280.2	2.5	159.4	0.65	0.45	2.03	0.41	0.45	374.23	0.30	5.90	0.35	1.50
3/28/02	87	818	708	280	1.9	230.9	3.25	4.21	6.31	0.59	0.65	542.92	4.21	8.43	0.50	2.14
4/2/02	92	823	704.2	284.4	5.3	233.5	10.11	14.39	10.68	0.59	0.65	587.54	15.28	8.47	1.58	16.29
4/8/02	98	829	640.1	289.1	5.2	225.3	13.26	11.22	16.09	0.65	0.72	762.28	17.69	9.32	1.86	117.72
4/16/02	106	837	560	297.2	1.4	200.9	127.11	133.17	20.66	0.74	0.82	17175.94	170.74	10.66	10.07	856.83
4/23/02	113	844	698.9	280.8	2.3	293.8	0.95	1.96	3.10	0.60	0.66	530.68	0.43	8.54	0.51	2.17
4/30/02	120	851	717.5	286.1	2.7	197.2	8.20	17.25	9.77	0.58	1.55	842.22	10.16	8.32	1.41	5.49
5/7/02	127	858	716	294.6	2.4	326.7	11.87	112.75	14.40	0.58	8.97	13573.69	95.39	8.33	3.49	596.34
5/14/02	134	865	711.5	289	4.5	326.1	5.26	6.49	13.53	0.59	0.64	763.31	5.52	8.39	1.10	2.13
5/21/02	141	872	814.9	285.8	1.8	292	6.54	13.18	10.15	0.51	0.56	6385.65	6.63	7.32	1.12	1.86
5/28/02	148	879	820.9	294.5	1.9	97.2	36.31	23.51	12.55	0.51	2.01	7668.16	60.76	7.27	2.98	208.60
6/4/02	155	886	710.1	299.3	3.7	250.2	17.58	21.72	18.46	0.59	1.86	4185.24	58.49	8.40	2.11	209.17
6/11/02	162	893	878.3	298.6	3.6	205.4	45.42	90.11	16.33	0.47	9.91	9327.95	174.04	20.69	4.45	462.41
6/18/02	169	900	814.5	294.6	1.4	117.7	36.24	83.41	28.66	0.51	5.94	4968.59	2456.83	34.17	2.98	132.60
6/25/02	176	907	1281	301.2	1.9	226.5	63.82	172.88	9.69	0.33	20.39	6074.59	210.09	15.68	4.96	491.14
7/2/02	183	914	705.2	300.6	1.4	209.7	31.05	176.16	19.57	0.59	10.04	5526.78	144.07	20.08	3.59	201.25
7/9/02	190	921	734.5	296.5	2.4	357.1	20.61	167.65	18.80	0.57	16.32	7485.89	146.34	19.17	2.76	184.58
7/16/02	197	928	722.4	301.4	2.3	288.6	10.22	72.99	9.25	0.58	3.39	522.46	30.90	8.26	1.66	2.10
7/23/02	204	935	1187	294.8	3	183.7	20.28	130.32	10.64	0.35	13.38	348.59	95.61	11.15	2.46	205.28
7/30/02	211	942	942	302	2.6	307.1	33.41	272.13	17.48	0.44	19.02	412.08	207.56	6.34	3.34	55.14
8/6/02	218	949	939.6	292.3	3.6	62.89	20.83	68.94	26.78	0.44	7.21	488.45	23.38	6.35	2.39	40.88
8/13/02	225	956	924.2	300.4	2.3	221.8	26.44	258.01	13.67	0.45	25.76	7171.54	735.56	44.98	3.12	119.59
8/20/02	232	963	940.4	295.2	2.1	25.75	47.26	136.53	24.11	0.44	11.80	4074.17	70.45	6.35	4.19	35.95
8/27/02	239	970	957.8	292.6	1.4	178.3	59.10	237.96	32.91	0.44	9.68	539.48	544.65	22.41	4.86	115.68
9/3/02	246	977	930.5	296.9	1.9	200.9	19.05	66.68	15.51	0.45	3.66	664.91	0.33	6.41	2.31	42.78

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	α-chlordane	α-endosulfan	α-HCH	Aldrin	β-endosulfan	chthnl	clrps	Chlorp. Oxon	Cis-nonachlor	Diazinon
9/10/02	253	984	933.7	293.2	2.6	54.97	34.92	44.48	18.25	0.45	3.14	431.86	45.71	6.39	3.68	49.43
9/17/02	260	991	951	292.5	1.3	283.3	14.09	97.93	14.90	0.44	5.98	409.74	27.18	6.27	1.72	40.57
9/24/02	267	998	938.8	293.1	1.5	75.79	26.18	58.84	29.12	0.44	6.26	457.52	35.84	6.36	2.54	61.33
10/1/02	274	1005	934.5	296.5	1.8	206.9	13.08	13.00	11.24	0.45	1.19	426.49	32.15	6.39	1.90	189.14
10/8/02	281	1012	895.8	291.1	1.6	57.34	18.97	13.12	25.67	0.47	1.40	455.16	9.67	6.66	2.21	18.26
10/15/02	288	1019	996.4	285.4	2.9	1.92	13.27	2.59	16.60	0.42	0.46	401.46	552.77	14.97	1.79	5.91
10/22/03	295	1026	942	285	0.7	242.9	8.40	3.40	13.69	0.44	0.49	400.29	77.79	6.34	1.34	1.61
10/29/02	302	1033	945.5	280.1	3.9	26.1	6.43	0.48	10.65	0.44	0.48	394.05	8.23	6.31	1.25	1.60
11/5/02	309	1040	946.7	282.1	1.2	322.7	9.43	4.74	17.78	0.44	0.48	405.30	38.15	6.30	1.43	4.50
11/12/02	316	1047	946.7	279.1	3.5	59.22	13.62	5.79	12.65	0.44	1.45	413.09	18.35	6.30	1.61	4.23
11/19/02	323	1054	943.6	280.4	1.7	216.3	11.94	4.36	19.14	0.44	0.49	433.09	19.10	6.32	1.47	1.61
11/26/02	330	1061	961.3	273.6	2.3	64.62	11.12	3.35	23.08	0.43	0.48	450.28	6.63	6.21	1.34	1.58
12/19/02	352	1083	952.6	281	0.7	156.3	8.67	0.48	10.78	0.44	0.48	421.95	118.32	6.26	1.52	1.59
1/21/03	21	1117	942.4	266.1	2.2	291.1	0.70	1.10	5.32	0.44	0.49	147.44	0.32	6.33	0.38	1.61
4/15/03	105	1201	970.5	282.9	3.9	207.3	20.70	43.64	15.68	0.43	2.51	2385.67	44.88	6.15	2.02	48.00
4/22/03	112	1208	726.5	282.3	3.2	284.1	27.65	58.29	20.95	0.57	3.36	3186.65	59.94	8.21	2.70	64.11
4/29/03	120	1216	741.9	280.2	1.9	129.6	12.39	16.74	13.07	0.56	0.62	239.95	187.44	8.04	1.31	36.34
5/6/03	127	1223	709.4	280	2	200.6	22.94	48.39	23.26	0.59	2.89	560.81	51.10	8.41	2.09	85.85

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	α-chlordane	α-endosulfan	α-HCH	Aldrin	β-endosulfan	chthnl	clrps	Chlorp. Oxon	Cis-nonachlor	Diazinon
5/13/03	133	1229	735	284.4	4.4	317.1	12.45	9.31	17.80	0.57	0.62	214.61	29.01	8.12	1.28	131.67
5/22/03	142	1238	725	297.2	1.7	18.82	5.52	8.17	10.29	0.58	0.63	421.55	22.18	8.23	0.49	23.94
5/27/03	147	1243	708.5	280.8	1.2	159.2	15.50	15.68	22.05	0.59	0.65	245.49	15.50	8.42	1.54	28.94
6/3/03	154	1250	708.5	286.1	1.9	255.6	10.83	12.89	10.53	0.59	0.65	355.96	13.85	8.42	1.17	50.84
6/12/03	163	1259	722.3	294.6	2.7	215.2	16.82	23.85	28.10	0.58	1.70	262.25	110.40	8.26	1.83	408.51
6/18/03	169	1265	720.5	289	1	137.3	56.15	382.27	28.41	0.58	41.64	10601.21	238.39	20.94	5.75	378.07
6/22/03	172	1268	686.8	285.8	2.2	291.1	40.43	60.50	38.48	0.61	3.44	549.97	363.92	19.25	3.61	404.18
7/1/03	182	1278	724.1	294.5	1.3	268.8	36.10	809.76	35.91	0.58	68.86	6197.68	72.89	8.24	3.07	347.32
7/8/03	189	1285	706.7	299.3	1.9	349.3	34.30	113.48	43.39	0.59	6.85	775.22	83.22	8.45	3.08	295.66
7/15/03	196	1292	731.6	298.6	2.3	255.7	44.49	89.59	23.00	0.57	10.16	6805.45	86.33	8.16	4.47	486.34
7/22/03	203	1299	730.1	294.6			46.96	91.15	55.85	0.57	5.57	584.55	174.87	8.17	4.44	683.16
7/29/03	210	1306	701.5	301.2			51.90	334.49	30.59	0.59	49.16	562.84	442.69	20.33	5.29	364.98
8/5/03	217	1313	707.3	300.6			52.77	92.88	52.10	0.59	11.07	579.58	40.72	8.44	3.78	285.75
8/12/03	224	1320	706.7	296.5			32.56	101.92	29.53	0.59	11.80	520.53	145.42	8.45	3.37	442.93
8/19/03	231	1327	719.9	301.4	0.9	113	67.16	77.08	26.11	0.58	4.85	871.96	366.01	16.97	5.95	318.40
8/26/03	238	1334	712.1	294.8			33.89	64.70	52.13	0.59	5.43	559.40	74.79	8.38	2.54	166.01
9/2/03	245	1341	730.4	302	1.8	25.88	58.42	312.92	33.65	0.57	30.11	5650.43	159.93	8.17	4.93	440.99
9/9/03	252	1348	707	292.3			68.43	116.41	59.95	0.59	13.93	653.77	49.47	8.44	5.39	213.53
9/16/03	259	1355	716.6	300.4	0.9	72.79	32.32	21.45	61.39	0.58	0.64	485.81	3.89	8.33	2.93	2.11

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Dieldrin	endo. sulfate	Fipronil	γ-chlordane	γ–HCH	HEPT	HEPTX	Mlthn	Mirex	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
4/11/01	101	467	702	284.8	1.5	86.25	18.68	1.40	0.36	26.00	14.63	16.84	4.54	2.62	0.57	0.74	14.64	17.27	3.05	1.56	
4/18/01	108	474	619.2	277.8	3.2	287.9	28.41	0.78	0.41	4.62	11.40	6.10	0.89	2.97	0.65	0.84	1.89	9.33	3.46	6.22	
4/25/01	115	481	626.4	280.6	2	281.9	96.82	0.77	0.41	26.02	27.57	21.39	3.93	2.94	0.64	5.33	14.73	45.43	3.42	5.64	
5/16/01	136	502	914.8	286.3	1.7	277.8	54.26	1.46	0.28	14.10	38.53	11.60	2.35	2.01	0.44	0.57	8.41	40.11	3.44	8.36	
5/23/01	143	509	789.5	291	1.5	276.2	211.96	5.93	0.32	48.01	87.21	41.95	7.36	2.33	0.51	6.62	31.48	112.87	6.31	28.26	
5/30/01	150	516	782.4	288	3.1	294	85.97	1.34	0.33	10.54	75.35	15.68	0.71	2.35	0.51	2.07	6.98	67.46	6.99	19.26	
6/6/01	157	523	777.5	293.8	1.5	280.9	148.60	3.34	0.33	39.25	97.54	28.98	5.58	2.37	0.52	4.73	25.77	168.85	13.07	34.13	
6/13/01	164	530	713.1	297.5	1.6	286	290.35	10.28	0.36	102.90	186.99	59.61	12.09	66.75	0.56	11.22	73.66	307.66	22.51	59.22	
6/20/02	171	537	713.7	297.2	2	286.8	67.92	0.68	0.36	7.89	12.37	4.33	0.77	2.58	0.56	0.73	3.95	48.83	7.43	17.71	
6/27/01	178	544	756.2	299.6	1.6	286.5	150.38	8.15	0.34	54.92	286.88	35.24	6.86	39.83	0.53	7.15	40.89	330.59	27.53	68.17	
7/11/01	192	558	749.4	295.6	2.1	285	89.53	5.94	0.34	26.35	96.00	19.29	9.66	2.46	0.54	5.82	20.19	189.51	19.31	35.16	
7/17/01	198	564	750.4	294.6	2.7	287.2	53.51	8.81	0.34	77.95	49.88	43.34	10.49	5.28	0.53	6.26	47.71	261.01	24.49	61.94	
7/25/01	206	572	742	300.8	4.2	275.3	95.41	16.17	0.34	46.04	42.13	33.30	2.26	40.51	0.54	3.25	29.78	340.06	35.40	90.36	
8/8/01	220	586	740.8	302.1	1.8	282.3	170.76	23.77	0.34	52.70	56.16	12.55	12.26	35.60	0.54	11.60	41.81	395.19	30.87	76.78	
8/15/01	227	593	715.5	294.5	1.2	277.9	48.16	4.26	0.36	49.92	32.76	37.25	5.10	######	0.56	4.98	31.88	161.48	13.72	33.79	
8/22/01	234	600	902.4	296.6	1	280.5	0.56	0.54	0.28	0.77	3.61	8.00	0.61	2.04	0.44	0.58	0.71	0.44	2.37	2.68	
8/29/01	241	607	602.9	296.6	1.1	278.9	96.79	13.90	0.42	92.86	59.47	58.20	10.76	695.27	0.67	11.26	62.10	351.84	23.50	69.26	
9/5/01	248	614	764.6	292.1	4.1	74.97	71.54	7.86	0.33	38.04	42.91	42.52	7.26	16.44	0.52	6.85	24.13	182.05	16.14	48.35	
9/12/01	255	621	743	293	4.2	218.3	16.46	3.81	0.34	27.82	21.12	27.09	2.62	2.48	0.54	3.01	16.43	125.05	13.00	45.01	
9/19/01	262	628	981.8	293.8	5.9	93.88	22.79	3.81	0.26	33.69	22.95	30.76	3.89	4.31	0.41	3.91	22.03	146.25	15.50	27.48	
9/26/01	269	635	980.2	287.2	5.6	200.7	12.13	1.23	3.68	14.56	15.14	18.31	2.36	1.88	0.41	1.54	8.38	78.78	9.16	19.77	
10/3/01	276	642	1116	294	4.5	217.3	72.32	2.92	4.51	30.15	30.09	32.85	4.14	16.63	0.36	4.44	20.15	231.59	25.85	44.37	
10/10/01	283	649	1156	290.3	5.8	230.3	19.49	2.15	0.63	18.58	14.00	17.42	0.48	1.59	0.35	1.30	10.85	145.69	12.63	26.20	
10/17/01	290	656	757.8	284.9	14	301.6	5.33	1.43	0.34	5.87	13.09	7.10	0.73	2.43	0.53	0.69	3.39	43.63	8.17	14.54	
10/24/01	296	662	983.1	296.2	6.7	239.5	20.19	3.08	0.26	33.73	26.05	32.22	4.11	6.22	0.41	3.15	21.62	96.27	14.99	23.50	
10/31/01	304	670	982.2	286.2	4.7	239.9	4.04	1.30	38.78	9.75	9.47	12.19	0.56	1.88	0.41	0.53	5.50	58.14	8.44	16.14	
11/7/01	311	677	981.8	284.2	4.8	331.7	14.36	0.49	17.70	12.22	18.93	22.33	0.56	1.88	0.41	2.06	7.23	78.06	13.55	21.21	
11/14/01	318	684	982.2	283.5	4.2	219.5	6.86	0.49	21.76	9.67	14.50	15.32	0.56	1.88	0.41	0.53	5.40	91.24	17.69	26.07	

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Dieldrin	endo. sulfate	Fipronil	γ-chlordane	γ–HCH	HEPT	HEPTX	Mlthn	Mirex	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
11/21/01	325	691	982.6	288	3.5	230.7	1.63	0.49	0.26	5.28	7.85	10.82	0.56	1.87	0.41	0.53	2.60	29.34	5.58	6.21	
1/3/02	3	734	977.8	270.6	3.4	279.4	1.83	2.30	0.26	4.46	4.09	9.01	0.56	1.88	0.41	1.37	2.20	13.73	2.19	5.25	
2/22/02	53	784	840.5	279.5	2.9	288.5	14.18	3.38	0.88	15.29	10.47	13.03	1.39	2.19	0.48	2.40	10.07	75.77	17.98	43.81	
3/6/02	65	796	922	282.9	4.4	204.9	4.72	2.87	0.28	5.34	5.63	6.61	0.60	2.00	0.44	1.58	3.22	31.56	2.32	16.18	
3/13/02	72	803	972.1	282.3	3.3	63.76	18.81	3.50	0.87	21.20	9.80	27.54	4.61	1.89	0.41	3.74	11.96	73.20	11.51	31.79	
3/19/02	78	809	1011	280.2	2.5	159.4	0.50	2.17	0.25	1.63	2.23	0.28	0.55	1.82	0.40	0.52	0.63	6.43	13.24	2.39	
3/28/02	87	818	708	280	1.9	230.9	2.82	3.19	0.36	4.05	4.58	0.40	0.78	2.60	0.57	0.74	2.36	16.02	10.04	5.16	
4/2/02	92	823	704.2	284.4	5.3	233.5	24.41	3.81	0.36	12.04	9.91	7.65	0.78	2.62	0.57	3.12	8.86	52.97	6.94	20.39	
4/8/02	98	829	640.1	289.1	5.2	225.3	20.40	3.95	0.40	15.98	19.58	12.20	6.41	2.88	0.63	3.92	10.97	65.09	12.31	18.39	
4/16/02	106	837	560	297.2	1.4	200.9	257.60	12.36	3.57	155.17	162.92	63.86	14.43	3.29	0.72	14.45	102.51	571.16	67.36	177.92	
4/23/02	113	844	698.9	280.8	2.3	293.8	1.60	3.58	0.36	2.00	8.79	0.40	0.79	2.64	0.57	0.75	0.91	14.28	3.07	5.39	
4/30/02	120	851	717.5	286.1	2.7	197.2	29.69	4.00	0.36	10.12	61.60	7.23	0.77	2.57	0.56	2.65	6.75	50.77	9.84	9.52	
5/7/02	127	858	716	294.6	2.4	326.7	103.70	5.99	0.36	50.91	166.16	20.26	0.77	2.57	0.56	4.71	31.76	305.97	23.57	66.74	
5/14/02	134	865	711.5	289	4.5	326.1	11.93	3.16	0.36	6.70	30.17	5.26	0.78	2.59	0.56	2.12	4.15	29.89	15.71	13.52	
5/21/02	141	872	814.9	285.8	1.8	292	13.41	3.03	0.31	8.18	38.74	7.85	0.68	2.26	0.49	1.98	4.93	46.58	2.63	7.39	
5/28/02	148	879	820.9	294.5	1.9	97.2	32.55	4.57	0.79	45.44	90.69	14.29	4.39	2.24	0.49	3.91	28.05	245.85	24.19	38.75	
6/4/02	155	886	710.1	299.3	3.7	250.2	25.62	4.42	0.36	18.04	61.87	16.35	6.25	2.59	0.57	4.55	13.91	42.21	3.02	8.00	
6/11/02	162	893	878.3	298.6	3.6	205.4	115.22	6.79	0.29	52.59	92.39	30.11	5.09	36.08	0.46	5.49	37.15	277.11	19.83	43.07	
6/18/02	169	900	814.5	294.6	1.4	117.7	57.32	4.83	0.79	43.94	47.98	37.56	0.68	2.26	0.49	5.28	28.01	115.79	14.81	23.63	
6/25/02	176	907	1281	301.2	1.9	226.5	132.61	7.90	0.20	72.70	93.60	30.97	0.43	1.44	0.31	6.47	50.81	261.71	14.54	36.57	
7/2/02	183	914	705.2	300.6	1.4	209.7	83.52	7.42	0.36	36.61	67.65	27.17	5.29	2.61	0.57	4.15	25.34	98.78	3.04	4.41	
7/9/02	190	921	734.5	296.5	2.4	357.1	51.78	8.24	0.35	22.68	45.77	15.77	3.43	8.74	0.55	4.33	16.61	326.69	2.92	12.39	
7/16/02	197	928	722.4	301.4	2.3	288.6	18.70	4.08	0.35	12.01	17.12	8.01	1.88	2.55	0.56	2.78	7.79	261.31	2.97	9.80	
7/23/02	204	935	1187	294.8	3	183.7	66.01	7.57	0.21	23.86	33.15	19.47	2.48	1.55	0.34	3.93	17.17	294.58	10.11	23.86	
7/30/02	211	942	942	302	2.6	307.1	106.88	8.59	0.27	36.34	44.99	26.34	5.65	1.96	0.43	7.62	27.64	533.92	17.23	32.90	
8/6/02	218	949	939.6	292.3	3.6	62.89	31.77	8.43	0.27	24.05	21.26	16.94	3.72	1.96	0.43	4.86	15.56	374.04	8.66	14.71	
8/13/02	225	956	924.2	300.4	2.3	221.8	31.40	12.28	0.28	29.47	19.64	26.19	0.60	1.99	0.43	3.46	20.32	372.73	14.59	32.15	
8/20/02	232	963	940.4	295.2	2.1	25.75	52.82	6.97	0.27	50.57	22.32	31.07	11.01	1.96	0.43	7.57	35.05	434.53	12.84	28.35	
8/27/02	239	970	957.8	292.6	1.4	178.3	76.41	8.01	0.27	64.57	27.54	41.00	9.31	1.92	0.42	7.91	43.64	543.55	18.22	39.59	
9/3/02	246	977	930.5	296.9	1.9	200.9	21.27	4.19	0.27	21.57	16.35	13.90	5.06	1.98	0.43	3.51	14.71	258.87	7.57	16.75	

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Dieldrin	endo. sulfate	Fipronil	γ-chlordane	γ–HCH	HEPT	HEPTX	Mlthn	Mirex	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
9/10/02	253	984	933.7	293.2	2.6	54.97	18.33	3.11	0.27	43.18	9.34	29.60	3.75	1.97	0.43	3.13	26.13	424.40	15.41	33.85	
9/17/02	260	991	951	292.5	1.3	283.3	19.72	4.50	0.27	16.48	12.89	19.81	2.95	1.94	0.42	3.50	10.63	194.81	5.49	16.16	
9/24/02	267	998	938.8	293.1	1.5	75.79	28.70	4.25	0.27	29.53	18.40	24.52	8.03	1.96	0.43	5.10	18.67	340.47	9.64	26.06	
10/1/02	274	1005	934.5	296.5	1.8	206.9	13.32	3.07	0.27	14.84	12.20	13.75	4.48	1.97	0.43	2.48	10.10	242.64	8.23	23.44	
10/8/02	281	1012	895.8	291.1	1.6	57.34	13.83	3.04	0.28	21.67	11.27	17.94	3.73	2.06	0.45	2.99	12.96	244.48	5.05	13.93	
10/15/02	288	1019	996.4	285.4	2.9	1.92	7.77	2.47	3.96	16.34	5.82	11.27	0.55	1.85	0.40	1.48	9.56	148.24	2.15	12.22	
10/22/03	295	1026	942	285	0.7	242.9	6.25	2.48	0.27	10.10	6.35	11.02	3.93	1.96	0.43	2.05	6.04	103.77	6.08	8.16	
10/29/02	302	1033	945.5	280.1	3.9	26.1	2.53	2.47	0.27	8.28	4.10	7.74	0.58	1.95	0.42	1.60	4.76	68.53	2.27	5.61	
11/5/02	309	1040	946.7	282.1	1.2	322.7	9.23	2.52	0.27	11.77	8.63	11.09	1.47	1.95	0.42	2.08	7.14	133.02	2.26	12.61	
11/12/02	316	1047	946.7	279.1	3.5	59.22	11.68	2.63	0.27	18.27	7.35	16.38	3.65	1.95	0.42	2.80	10.69	108.98	2.26	9.32	
11/19/02	323	1054	943.6	280.4	1.7	216.3	11.04	2.49	0.27	15.56	10.58	20.77	0.59	1.95	0.43	2.48	8.81	144.61	5.09	9.93	
11/26/02	330	1061	961.3	273.6	2.3	64.62	10.24	2.40	0.27	15.03	9.14	32.50	0.57	1.92	0.42	2.09	7.54	103.53	2.23	9.26	
12/19/02	352	1083	952.6	281	0.7	156.3	5.81	2.53	0.27	10.63	6.76	9.83	0.58	1.93	0.42	3.53	6.96	135.54	5.75	11.09	
1/21/03	21	1117	942.4	266.1	2.2	291.1	2.44	0.51	0.27	1.80	2.42	3.18	0.59	1.95	0.43	0.55	0.68	21.98	2.27	5.59	
4/15/03	105	1201	970.5	282.9	3.9	207.3	58.07	1.78	0.26	24.34	40.04	15.88	2.84	1.90	2.49	3.56	16.93	663.02	54.82	127.15	
4/22/03	112	1208	726.5	282.3	3.2	284.1	77.56	2.38	0.35	32.51	53.49	21.21	3.80	2.54	3.33	4.75	22.61	323.06	21.72	39.48	
4/29/03	120	1216	741.9	280.2	1.9	129.6	64.05	0.65	0.34	14.92	23.51	15.49	6.23	2.48	0.54	3.42	10.41	543.84	38.46	80.50	
5/6/03	127	1223	709.4	280	2	200.6	62.03	1.83	0.36	28.19	283.11	29.15	0.78	2.60	3.33	5.57	18.83	251.41	20.22	30.48	

APPENDIX Z - Analyte concentrations in gas phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol (m^3)	Temp (K)	wS (mph)	WD	Dieldrin	endo. sulfate	Fipronil	γ-chlordane	γ–HCH	HEPT	HEPTX	Mlthn	Mirex	Oxy-chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
5/13/03	133	1229	735	284.4	4.4	317.1	32.45	0.66	0.35	15.82	66.93	15.31	0.75	2.51	1.27	2.65	9.77	170.21	12.50	24.31	
5/22/03	142	1238	725	297.2	1.7	18.82	18.88	0.67	0.35	6.19	72.98	0.39	0.76	2.54	0.55	2.46	4.68	160.93	13.20	24.69	
5/27/03	147	1243	708.5	280.8	1.2	159.2	21.53	0.68	0.36	19.39	17.74	13.95	0.78	2.60	0.57	2.47	11.63	120.39	9.63	19.44	
6/3/03	154	1250	708.5	286.1	1.9	255.6	12.87	0.68	0.36	12.39	11.31	7.81	0.78	2.60	0.57	2.33	7.97	276.89	27.98	47.85	
6/12/03	163	1259	722.3	294.6	2.7	215.2	51.09	1.91	0.35	20.19	66.25	0.39	0.76	2.55	0.56	3.93	14.00	670.90	73.18	168.36	
6/18/03	169	1265	720.5	289	1	137.3	197.93	15.68	0.35	64.34	158.36	14.55	0.77	63.21	12.06	8.72	47.48	318.21	33.14	68.62	
6/22/03	172	1268	686.8	285.8	2.2	291.1	94.64	3.33	0.37	49.48	72.15	36.84	0.80	2.68	5.96	6.28	30.94	389.88	40.87	90.56	
7/1/03	182	1278	724.1	294.5	1.3	268.8	155.62	15.69	0.35	39.86	178.84	26.54	6.85	91.70	2.62	8.34	29.19	323.21	33.45	67.01	
7/8/03	189	1285	706.7	299.3	1.9	349.3	89.99	5.29	0.36	39.01	346.77	30.23	4.03	31.46	0.57	7.98	27.84	432.51	44.24	112.44	
7/15/03	196	1292	731.6	298.6	2.3	255.7	313.66	7.15	0.35	48.84	382.33	34.91	5.85	11.74	54.04	8.53	38.46	349.56	37.60	107.17	
7/22/03	203	1299	730.1	294.6			105.75	2.66	0.35	54.14	70.25	30.99	4.71	15.15	36.18	7.93	36.43	355.47	39.92	91.64	
7/29/03	210	1306	701.5	301.2			140.16	9.29	1.81	61.11	71.37	25.16	0.79	45.74	1.70	7.10	43.62	243.95	21.98	72.43	
8/5/03	217	1313	707.3	300.6			65.82	3.42	0.36	63.29	33.00	49.98	11.20	2.60	16.01	7.20	37.20	149.94	16.71	48.74	
8/12/03	224	1320	706.7	296.5			70.98	4.20	0.36	39.79	36.55	28.81	3.96	5.62	26.41	5.83	26.90	289.19	27.82	77.31	
8/19/03	231	1327	719.9	301.4	0.9	113	104.67	5.97	0.35	80.86	40.64	39.62	6.14	39.12	4.06	8.45	52.28	213.65	26.34	57.52	
8/26/03	238	1334	712.1	294.8			39.21	0.68	0.36	39.18	45.39	25.19	7.72	2.59	0.56	3.16	25.49	364.34	32.12	92.01	
9/2/03	245	1341	730.4	302	1.8	25.88	132.48	12.66	0.35	65.93	68.01	39.76	9.08	18.80	0.55	9.86	46.31	300.59	26.18	74.54	
9/9/03	252	1348	707	292.3			82.07	8.80	0.36	81.83	45.32	44.57	4.64	2.61	0.57	7.03	49.11	157.84	14.77	36.51	
9/16/03	259	1355	716.6	300.4	0.9	72.79	25.57	0.68	0.36	37.79	15.13	18.00	2.55	2.57	0.56	3.67	22.62	169.98	15.18	33.32	

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	CHTHNL	CLRPS	Chlorpyfs Oxon	Diazinon	a-endosulfan
4/2/02	92	823	715.3	289.6	93.73	11.01	7.75	4.72	4.61	700.43	5.40	198.24	79.72	8.34	8.98	68.28
4/9/02	99	830	715.3	291.2	196.2	6.855	7.75	4.72	489.69	10.82	5.40	87.36	345.55	8.34	126.62	82.36
4/16/02	106	837	670.0	297.3	204.7	2.555	224.66	141.61	7015.36	649.19	1008.21	258.78	28.45	8.91	56.61	51.55
4/23/02	113	844	414.9	281.4	317.4	3.945	13.36	8.14	209.15	18.66	9.31	21.62	0.73	14.38	17.74	14.53
4/30/02	120	851	711.4	286.7	197.1	5.086	105.20	160.53	142.98	10.88	5.43	12.61	40.58	8.39	95.04	39.48
5/7/02	127	858	704.9	294.7	357.9	3.982	516.36	235.57	870.44	252.62	136.72	206.50	85.48	8.47	17.22	177.33
5/14/02	134	865	740.3	285.8	351.2	5.735	20.37	61.72	4.45	207.82	5.22	12.12	27.47	8.06	13.05	10.82
5/22/02	142	873	736.1	286.2	349.5	2.281	33.62	39.26	172.41	10.52	5.25	12.19	11.61	8.11	18.05	15.27
7/9/02	190	921	698.3	300.7	192	4.256	7.94	54.38	214.01	11.09	5.53	265.98	409.28	8.55	257.33	322.43
7/16/02	197	928	718.6	298.1	303.4	3.181	7.71	100.35	4.59	904.32	5.37	225.73	26.27	8.31	15.98	221.44
7/23/02	204	935	735.3	299.7	187.9	5.393	7.54	4.59	4.48	276.18	5.25	245.83	62.22	8.12	38.37	142.09
7/30/02	211	942	716.5	301	322.9	3.073	7.73	14.26	4.60	669.47	5.39	224.29	144.05	8.33	34.99	214.79
9/24/02	267	998	641.2	291.6	277.5	3.097	8.64	54.76	5.14	469.17	6.02	259.60	28.96	9.31	13.16	32.25
10/1/02	274	1005	661.2	295	225.2	3.324	8.38	58.54	935.16	11.71	5.84	217.63	14.05	9.03	21.76	34.94
10/8/02	281	1012	638.2	286.8	76.69	2.226	8.68	5.29	5.16	12.13	6.05	244.68	3.32	9.35	8.65	12.08
10/15/02	288	1019	649.1	287.8	55.81	6.031	8.54	13.80	5.08	11.92	5.95	224.19	53.56	9.19	9.57	14.51
10/22/02	295	1026	665.9	283.1	241.2	1.568	8.32	88.31	4.95	11.62	5.80	225.75	1.34	8.96	10.03	1.50
10/29/02	302	1033	656.5	278.7	65.12	6.948	8.44	5.14	54.89	11.79	5.88	207.02	9.21	9.09	8.53	2.48
11/6/02	310	1041	654.9	282.1	329.4	6.759	8.46	5.16	609.07	11.82	5.90	213.71	0.46	9.11	2.31	1.83
11/12/02	317	1048	645.6	283.2	334.4	3.025	8.58	34.12	5.10	11.99	5.98	217.82	18.70	9.24	2.35	5.45
11/19/02	323	1054	642.6	279.6	221.3	2.908	8.62	59.96	5.13	12.05	6.01	218.84	0.47	9.29	2.36	0.71
11/26/02	330	1061	642.6	278.8	290	3.193	8.62	5.26	5.13	12.05	6.01		0.47	9.29	2.36	0.71
4/1/03	91	1187	903.4	289.6	233.6	5.358	6.13	3.74	3.65	8.57	4.28	296.99	69.96	6.61	1.68	7.15
4/7/03	97	1193	926.8	291.2	37.51	7.569	218.28	3.64	3.56	8.35	84.37	274.27	14.48	6.44	1.64	6.12

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	CHTHNL	CLRPS	Chlorpyfs Oxon	Diazinon	a-endosulfan
4/15/03	104	1200	871.4	297.3	98.04	6.925	213.97	3.88	3.78	8.88	4.43	10.29	23.38	6.85	1.74	49.07
4/22/03	112	1208	857.0	281.4	311.9	5.955	6.47	3.94	3.84	9.03	117.73	348.31	149.66	6.96	66.17	17.77
4/29/03	119	1215	898.1	286.7	308.8	3.818	427.06	3.76	3.67	8.62	4.30	9.99	63.83	6.64	551.91	74.50
5/6/03	126	1222	898.5	294.7	64.07	1.758	6.17	3.76	449.84	8.62	4.30	483.78	22.37	6.64	25.87	23.13
5/13/03	133	1229	776.9	286.2	333.9	5.628	1015.31	4.35	758.29	9.96	110.10	332.17	20.66	7.68	32.04	18.51
5/20/03	140	1236	764.3	294.2	97.58	3.892	693.75	4.42	284.61	10.13	5.05	477.21	97.51	7.81	69.21	12.43
5/27/03	147	1243	776.9	295.3	99.87	2.376	7.13	4.35	4.24	9.96	4.97	480.02	11.34	7.68	41.74	25.65
6/3/03	154	1250	765.6	294	152.7	5.125	804.72	4.41	154.45	10.11	139.14	11.72	19.25	7.79	22.18	35.11
6/10/03	161	1257	758.9	301.2	116.1	4.18	7.30	4.45	255.66	10.20	164.27	230.16	37.45	7.86	45.99	62.54
6/17/03	168	1264	759.5	302	161.7	3.588	7.30	4.45	4.34	10.19	102.41	225.38	38.12	7.86	28.00	59.37
6/24/03	175	1271	757.6	300.7	322	2.113	7.32	4.46	816.38	10.22	407.68	11.84	113.77	7.88	443.96	745.10
7/1/03	182	1278	773.0	298.1	260.8	2.823	7.17	4.37	426.27	10.01	169.93	11.60	62.74	7.72	174.29	162.04
7/8/03	189	1285	634.6	301	187.7	2.511	8.73	5.32	474.81	12.20	231.82	14.13	249.96	9.40	195.74	119.12
7/15/03	196	1292	621.7	294.7	106.5	6.585	8.91	5.43	289.74	12.45	6.21	2818.88	131.06	9.60	69.15	365.48
7/22/03	203	1299	625.1	300.6	240.6	6.552	8.86	5.40	169.55	12.38	6.18	14.35	717.82	9.55	168.36	299.57
7/29/03	210	1306	644.1	299.2	154.2	2.239	8.60	5.24	5.12	12.02	6.00	13.93	149.57	9.26	39.91	210.04
8/5/03	217	1313	628.0	297.7	268.6	3.664	8.82	5.38	5.25	12.33	6.15	298.74	577.79	9.50	74.25	284.79
8/12/03	224	1320	643.9	297.3	122.3	2.106	8.61	5.24	5.12	12.02	6.00	13.93	146.74	9.27	65.56	110.74
8/19/03	231	1327	626.7	293.7	258.2	2.585	8.84	5.39	5.26	12.35	6.16	14.31	40.88	9.52	122.46	734.67
8/26/03	238	1334	590.6	291.6	212.8	3.328	9.38	5.72	5.58	13.11	6.54	15.19	143.82	10.10	336.18	4805.52
9/2/03	245	1341	627.0	295	44.29	2.762	8.84	5.39	5.26	12.35	6.16	14.31	27.83	9.52	46.68	740.15
9/9/03	252	1348	596.1	286.8	49.9	5.382	9.30	5.66	5.53	12.99	6.48	15.05	29.44	10.01	40.19	88.87
9/16/03	259	1355	567.4	283.1	290.4	3.25	9.77	5.95	5.81	13.64	6.81	15.81	41.24	10.52	41.56	301.04

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	b-endosulfan	endo. sulfate	Fipronil	Metolachlr	Metribuzin	Pendimeth	Simazine	Trifluralin	Aldrin
4/2/02	92	823	715.3	289.6	93.73	11.01	10.51	2.77	0.36	40.86	14.60	8.29	15.98	50.57	0.58
4/9/02	99	830	715.3	291.2	196.2	6.855	15.88	11.27	0.36	3281.91	14.60	8.29	15.98	512.63	0.58
4/16/02	106	837	670.0	297.3	204.7	2.555	5.51	4.58	0.38	9797.03	679.66	21840.99	1513.42	150.88	0.62
4/23/02	113	844	414.9	281.4	317.4	3.945	1.10	1.17	0.61	537.07	25.16	1069.62	27.55	17.19	1.01
4/30/02	120	851	711.4	286.7	197.1	5.086	2.11	0.68	0.36	356.35	14.67	370.39	16.07	413.09	0.59
5/7/02	127	858	704.9	294.7	357.9	3.982	6.28	3.11	0.36	1449.38	14.81	455.81	237.67	312.87	0.59
5/14/02	134	865	740.3	285.8	351.2	5.735	1.36	1.34	0.34	134.25	14.10	73.74	15.44	114.49	0.56
5/22/02	142	873	736.1	286.2	349.5	2.281	1.82	0.66	0.35	319.73	14.18	340.92	15.53	366.61	0.57
7/9/02	190	921	698.3	300.7	192	4.256	20.69	4.68	0.36	485.97	14.95	158.20	16.37	1466.15	0.60
7/16/02	197	928	718.6	298.1	303.4	3.181	31.40	4.88	0.35	153.28	14.53	95.50	15.91	78.25	0.58
7/23/02	204	935	735.3	299.7	187.9	5.393	12.00	4.24	0.35	243.93	14.20	295.50	15.55	262.59	0.57
7/30/02	211	942	716.5	301	322.9	3.073	12.24	4.37	0.36	173.72	14.57	109.03	15.95	689.85	0.58
9/24/02	267	998	641.2	291.6	277.5	3.097	6.85	3.23	0.40	7.55	16.28	9.25	17.83	53.48	0.65
10/1/02	274	1005	661.2	295	225.2	3.324	7.43	3.90	0.39	1331.09	15.79	8.97	17.29	321.70	0.63
10/8/02	281	1012	638.2	286.8	76.69	2.226	2.46	1.79	0.40	7.58	16.36	9.29	17.91	15.97	0.65
10/15/02	288	1019	649.1	287.8	55.81	6.031	2.28	1.69	3.42	7.46	16.08	9.13	17.61	21.46	0.64
10/22/02	295	1026	665.9	283.1	241.2	1.568	0.69	0.73	0.38	17.54	35.08	8.90	17.17	28.38	0.63
10/29/02	302	1033	656.5	278.7	65.12	6.948	0.70	0.74	0.39	461.84	90.52	9.03	17.41	28.89	0.64
11/6/02	310	1041	654.9	282.1	329.4	6.759	0.70	0.74	0.39	1488.83	81.91	9.05	17.45	13.77	0.64
11/12/02	317	1048	645.6	283.2	334.4	3.025	1.78	0.75	0.39	7.50	43.95	9.18	17.71	30.78	0.65
11/19/02	323	1054	642.6	279.6	221.3	2.908	0.71	0.75	0.40	7.53	107.12	9.23	17.79	24.04	0.65
11/26/02	330	1061	642.6	278.8	290	3.193	0.71	0.75	0.40	7.53	131.92	9.23	17.79	13.68	0.65
4/1/03	91	1187	903.4	289.6	233.6	5.358	0.51	0.54	0.28	5.36	11.56	6.56	12.65	146.16	0.46
4/7/03	97	1193	926.8	291.2	37.51	7.569	0.49	0.52	0.27	5.22	11.26	6.40	12.33	139.98	0.45

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	b-endosulfan	endo. sulfate	Fipronil	Metolachlr	Metribuzin	Pendimeth	Simazine	Trifluralin	Aldrin
4/15/03	104	1200	871.4	297.3	98.04	6.925	3.35	2.75	0.29	773.63	11.98	6.80	13.12	265.78	0.48
4/22/03	112	1208	857.0	281.4	311.9	5.955	0.53	0.57	0.30	5.65	12.18	6.92	13.34	249.44	0.49
4/29/03	119	1215	898.1	286.7	308.8	3.818	4.08	1.78	0.28	963.24	11.62	6.60	12.73	417.34	0.46
5/6/03	126	1222	898.5	294.7	64.07	1.758	1.45	0.54	0.28	303.21	11.62	6.60	12.72	245.56	0.46
5/13/03	133	1229	776.9	286.2	333.9	5.628	0.59	0.62	0.33	2827.51	193.63	2779.51	718.33	426.01	0.54
5/20/03	140	1236	764.3	294.2	97.58	3.892	0.60	0.63	0.33	1034.87	13.66	7.76	14.96	277.23	0.55
5/27/03	147	1243	776.9	295.3	99.87	2.376	1.96	0.62	0.33	313.68	13.44	2087.56	14.71	243.44	0.54
6/3/03	154	1250	765.6	294	152.7	5.125	2.32	1.49	2.18	717.45	13.64	1609.76	14.93	913.64	0.54
6/10/03	161	1257	758.9	301.2	116.1	4.18	4.99	4.11	0.34	1115.38	13.76	1708.26	15.06	557.10	0.55
6/17/03	168	1264	759.5	302	161.7	3.588	2.37	1.82	0.34	218.80	13.75	7.80	15.05	265.38	0.55
6/24/03	175	1271	757.6	300.7	322	2.113	52.26	12.36	0.34	2882.77	13.78	7.82	15.09	1392.77	0.55
7/1/03	182	1278	773.0	298.1	260.8	2.823	9.21	4.13	2.26	1186.37	13.50	7.67	14.79	2204.30	0.54
7/8/03	189	1285	634.6	301	187.7	2.511	11.63	7.09	6.76	4862.78	16.45	9.34	18.01	3433.47	0.66
7/15/03	196	1292	621.7	294.7	106.5	6.585	24.80	7.25	2.53	1227.51	16.79	677.03	18.39	4678.03	0.67
7/22/03	203	1299	625.1	300.6	240.6	6.552	38.65	12.45	0.41	1498.08	16.70	9.48	18.29	5686.10	0.67
7/29/03	210	1306	644.1	299.2	154.2	2.239	20.57	5.95	0.40	477.10	16.21	9.20	17.75	2589.56	0.65
8/5/03	217	1313	628.0	297.7	268.6	3.664	37.77	9.30	0.41	273.11	16.62	9.44	18.20	2323.76	0.66
8/12/03	224	1320	643.9	297.3	122.3	2.106	10.53	7.70	0.40	272.34	16.21	9.21	17.75	1786.75	0.65
8/19/03	231	1327	626.7	293.7	258.2	2.585	53.76	11.58	0.41	7.72	16.66	9.46	18.24	1404.70	0.67
8/26/03	238	1334	590.6	291.6	212.8	3.328	516.63	71.98	0.43	207.61	17.68	10.04	19.36	1019.66	0.71
9/2/03	245	1341	627.0	295	44.29	2.762	300.84	46.97	0.41	287.41	16.65	9.45	18.23	395.58	0.67
9/9/03	252	1348	596.1	286.8	49.9	5.382	15.74	6.63	0.43	8.12	17.51	9.94	19.18	567.94	0.70
9/16/03	259	1355	567.4	283.1	290.4	3.25	105.10	32.31	0.45	8.53	18.40	10.45	20.15	393.80	0.74

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Cyanazine	a-chlordane	$\gamma-$ chlordane	Cis-nonachlor	Trans-nonachlor
4/2/02	92	823	715.3	289.6	93.73	11.01	56.74	5.35	6.58	0.49	4.36
4/9/02	99	830	715.3	291.2	196.2	6.855	56.74	15.18	18.09	3.91	12.93
4/16/02	106	837	670.0	297.3	204.7	2.555	60.57	21.02	23.30	0.53	18.16
4/23/02	113	844	414.9	281.4	317.4	3.945	97.82	1.59	1.68	0.85	0.97
4/30/02	120	851	711.4	286.7	197.1	5.086	57.04	15.24	13.92	0.50	10.58
5/7/02	127	858	704.9	294.7	357.9	3.982	57.58	31.21	26.81	0.50	20.90
5/14/02	134	865	740.3	285.8	351.2	5.735	54.82	6.54	5.40	0.48	3.85
5/22/02	142	873	736.1	286.2	349.5	2.281	55.13	6.82	5.64	0.48	3.72
7/9/02	190	921	698.3	300.7	192	4.256	58.12	57.34	45.24	0.51	40.76
7/16/02	197	928	718.6	298.1	303.4	3.181	56.48	33.40	34.67	0.49	18.31
7/23/02	204	935	735.3	299.7	187.9	5.393	55.19	31.78	35.46	0.48	23.03
7/30/02	211	942	716.5	301	322.9	3.073	56.64	18.66	23.38	0.49	18.52
9/24/02	267	998	641.2	291.6	277.5	3.097	63.29	15.81	17.75	0.55	9.03
10/1/02	274	1005	661.2	295	225.2	3.324	61.38	13.57	16.91	1.15	12.36
10/8/02	281	1012	638.2	286.8	76.69	2.226	63.59	3.87	6.05	0.55	2.10
10/15/02	288	1019	649.1	287.8	55.81	6.031	62.52	5.05	5.98	0.54	2.39
10/22/02	295	1026	665.9	283.1	241.2	1.568	60.95	4.42	5.56	0.53	2.03
10/29/02	302	1033	656.5	278.7	65.12	6.948	61.81	3.81	5.09	0.54	1.54
11/6/02	310	1041	654.9	282.1	329.4	6.759	61.97	13.86	19.13	0.54	9.45
11/12/02	317	1048	645.6	283.2	334.4	3.025	62.86	8.89	11.99	0.55	6.03
11/19/02	323	1054	642.6	279.6	221.3	2.908	63.16	1.03	3.21	0.55	0.62
11/26/02	330	1061	642.6	278.8	290	3.193	63.16	6.35	7.24	0.55	2.44
4/1/03	91	1187	903.4	289.6	233.6	5.358	44.92	5.67	7.42	0.39	4.49
4/7/03	97	1193	926.8	291.2	37.51	7.569	43.79	4.09	5.08	0.38	3.10

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Cyanazine	a-chlordane	γ–chlordane	Cis-nonachlor	Trans-nonachlor
4/15/03	104	1200	871.4	297.3	98.04	6.925	46.57	21.28	23.79	1.39	15.56
4/22/03	112	1208	857.0	281.4	311.9	5.955	47.35	27.33	36.71	1.48	23.01
4/29/03	119	1215	898.1	286.7	308.8	3.818	45.19	24.35	28.25	1.67	20.85
5/6/03	126	1222	898.5	294.7	64.07	1.758	45.17	18.33	22.77	1.11	14.98
5/13/03	133	1229	776.9	286.2	333.9	5.628	52.24	9.85	11.48	0.46	7.89
5/20/03	140	1236	764.3	294.2	97.58	3.892	53.09	15.66	17.61	0.97	12.94
5/27/03	147	1243	776.9	295.3	99.87	2.376	52.24	19.96	21.57	1.04	14.54
6/3/03	154	1250	765.6	294	152.7	5.125	53.00	14.85	16.76	0.99	12.09
6/10/03	161	1257	758.9	301.2	116.1	4.18	53.48	29.08	28.66	2.16	25.25
6/17/03	168	1264	759.5	302	161.7	3.588	53.43	21.24	23.27	1.38	15.27
6/24/03	175	1271	757.6	300.7	322	2.113	53.57	60.92	65.22	4.00	50.87
7/1/03	182	1278	773.0	298.1	260.8	2.823	52.50	36.07	37.88	2.10	28.69
7/8/03	189	1285	634.6	301	187.7	2.511	63.95	86.57	90.37	6.85	75.89
7/15/03	196	1292	621.7	294.7	106.5	6.585	65.28	29.24	32.11	2.56	23.92
7/22/03	203	1299	625.1	300.6	240.6	6.552	64.92	43.62	51.22	4.02	37.78
7/29/03	210	1306	644.1	299.2	154.2	2.239	63.00	38.33	37.49	2.38	27.82
8/5/03	217	1313	628.0	297.7	268.6	3.664	64.62	37.45	43.69	3.12	31.40
8/12/03	224	1320	643.9	297.3	122.3	2.106	63.03	47.71	52.74	3.43	36.70
8/19/03	231	1327	626.7	293.7	258.2	2.585	64.75	31.16	32.09	2.12	23.60
8/26/03	238	1334	590.6	291.6	212.8	3.328	68.72	119.68	51.34	3.49	40.32
9/2/03	245	1341	627.0	295	44.29	2.762	64.73	43.99	48.07	2.66	32.01
9/9/03	252	1348	596.1	286.8	49.9	5.382	68.08	11.64	11.89	0.59	8.57
9/16/03	259	1355	567.4	283.1	290.4	3.25	71.53	26.31	28.87	1.46	20.46

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Oxy chlordane	p,p-DDD	p,p-DDE	p,p-DDT	Dieldrin	a-HCH	g-HCH	HEPT	HEPTX	Malathion	Mirex
4/2/02	92	823	715.3	289.6	93.73	11.01	0.89	11.91	2.98	0.00	10.39	8.11	0.98	3.30	0.77	2.58	0.73
4/9/02	99	830	715.3	291.2	196.2	6.855	7.20	11.91	2.98	0.00	150.50	15.53	85.62	18.37	0.77	2.58	0.73
4/16/02	106	837	670.0	297.3	204.7	2.555	0.78	12.71	115.05	0.00	134.32	15.48	117.38	11.25	0.82	2.75	8.40
4/23/02	113	844	414.9	281.4	317.4	3.945	1.54	20.53	5.13	0.00	1.22	19.11	36.40	0.68	1.33	4.44	15.57
4/30/02	120	851	711.4	286.7	197.1	5.086	0.90	11.97	24.80	0.00	38.28	31.92	90.07	12.07	0.78	2.59	2.59
5/7/02	127	858	704.9	294.7	357.9	3.982	1.84	12.08	126.52	0.00	57.05	24.54	238.40	17.37	4.71	2.61	5.36
5/14/02	134	865	740.3	285.8	351.2	5.735	0.86	11.51	15.51	0.00	5.93	22.31	36.25	6.82	0.75	2.49	2.82
5/22/02	142	873	736.1	286.2	349.5	2.281	0.71	11.57	45.51	0.00	6.15	22.69	228.02	6.85	1.71	2.50	0.71
7/9/02	190	921	698.3	300.7	192	4.256	8.92	12.20	152.61	0.00	121.32	39.95	107.59	27.82	8.75	2.64	2.64
7/16/02	197	928	718.6	298.1	303.4	3.181	0.73	11.85	116.30	0.00	21.32	27.04	35.31	21.77	4.87	2.56	2.56
7/23/02	204	935	735.3	299.7	187.9	5.393	2.04	11.58	162.66	0.00	66.19	18.67	36.61	21.97	0.75	2.51	0.71
7/30/02	211	942	716.5	301	322.9	3.073	0.89	11.89	104.73	0.00	39.68	19.12	25.97	18.17	3.63	2.57	2.57
9/24/02	267	998	641.2	291.6	277.5	3.097	0.81	13.28	61.11	0.00	14.58	23.66	8.41	18.59	2.56	2.87	2.87
10/1/02	274	1005	661.2	295	225.2	3.324	0.79	12.88	36.93	0.00	14.52	18.80	9.47	14.72	0.84	2.79	2.79
10/8/02	281	1012	638.2	286.8	76.69	2.226	0.82	13.35	23.79	0.00	0.80	17.61	1.09	7.16	0.44	2.89	2.89
10/15/02	288	1019	649.1	287.8	55.81	6.031	0.80	13.12	19.92	0.00		23.20	1.08	4.76	0.43	2.84	2.84
10/22/02	295	1026	665.9	283.1	241.2	1.568	0.78	12.79	11.74	0.00		11.79	1.05	6.49	0.42	2.77	2.77
10/29/02	302	1033	656.5	278.7	65.12	6.948	0.80	12.97	9.85	0.00		13.77	1.06	4.89	0.43	2.81	2.81
11/6/02	310	1041	654.9	282.1	329.4	6.759	0.80	13.01	7.88	0.00		13.74	1.07	21.09	0.43	2.81	2.81
11/12/02	317	1048	645.6	283.2	334.4	3.025	0.81	13.19	20.45	0.00	4.23	15.57	1.08	11.15	0.44	2.85	2.85
11/19/02	323	1054	642.6	279.6	221.3	2.908	0.81	13.26	3.31	0.00		7.55	1.09	6.44	0.44	2.87	2.87
11/26/02	330	1061	642.6	278.8	290	3.193	0.81	13.26	9.52	0.00		16.33	1.09	10.33	0.44	2.87	2.87
4/1/03	91	1187	903.4	289.6	233.6	5.358	1.56	9.43	15.30	0.00	5.60	13.12	9.62	0.31	0.61	2.04	0.58
4/7/03	97	1193	926.8	291.2	37.51	7.569	0.69	9.19	12.09	0.00	0.55	11.60	3.91	0.30	0.60	1.99	0.56

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	Oxy chlordane	p,p-DDD	p,p-DDE	p,p-DDT	Dieldrin	a-HCH	g-HCH	HEPT	HEPTX	Malathion	Mirex
4/15/03	104	1200	871.4	297.3	98.04	6.925	0.73	9.77	2.44	0.00	29.79	5.53	1.24	0.32	21.54	2.11	0.60
4/22/03	112	1208	857.0	281.4	311.9	5.955	4.91	9.94	47.55	0.00	64.68	17.95	22.29	92.32	0.64	2.15	0.61
4/29/03	119	1215	898.1	286.7	308.8	3.818	5.97	9.48	63.99	0.00	54.22	21.77	244.17	41.43	8.80	2.05	0.58
5/6/03	126	1222	898.5	294.7	64.07	1.758	3.66	9.48	92.37	0.00	44.05	19.13	72.22	19.79	0.61	2.05	0.58
5/13/03	133	1229	776.9	286.2	333.9	5.628	2.65	10.96	69.09	0.00	34.05	25.78	56.48	0.36	8.44	2.37	0.67
5/20/03	140	1236	764.3	294.2	97.58	3.892	3.64	11.14	41.57	0.00	20.50	17.41	127.89	30.42	7.94	2.41	0.68
5/27/03	147	1243	776.9	295.3	99.87	2.376	4.47	10.96	40.92	0.00	25.59	25.23	29.69	10.27	5.99	2.37	0.67
6/3/03	154	1250	765.6	294	152.7	5.125	3.68	11.12	37.34	0.00	27.91	27.77	75.49	0.37	5.54	2.41	0.68
6/10/03	161	1257	758.9	301.2	116.1	4.18	9.25	11.22	106.13	0.00	136.64	26.88	86.23	0.37	15.23	2.43	0.69
6/17/03	168	1264	759.5	302	161.7	3.588	4.88	11.21	79.38	0.00	76.31	38.30	27.24	0.37	8.69	2.43	0.69
6/24/03	175	1271	757.6	300.7	322	2.113	15.83	11.24	230.39	0.00	191.29	32.85	172.88	46.24	28.21	38.78	0.69
7/1/03	182	1278	773.0	298.1	260.8	2.823	9.07	11.02	102.66	0.00	97.59	30.14	342.48	16.56	13.08	2.38	0.68
7/8/03	189	1285	634.6	301	187.7	2.511	20.41	13.42	221.23	0.00	262.72	27.80	230.97	25.24	23.21	2.90	0.82
7/15/03	196	1292	621.7	294.7	106.5	6.585	6.03	13.70	130.09	0.00	81.66	35.31	88.58	20.15	9.43	0.89	0.84
7/22/03	203	1299	625.1	300.6	240.6	6.552	7.73	13.63	161.52	0.00	95.26	27.91	161.13	6.99	10.38	8.78	0.84
7/29/03	210	1306	644.1	299.2	154.2	2.239	8.71	13.22	109.56	0.00	62.92	53.05	87.86	0.44	10.46	2.86	0.81
8/5/03	217	1313	628.0	297.7	268.6	3.664	7.15	13.56	152.49	0.00	99.74	37.39	63.18	0.45	14.25	2.93	0.83
8/12/03	224	1320	643.9	297.3	122.3	2.106	9.38	13.23	122.36	0.00	94.03	24.07	48.27	0.44	17.81	2.86	0.81
8/19/03	231	1327	626.7	293.7	258.2	2.585	6.91	13.59	98.93	0.00	53.20	37.26	32.49	0.45	8.65	0.88	0.83
8/26/03	238	1334	590.6	291.6	212.8	3.328	14.78	14.42	80.18	0.00	98.17	32.98	52.44	16.70	16.61	26.72	0.88
9/2/03	245	1341	627.0	295	44.29	2.762	8.07	13.58	92.19	0.00	46.72	42.12	29.22	0.45	8.26	2.94	0.83
9/9/03	252	1348	596.1	286.8	49.9	5.382	3.09	14.29	44.87	0.00	6.39	53.14	12.58	6.79	4.21	0.93	0.88
9/16/03	259	1355	567.4	283.1	290.4	3.25	7.67	15.01	156.00	0.00	56.72	38.72	37.51	25.80	14.91	0.97	0.92

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	BDE 47	BDE 100	BDE 99	BDE 154	Σ BDE	Σ Endosulfan	Σ DDT	Σ chlordane	ΣHCH
4/2/02	92	823	715.3	289.6	93.73	11.01	13.48	5.34	9.34	1.36	28.16	78.79		17.69	9.09
4/9/02	99	830	715.3	291.2	196.2	6.855	37.61	3.00	1.53	1.36	42.14	98.24	14.88	57.32	101.15
4/16/02	106	837	670.0	297.3	204.7	2.555	26.96	3.20	3.27	1.45	33.42	57.06	127.76	63.79	132.85
4/23/02	113	844	414.9	281.4	317.4	3.945	0.97	5.17	6.12	2.34	12.26	15.64			55.51
4/30/02	120	851	711.4	286.7	197.1	5.086	9.83	3.01	1.54	1.37	14.38	41.59	36.77	41.13	122.00
5/7/02	127	858	704.9	294.7	357.9	3.982	11.32	3.04	5.22	1.38	19.58	183.61	138.61	81.27	262.95
5/14/02	134	865	740.3	285.8	351.2	5.735	0.54	2.89	1.48	1.31	4.92	12.18	27.01	17.13	58.57
5/22/02	142	873	736.1	286.2	349.5	2.281	0.55	2.91	1.49	1.32	4.95	17.09	57.08	17.37	250.71
7/9/02	190	921	698.3	300.7	192	4.256	17.89	3.07	3.65	1.39	24.61	343.12	164.81	152.76	147.54
7/16/02	197	928	718.6	298.1	303.4	3.181	13.12	2.98	6.89	1.35	22.99	252.84	128.15	87.60	62.35
7/23/02	204	935	735.3	299.7	187.9	5.393	13.19	2.91	6.16	1.32	22.27	154.08	174.25	92.79	55.29
7/30/02	211	942	716.5	301	322.9	3.073	10.59	2.99	3.48	1.36	17.06	227.03	116.62	61.94	45.10
9/24/02	267	998	641.2	291.6	277.5	3.097	9.44	3.34	1.71	1.52	14.49	39.10	74.39	43.96	32.07
10/1/02	274	1005	661.2	295	225.2	3.324	10.48	3.24	2.96	1.47	16.69	42.36	49.81	44.77	28.27
10/8/02	281	1012	638.2	286.8	76.69	2.226	0.63	3.36	1.72	1.52	5.71	14.54	37.13	13.39	18.71
10/15/02	288	1019	649.1	287.8	55.81	6.031	0.62	3.30	3.25	1.50	7.17	16.79	33.04	14.77	24.28
10/22/02	295	1026	665.9	283.1	241.2	1.568	0.60	3.22	1.65	1.46	5.47	2.19	24.54	13.31	12.84
10/29/02	302	1033	656.5	278.7	65.12	6.948	0.61	3.26	1.67	1.48	5.55	3.18	22.83	11.77	14.83
11/6/02	310	1041	654.9	282.1	329.4	6.759	0.61	3.27	1.68	1.48	5.56	2.53	20.88	43.79	14.81
11/12/02	317	1048	645.6	283.2	334.4	3.025	0.62	3.32	1.70	1.51	5.64	7.23	33.64	28.26	16.65
11/19/02	323	1054	642.6	279.6	221.3	2.908	0.62	3.34	1.71	1.51	5.67	1.42		6.22	8.64
11/26/02	330	1061	642.6	278.8	290	3.193	0.62	3.34	1.71	1.51	5.67	1.42	22.78	17.39	17.41
4/1/03	91	1187	903.4	289.6	233.6	5.358	0.44	2.37	1.21	1.08	4.03	7.66	24.73	19.53	22.74
4/7/03	97	1193	926.8	291.2	37.51	7.569	0.43	2.31	1.18	1.05	3.93	6.61	21.28	13.34	15.51

APPENDIX AA - Analyte concentrations in gas phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Sample Vol. (m^3)	Temp. (K)	WD	WS (mph)	BDE 47	BDE 100	BDE 99	BDE 154	Σ BDE	Σ Endosulfan	Σ DDT	Σ chlordane	ΣHCH
4/15/03	104	1200	871.4	297.3	98.04	6.925	22.01	2.46	1.26	1.12	25.73	52.42		62.75	6.77
4/22/03	112	1208	857.0	281.4	311.9	5.955	6.01	2.50	5.68	1.13	14.19	18.31	57.49	93.44	40.23
4/29/03	119	1215	898.1	286.7	308.8	3.818	11.61	2.39	3.06	1.08	17.06	78.58	73.47	81.09	265.94
5/6/03	126	1222	898.5	294.7	64.07	1.758	5.49	2.39	1.22	1.08	9.09	24.57	101.85	60.86	91.35
5/13/03	133	1229	776.9	286.2	333.9	5.628	11.31	2.76	1.41	1.25	15.49	19.10	80.06	32.33	82.26
5/20/03	140	1236	764.3	294.2	97.58	3.892	6.18	2.80	1.44	1.27	10.41	13.03	52.71	50.82	145.30
5/27/03	147	1243	776.9	295.3	99.87	2.376	10.14	2.76	1.41	1.25	14.31	27.61	51.88	61.59	54.92
6/3/03	154	1250	765.6	294	152.7	5.125	11.23	2.80	1.43	1.27	15.47	37.43	48.47	48.38	103.26
6/10/03	161	1257	758.9	301.2	116.1	4.18	25.87	2.82	6.47	1.28	35.16	67.54	117.36	94.40	113.12
6/17/03	168	1264	759.5	302	161.7	3.588	9.93	2.82	9.02	1.28	21.77	61.74	90.59	66.04	65.54
6/24/03	175	1271	757.6	300.7	322	2.113	37.86	2.83	10.19	1.28	50.88	797.36	241.64	196.84	205.73
7/1/03	182	1278	773.0	298.1	260.8	2.823	25.57	2.77	7.65	1.26	35.99	171.25	113.68	113.80	372.62
7/8/03	189	1285	634.6	301	187.7	2.511	52.00	3.38	12.01	1.53	67.38	130.75	234.65	280.09	258.77
7/15/03	196	1292	621.7	294.7	106.5	6.585	29.97	3.45	16.65	1.56	50.06	390.28	143.79	93.85	123.89
7/22/03	203	1299	625.1	300.6	240.6	6.552	25.07	3.43	6.65	1.55	35.15	338.22	175.14	144.37	189.05
7/29/03	210	1306	644.1	299.2	154.2	2.239	16.92	3.33	5.76	1.51	26.01	230.61	122.78	114.73	140.90
8/5/03	217	1313	628.0	297.7	268.6	3.664	27.16	3.41	1.75	1.55	32.32	322.56	166.05	122.81	100.57
8/12/03	224	1320	643.9	297.3	122.3	2.106	20.05	3.33	7.07	1.51	30.45	121.27	135.58	149.97	72.34
8/19/03	231	1327	626.7	293.7	258.2	2.585	26.26	3.42	1.75	1.55	31.43	788.43	112.52	95.88	69.74
8/26/03	238	1334	590.6	291.6	212.8	3.328	30.29	3.63	7.38	1.65	41.30	5322.15	94.60	229.61	85.42
9/2/03	245	1341	627.0	295	44.29	2.762	31.01	3.42	15.36	1.55	49.78	1040.99	105.77	134.81	71.34
9/9/03	252	1348	596.1	286.8	49.9	5.382	12.51	3.60	1.84	1.63	17.95	104.61	59.16	35.79	65.73
9/16/03	259	1355	567.4	283.1	290.4	3.25	11.72	3.78	1.93	1.71	17.43	406.14	171.01	84.78	76.23

for pesticides, conc. < mdl have been replaced by 0.5*mdl

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin
4/18/00	109	109	786	282	2.21	1.98	75.08	3.78	2.49	8.82	134.52	5.53	0.68
4/25/00	116	116	777	282	2.23	2.00	72.66	3.83	2.51	8.92	175.47	5.59	58.67
5/2/00	123	123	773	288	2.24	2.01	173.87	32.60	2.53	8.97	374.02	5.62	0.69
5/9/00	130	130	777	300	2.23	2.00	433.70	38.67	2.51	8.92	169.74	5.59	0.68
5/16/00	137	137	1054	292	1.64	1.47	776.99	82.33	1.85	6.57	1073.73	4.12	256.49
5/23/00	144	144	794	293	2.18	1.96	272.92	33.11	2.46	8.73	231.56	5.47	0.67
5/30/00	151	151	774	288	2.24	2.01	189.81	104.91	2.52	8.95	229.70	5.61	0.69
6/6/00	158	158	767	290	2.26	2.03	118.40	32.49	2.55	9.03	169.23	5.66	129.97
6/13/00	165	165	775	292	2.24	2.01	79.00	27.39	2.52	8.94	244.85	5.60	0.68
6/20/00	172	172	789	296	2.20	1.97	4.44	3.77	2.48	8.78	70.39	5.50	0.67
6/27/00	179	179	782	299	2.22	1.99	141.28	3.80	2.50	8.86	56.85	5.55	0.68
7/4/00	186	186	876	300	1.98	1.77	85.60	3.39	2.23	7.91	2.08	4.95	0.61
7/11/00	193	193	857	295	2.02	1.81	121.54	3.47	2.28	8.09	252.02	5.07	0.62
7/18/00	200	200	777	300	2.23	2.00	95.20	3.83	2.51	8.92	2.35	5.59	0.68
7/25/00	207	207	721	295	2.40	2.16	4.86	4.12	2.71	9.61	2.53	6.02	0.74
8/1/00	214	214	716	301	2.42	2.17	4.89	4.15	2.73	9.67	62.49	6.06	0.74
9/12/00	256	256	430	299	4.03	3.62	139.99	6.92	4.55	16.13	4.24	10.11	1.23
9/19/00	263	263	418	296	4.15	3.72	73.54	7.11	4.67	16.57	191.35	10.38	1.27
9/26/00	270	270	417	287	4.16	3.73	8.40	7.14	4.69	16.63	4.38	10.42	1.27
10/3/00	277	277	423	296	4.10	3.68	271.76	7.03	4.62	16.38	4.31	10.26	1.25
10/10/00	284	284	417	285	4.16	3.73	149.66	7.14	4.69	16.63	220.03	10.42	1.27
10/17/00	291	291	416	291	4.17	3.74	8.42	7.15	4.70	16.67	120.41	10.44	1.28
10/24/00	298	298	417	286	4.16	3.73	72.36	7.13	4.68	16.61	201.44	10.41	1.27
10/31/00	305	305	434	285	3.99	3.58	8.06	6.84	4.50	15.95	208.04	10.00	1.22
11/7/00	312	312	416	284	4.16	3.73	212.02	7.14	4.69	16.65	4.38	10.43	1.27
11/14/00	319	319	427	282	4.06	3.64	8.20	6.96	4.57	16.22	150.82	10.16	1.24
11/21/00	326	326	415	274	4.17	3.74	8.43	7.16	4.70	16.69	96.71	10.46	1.28
11/28/00	333	333	427	281	4.06	3.64	98.41	6.96	4.57	16.21	368.50	10.16	1.24
12/5/00	340	340	416	277	4.17	3.74	8.42	7.15	4.70	16.66	128.19	10.44	1.28
12/12/00	347	347	418	275	4.15	3.72	8.38	7.11	4.67	16.58	140.07	10.39	1.27
12/19/00	354	354	415	275	4.17	3.74	165.88	7.16	4.70	16.68	217.40	10.45	1.28
5/15/01	135	501	718	289	2.42	32.14	539.62	726.16	397.63	9.66	411.25	6.05	0.74
5/22/01	142	508	718	292	2.41	2.17	78.62	4.14	149.58	9.65	144.12	6.05	83.61
5/29/01	149	515	718	292	2.41	28.95	55.06	4.14	2.72	9.65	153.18	6.05	0.74
6/5/01	156	522	718	295	2.42	2.17	4.88	4.14	2.72	9.66	2.54	6.05	0.74
6/12/01	163	529	718	300	2.41	2.17	4.88	4.14	115.87	9.65	2.54	6.05	0.74
6/19/01	170	536	719	298	2.41	2.16	4.87	4.13	2.72	9.64	2.54	6.04	0.74
6/26/01	177	543	718	298	2.42	60.49	4.88	4.14	2.72	9.66	2.54	6.05	0.74
7/3/01	184	550	718	296	2.42	38.92	4.88	4.14	113.89	192.59	113.76	6.05	0.74
7/10/01	191	557	718	299	2.41	2.17	4.88	4.14	2.72	9.65	2.54	6.05	0.74
7/17/01	198	564	718	300	2.42	33.19	4.88	4.14	2.72	9.66	209.73	6.05	0.74
7/24/01	205	571	718	301	2.42	2.17	4.88	4.14	2.72	9.66	2.54	6.05	0.74
7/31/01	212	578	718	295	2.42	2.17	4.88	4.14	2.72	9.66	2.54	6.05	0.74
8/7/01	219	585	718	302	2.42	2.17	4.88	662.53	2.72	191.07	2.54	6.05	0.74
8/14/01	226	592	1448	297	1.20	1.07	2.42	2.05	1.35	4.79	1.26	3.00	0.37
8/21/01	233	599	726	296	2.39	2.14	4.82	4.09	119.47	9.55	151.59	5.98	0.73
8/28/01	240	606	718	299	2.41	2.17	4.88	4.14	2.72	9.65	99.00	6.05	0.74
9/4/01	247	613	718	297	2.41	2.17	4.88	4.14	2.72	9.65	107.35	6.05	0.74

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin
9/11/01	254	620	722	297	2.40	2.15	44.66	4.12	2.71	9.60	214.86	6.02	0.73
9/18/01	261	627	785	292	2.21	1.98	21.92	3.79	2.49	8.83	77.65	5.53	0.68
9/25/01	268	634	722	289	2.40	2.15	29.93	4.12	2.71	9.60	144.76	6.01	0.73
10/2/01	275	641	676	292	2.57	2.30	36.83	4.40	2.89	10.26	87.13	6.43	0.78
10/9/01	282	648	671	284	2.58	2.32	38.08	4.43	2.91	10.32	146.69	6.47	0.79
10/16/01	289	655	696	287	2.49	2.23	33.59	4.27	2.81	9.95	150.51	6.24	0.76
10/23/01	296	662	642	294	2.70	2.42	27.24	4.63	3.04	10.79	2.84	6.76	0.83
10/30/01	303	669	642	284	2.70	2.42	61.94	4.63	3.04	10.78	259.02	6.76	0.83
11/6/01	310	676	642	284	2.70	2.42	71.91	4.63	3.04	10.79	256.26	6.76	0.83
11/13/01	317	683	646	280	2.68	2.41	77.53	4.60	3.02	10.72	313.04	6.72	0.82
3/5/02	64	795	950	284	1.83	1.64	56.20	3.13	2.06	7.30	215.15	4.57	0.56
3/12/02	71	802	923	282	1.88	1.68	68.18	3.22	2.12	7.51	229.64	4.70	274.28
3/19/02	78	809	718	281	2.41	2.16	28.89	4.14	2.72	9.65	134.26	6.05	0.74
3/26/02	85	816	718	279	2.42	2.17	37.85	4.14	2.72	9.66	163.94	6.05	0.74
4/2/02	92	823	718	290	2.41	2.16	77.13	4.14	2.72	9.65	300.67	6.05	0.74
4/9/02	99	830	718	290	2.41	2.16	136.49	4.14	2.72	9.65	191.15	6.05	0.74
4/16/02	106	837	718	297	2.41	2.16	140.73	4.14	344.55	9.65	624.79	6.05	0.74
4/23/02	113	844	704	284	151.3	131.9	220.1	4.2	267.2	9.8	689.6	6.2	426.4
4/30/02	120	851	774	287	168.3	81.5	321.1	3.8	357.2	547.5	1113.0	5.6	0.69
5/7/02	127	858	773	294	129.8	2.0	394.0	3.8	326.0	706.4	869.1	5.6	0.69
5/14/02	134	865	718	287	98.9	88.2	217.3	4.1	258.8	9.6	513.8	6.0	0.74
5/21/02	141	872	714	285	121.9	110.8	382.9	4.2	338.2	9.7	765.1	6.1	0.74
5/28/02	148	879	718	295	2.41	2.16	621.67	4.14	312.50	9.65	476.88	6.05	0.74
6/4/02	155	886	718	297	2.41	2.16	467.31	4.14	321.74	9.65	373.87	6.05	0.74
6/11/02	162	893	740	301	2.34	2.10	136.48	4.02	237.94	9.37	138.94	5.87	0.72
6/18/02	169	900	704	296	2.46	2.21	117.88	4.22	255.08	9.84	232.90	6.17	0.75
6/25/02	176	907	723	302	2.40	2.15	95.68	4.11	2.70	9.59	326.30	6.01	0.73
7/2/02	183	914	740	302	2.34	2.10	24.20	4.02	2.64	9.37	2.46	5.87	0.72
7/9/02	190	921	725	301	2.39	2.14	35.82	4.10	2.69	9.56	172.31	5.99	0.73
7/16/02	197	928	718	298	2.41	2.16	51.56	4.14	2.72	9.64	131.52	6.04	0.74
7/23/02	204	935	718	300	2.41	2.16	30.89	4.14	2.72	9.65	117.49	6.05	0.74
7/30/02	211	942	718	302	2.41	2.16	29.41	4.14	2.72	9.65	137.05	6.05	0.74
8/6/02	218	949	719	296	2.41	2.16	34.14	4.13	2.72	9.64	168.62	6.04	0.74
8/13/02	225	956	718	302	2.41	67.33	37.31	4.14	2.72	9.65	414.71	6.05	0.74
8/20/02	232	963	718	300	2.41	2.16	30.86	4.14	2.72	9.65	207.01	6.05	0.74
8/27/02	239	970	718	297	2.41	2.16	23.44	4.14	2.72	9.65	130.10	6.05	0.74
9/3/02	246	977	718	298	2.41	2.16	4.88	4.14	2.72	9.65	87.52	6.05	0.74
9/10/02	253	984	718	299	2.41	2.16	22.02	4.14	2.72	9.65	113.66	6.05	0.74
9/17/02	260	991	718	294	2.41	2.16	28.34	4.14	2.72	9.65	176.10	6.05	0.74
9/24/02	267	998	718	293	2.41	2.16	4.88	4.14	2.72	9.65	104.21	6.05	0.74
10/1/02	274	1005	718	295	2.41	2.16	25.55	4.14	2.72	9.65	101.29	6.05	0.74
10/8/02	281	1012	718	287	2.41	2.16	4.87	4.14	2.72	9.64	75.14	6.04	0.74
10/15/02	288	1019	718	288	2.41	2.16	4.88	4.14	2.72	9.65	91.29	6.05	0.74
10/22/02	295	1026	718	283	2.41	2.16	45.35	4.14	2.72	9.65	249.83	6.05	0.74
10/29/02	302	1033	718	279	2.41	2.16	27.35	4.14	2.72	9.65	124.13	6.05	0.74
11/5/02	309	1040	718	282	2.41	2.16	4.88	4.14	2.72	9.65	76.96	6.05	0.74
11/12/02	316	1047	718	284	2.41	2.16	18.76	4.14	2.72	9.65	89.76	6.05	0.74
11/19/02	323	1054	719	280	2.41	2.16	48.75	4.13	2.72	9.64	210.27	6.04	0.74

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin
11/26/02	330	1061	719	279	2.41	2.16	25.35	4.13	2.72	9.64	178.81	6.04	0.74
3/31/03	90	1186	712	277	2.43	2.18	4.92	4.18	2.74	9.73	40.50	6.10	0.74
4/1/03	91	1187	804	286	2.16	1.93	54.76	3.70	2.43	8.62	71.46	5.40	0.66
4/2/03	92	1188	847	292	2.05	1.83	99.18	3.51	45.70	8.18	179.30	124.73	80.61
4/3/03	93	1189	712	287	2.43	2.18	77.54	4.18	48.61	9.73	158.19	171.57	0.74
4/8/03	98	1194	759	277	2.28	2.05	4.61	3.92	2.57	9.13	34.41	5.72	0.70
4/15/03	105	1201	712	293	2.43	2.18	42.80	4.18	57.55	9.73	159.37	6.10	0.74
6/3/03	154	1250	712	291	2.43	2.18	55.97	4.18	2.74	9.73	100.23	6.10	0.74
6/10/03	161	1257	712	297	2.43	2.18	55.97	4.18	2.74	9.73	100.23	6.10	0.74
6/17/03	168	1264	710	290	2.44	2.19	51.38	4.19	2.75	9.76	104.46	6.11	0.75
6/23/03	174	1270	715	298	2.42	2.17	41.94	4.16	2.73	9.69	125.21	6.07	0.74
6/24/03	175	1271	712	298	2.43	2.18	62.74	4.18	54.46	9.73	96.36	6.10	0.74
6/25/03	176	1272	712	299	2.43	2.18	46.87	4.18	2.74	9.73	71.41	6.10	0.74
6/26/03	177	1273	712	301	2.43	2.18	24.33	4.18	2.74	9.73	42.66	6.10	0.74
7/1/03	182	1278	712	297	37.64	2.18	92.27	4.17	2.74	9.73	78.64	6.10	0.74
7/8/03	189	1285	712	300	2.43	18.25	129.91	4.18	51.38	9.73	723.34	6.10	0.74
7/15/03	196	1292	712	298	2.43	2.18	4.92	4.18	2.74	9.73	29.09	6.10	0.74
7/22/03	203	1299	712	298	2.43	2.18	4.92	4.18	2.74	9.73	93.48	6.10	0.74
7/29/03	210	1306	712	296	2.43	2.18	14.34	4.18	2.74	9.73	53.92	6.10	0.74
8/5/03	217	1313	712	296	2.43	2.18	14.28	4.18	2.74	9.73	64.95	6.10	0.74
8/12/03	224	1320	712	299	2.43	2.18	13.33	4.18	2.74	9.73	54.64	6.10	0.74
8/19/03	231	1327	712	297	2.43	2.18	4.92	4.18	2.74	9.73	57.41	6.10	0.74
8/26/03	238	1334	712	298	2.43	2.18	16.25	4.18	2.74	9.73	66.72	6.10	0.74
9/2/03	245	1341	707	297	2.45	2.20	4.95	4.20	2.76	9.80	2.58	6.14	0.75
9/9/03	252	1348	712	292	2.43	2.18	20.21	4.18	2.74	9.73	72.44	6.10	0.74
9/16/03	259	1355	712	293	2.43	2.18	21.87	4.18	2.74	9.73	73.67	6.10	0.74
9/29/03	272	1368	712	289	2.43	2.18	13.41	4.18	2.74	9.73	25.70	6.10	0.74

blanks mean that the compound was not analyzed for

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	CHTHNL	CLRPS	CLRPS Oxon
4/18/00	109	109	786	282	5.04												
4/25/00	116	116	777	282	5.10												
5/2/00	123	123	773	288	72.94												
5/9/00	130	130	777	300	157.85												
5/16/00	137	137	1054	292	191.03												
5/23/00	144	144	794	293	106.38												
5/30/00	151	151	774	288	74.18												
6/6/00	158	158	767	290	63.96												
6/13/00	165	165	775	292	5.11												
6/20/00	172	172	789	296	5.02												
6/27/00	179	179	782	299	5.07												
7/4/00	186	186	876	300	4.52												
7/11/00	193	193	857	295	4.62												
7/18/00	200	200	777	300	5.10												
7/25/00	207	207	721	295	5.50												
8/1/00	214	214	716	301	5.53												
9/12/00	256	256	430	299	9.22												
9/19/00	263	263	418	296	9.47												
9/26/00	270	270	417	287	9.51												
10/3/00	277	277	423	296	9.37												
10/10/00	284	284	417	285	9.51												
10/17/00	291	291	416	291	9.53												
10/24/00	298	298	417	286	9.50												
10/31/00	305	305	434	285	9.12												
11/7/00	312	312	416	284	412.85												
11/14/00	319	319	427	282	9.27												
11/21/00	326	326	415	274	9.54												
11/28/00	333	333	427	281	9.27												
12/5/00	340	340	416	277	9.52												
12/12/00	347	347	418	275	9.48												
12/19/00	354	354	415	275	9.54												
5/15/01	135	501	718	289	255.76												
5/22/01	142	508	718	292	5.52	0.41	4.84	1.52	3.72	1.94	3.58	0.44	1.19	2.48	53.58	4.82	0.00
5/29/01	149	515	718	292	5.52	0.41	4.84	1.52	3.72	1.99	4.22	0.44	1.19	2.48	24.99	5.22	0.00
6/5/01	156	522	718	295	5.52	0.41	4.84	1.52	3.72	0.62	3.69	0.44	1.19	2.48	25.25	4.68	0.00
6/12/01	163	529	718	300	5.52	0.41	4.84	1.52	3.72	1.85	3.96	0.44	1.19	2.48	144.39	5.98	0.00
6/19/01	170	536	719	298	5.51	4.27	4.83	1.51	3.71	0.62	3.60	0.44	1.18	2.48	10.19	5.16	0.00
6/26/01	177	543	718	298	5.52	0.41	4.84	1.52	3.72	0.62	3.64	0.44	1.19	2.48	135.22	4.65	0.00
7/3/01	184	550	718	296	5.52	4.46	4.84	1.52	3.72	0.62	4.00	0.44	1.19	2.48	179.23	6.20	0.00
7/10/01	191	557	718	299	5.52	0.41	4.84	1.52	3.72	0.62	3.57	0.44	1.19	2.48	78.53	1.38	0.00
7/17/01	198	564	718	300	5.52	4.42	4.84	1.52	3.72	0.62	4.22	0.44	1.19	5.10	90.61	6.22	0.00
7/24/01	205	571	718	301	5.52	4.63	4.84	1.52	3.72	0.62	3.57	0.44	1.19	2.48	10.21	4.71	0.00
7/31/01	212	578	718	295	5.52	0.41	4.84	1.52	3.72	0.62	3.57	0.44	1.19	2.48	701.14	1.38	0.00
8/7/01	219	585	718	302	5.52	4.43	4.84	1.52	3.72	0.62	4.04	0.44	1.19	5.71	220.02	1.38	0.00
8/14/01	226	592	1448	297	2.74	0.20	2.40	0.75	1.84	0.31	1.83	0.22	0.59	2.61	235.89	0.68	0.00
8/21/01	233	599	726	296	5.46	0.41	4.79	1.50	3.68	0.61	3.72	0.44	1.17	6.03	89.84	1.36	0.00
8/28/01	240	606	718	299	5.52	0.41	4.84	1.52	3.72	0.62	4.00	0.44	1.19	7.76	43.21	5.03	0.00
9/4/01	247	613	718	297	90.19	0.41	4.84	1.52	3.72	0.62	3.71	0.44	1.19	9.43	120.33	4.92	0.00

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	CHTHNL	CLRPS	CLRPS Oxon
9/11/01	254	620	722	297	5.49	0.41	4.81	1.51	3.70	0.62	3.55	0.44	1.18	9.16	126.55	4.78	0.00
9/18/01	261	627	785	292	5.05	0.38	4.43	1.39	3.40	0.57	3.30	0.41	1.08	2.27	127.10	1.26	0.00
9/25/01	268	634	722	289	5.49	0.41	4.81	1.51	3.70	0.62	4.60	0.44	1.18	2.47	22.26	1.37	0.00
10/2/01	275	641	676	292	5.86	0.44	5.14	1.61	3.95	2.47	5.21	0.47	1.26	6.32	46.46	1.47	0.00
10/9/01	282	648	671	284	5.90	0.44	5.18	1.62	3.98	1.98	5.04	0.48	1.27	2.65	10.91	1.48	0.00
10/16/01	289	655	696	287	5.69	3.38	4.99	1.56	3.83	2.70	5.07	0.46	1.22	5.47	22.52	3.91	0.00
10/23/01	296	662	642	294	6.17	0.46	5.41	1.69	4.16	1.92	5.39	0.50	1.33	5.54	86.81	4.13	0.00
10/30/01	303	669	642	284	6.17	0.46	5.41	1.69	4.15	3.18	5.46	1.20	1.32	7.19	26.01	9.14	0.00
11/6/01	310	676	642	284	6.17	3.88	5.41	1.70	4.16	2.20	6.06	0.50	1.33	7.43	51.17	6.04	0.00
11/13/01	317	683	646	280	6.13	0.46	5.38	1.68	4.13	0.69	5.20	0.49	1.32	5.56	24.09	1.53	0.00
3/5/02	64	795	950	284	4.17	1.40	3.66	1.15	2.81	0.47	1.07	0.34	0.90	1.87	7.71	1.04	0.00
3/12/02	71	802	923	282	4.29	1.33	3.76	1.18	2.89	0.48	1.11	0.35	0.92	1.93	7.94	1.07	0.00
3/19/02	78	809	718	281	5.52	1.67	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
3/26/02	85	816	718	279	5.52	1.67	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.21	1.38	0.00
4/2/02	92	823	718	290	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
4/9/02	99	830	718	290	335.9	1.66	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
4/16/02	106	837	718	297	5.52	1.73	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	33.61	1.38	0.00
4/23/02	113	844	704	284	5.63	2.26	4.94	1.55	3.79	0.63	1.45	0.45	1.21	2.53	10.41	3.08	0.00
4/30/02	120	851	774	287	5.12	1.63	4.49	1.41	3.45	0.58	1.32	0.41	1.10	2.30	9.46	1.28	0.00
5/7/02	127	858	773	294	5.12	1.62	4.49	1.41	3.45	0.58	1.32	0.41	1.10	2.30	9.47	1.28	0.00
5/14/02	134	865	718	287	5.52	1.70	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
5/21/02	141	872	714	285	406.43	1.76	4.87	1.52	3.74	0.62	1.43	0.45	1.19	2.49	10.26	1.39	0.00
5/28/02	148	879	718	295	591.20	1.67	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
6/4/02	155	886	718	297	432.04	1.67	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	42.30	1.38	0.00
6/11/02	162	893	740	301	5.36	1.72	4.70	1.47	3.61	0.60	1.38	0.43	1.15	2.41	27.91	1.34	0.00
6/18/02	169	900	704	296	5.63	1.72	4.93	1.55	3.79	0.63	1.45	0.45	1.21	2.53	97.17	6.38	0.00
6/25/02	176	907	723	302	5.48	1.33	4.81	1.51	3.69	0.62	1.41	0.44	1.18	2.46	10.14	1.37	0.00
7/2/02	183	914	740	302	5.35	0.40	4.70	1.47	3.61	0.60	2.92	0.43	1.15	2.41	9.90	1.34	0.00
7/9/02	190	921	725	301	5.46	1.31	4.79	1.50	3.68	0.61	1.41	0.44	1.17	2.46	10.10	1.37	0.00
7/16/02	197	928	718	298	5.51	1.38	4.84	1.51	3.71	0.62	1.42	0.44	1.18	5.46	93.54	4.22	0.00
7/23/02	204	935	718	300	5.52	1.30	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
7/30/02	211	942	718	302	5.52	1.35	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	106.79	1.38	0.00
8/6/02	218	949	719	296	5.51	1.31	4.83	1.51	3.71	0.62	1.42	0.44	1.18	2.48	62.26	1.38	0.00
8/13/02	225	956	718	302	5.52	1.32	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	50.27	1.38	0.00
8/20/02	232	963	718	300	5.52	1.32	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	235.85	1.38	0.00
8/27/02	239	970	718	297	5.52	1.34	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	36.02	3.83	0.00
9/3/02	246	977	718	298	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
9/10/02	253	984	718	299	5.52	1.36	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	31.80	3.04	0.00
9/17/02	260	991	718	294	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	130.35	1.38	0.00
9/24/02	267	998	718	293	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	33.25	1.38	0.00
10/1/02	274	1005	718	295	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
10/8/02	281	1012	718	287	5.51	0.41	4.84	1.51	3.71	0.62	1.42	0.44	1.18	2.48	10.20	1.38	0.00
10/15/02	288	1019	718	288	5.52	1.30	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
10/22/02	295	1026	718	283	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
10/29/02	302	1033	718	279	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
11/5/02	309	1040	718	282	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
11/12/02	316	1047	718	284	5.52	0.41	4.84	1.52	3.72	0.62	1.42	0.44	1.19	2.48	10.20	1.38	0.00
11/19/02	323	1054	719	280	5.51	0.41	4.83	1.51	3.71	0.62	1.42	0.44	1.18	2.48	10.19	1.38	0.00

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Simazine	Trifluralin	DDD	DDE	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	CHTHNL	CLRPS	CLRPS Oxon
11/26/02	330	1061	719	279	5.51	2.49	4.83	1.51	3.71	0.62	1.42	0.44	1.18	2.48	10.19	1.38	0.00
3/31/03	90	1186	712	277	5.56	6.17	4.88	1.53	3.75	2.78	1.43	0.45	1.20	2.50	10.29	1.39	0.00
4/1/03	91	1187	804	286	4.93	5.67	4.32	1.35	3.32	3.68	1.27	0.40	1.06	2.21	9.11	1.23	0.00
4/2/03	92	1188	847	292	4.68	5.17	4.10	1.28	3.15	2.58	1.20	0.38	1.00	2.10	8.65	1.17	0.00
4/3/03	93	1189	712	287	5.56	6.18	4.88	1.53	3.75	2.47	1.43	0.45	1.20	2.50	10.29	1.39	0.00
4/8/03	98	1194	759	277	5.22	5.80	4.58	1.43	3.52	1.95	1.34	0.42	1.12	2.35	9.65	1.30	0.00
4/15/03	105	1201	712	293	5.56	6.19	4.88	1.53	3.75	2.58	1.43	0.45	1.20	2.50	10.29	1.39	0.00
6/3/03	154	1250	712	291	5.56	0.41	4.88	1.53	3.75	0.63	1.43	0.45	1.20	2.50	10.29	1.39	0.00
6/10/03	161	1257	712	297	5.56	0.41	4.88	1.53	3.75	0.63	1.43	0.45	1.20	2.50	10.29	1.39	0.00
6/17/03	168	1264	710	290	5.58	0.41	4.89	1.53	3.76	2.20	1.44	0.45	1.20	2.51	205.84	1.39	0.00
6/23/03	174	1270	715	298	5.54	0.41	4.86	1.52	3.73	2.14	1.43	0.45	1.19	2.49	10.25	1.38	0.00
6/24/03	175	1271	712	298	5.56	0.41	4.88	1.53	3.75	2.18	1.43	0.45	1.20	2.50	10.29	1.39	0.00
6/25/03	176	1272	712	299	5.56	0.41	4.88	1.53	3.75	2.22	1.43	0.45	1.20	2.50	10.29	1.39	0.00
6/26/03	177	1273	712	301	5.56	0.41	4.88	1.53	3.75	2.18	1.43	0.45	1.20	2.50	10.29	1.39	0.00
7/1/03	182	1278	712	297	5.56	0.41	4.88	1.53	3.75	2.27	1.43	0.45	1.19	2.50	10.28	1.39	0.00
7/8/03	189	1285	712	300	5.56	0.41	4.88	1.53	3.75	0.63	1.43	0.45	1.20	2.50	22.52	1.39	0.00
7/15/03	196	1292	712	298	5.56	0.41	4.88	1.53	3.75	2.11	1.43	0.45	1.20	2.50	10.29	1.39	0.00
7/22/03	203	1299	712	298	5.56	0.41	4.88	1.53	3.75	2.37	1.43	0.45	1.20	2.50	10.29	1.39	0.00
7/29/03	210	1306	712	296	5.56	0.41	4.88	1.53	3.75	2.37	1.43	0.45	1.20	2.50	10.29	1.39	0.00
8/5/03	217	1313	712	296	5.56	0.41	4.88	1.53	3.75	2.40	1.43	0.45	1.20	2.50	112.59	1.39	0.00
8/12/03	224	1320	712	299	5.56	0.41	4.88	1.53	3.75	2.16	1.43	0.45	1.20	2.50	10.29	1.39	0.00
8/19/03	231	1327	712	297	5.56	0.41	4.88	1.53	3.75	0.63	1.43	0.45	1.20	2.50	10.29	1.39	0.00
8/26/03	238	1334	712	298	5.56	0.41	4.88	1.53	3.75	2.14	1.43	0.45	1.20	2.50	10.29	1.39	0.00
9/2/03	245	1341	707	297	5.60	0.42	4.91	1.54	3.77	2.16	1.44	0.45	1.20	2.52	10.36	1.40	0.00
9/9/03	252	1348	712	292	5.56	0.41	4.88	1.53	3.75	2.18	1.43	0.45	1.20	2.50	10.29	1.39	0.00
9/16/03	259	1355	712	293	5.56	0.41	4.88	1.53	3.75	2.25	1.43	0.45	1.20	2.50	10.29	1.39	0.00
9/29/03	272	1368	712	289	5.56	0.41	4.88	1.53	3.75	2.14	1.43	0.45	1.20	2.50	10.29	1.39	0.00

blanks mean that the compound was not analy

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Malathion	Oxy chlordane
4/18/00	109	109	786	282											
4/25/00	116	116	777	282											
5/2/00	123	123	773	288											
5/9/00	130	130	777	300											
5/16/00	137	137	1054	292											
5/23/00	144	144	794	293											
5/30/00	151	151	774	288											
6/6/00	158	158	767	290											
6/13/00	165	165	775	292											
6/20/00	172	172	789	296											
6/27/00	179	179	782	299											
7/4/00	186	186	876	300											
7/11/00	193	193	857	295											
7/18/00	200	200	777	300											
7/25/00	207	207	721	295											
8/1/00	214	214	716	301											
9/12/00	256	256	430	299											
9/19/00	263	263	418	296											
9/26/00	270	270	417	287											
10/3/00	277	277	423	296											
10/10/00	284	284	417	285											
10/17/00	291	291	416	291											
10/24/00	298	298	417	286											
10/31/00	305	305	434	285											
11/7/00	312	312	416	284											
11/14/00	319	319	427	282											
11/21/00	326	326	415	274											
11/28/00	333	333	427	281											
12/5/00	340	340	416	277											
12/12/00	347	347	418	275											
12/19/00	354	354	415	275											
5/15/01	135	501	718	289											
5/22/01	142	508	718	292	0.51	34.03	0.62	0.50	0.48	1.73	0.47	0.53	0.60	1.58	0.51
5/29/01	149	515	718	292	0.51	2.15	0.62	3.66	2.94	1.67	0.47	0.53	0.60	28.09	0.51
6/5/01	156	522	718	295	0.51	2.15	0.62	3.86	0.48	1.49	0.47	0.53	0.60	1.58	0.51
6/12/01	163	529	718	300	0.51	2.15	0.62	4.68	0.48	1.81	0.47	0.53	0.60	1.58	0.51
6/19/01	170	536	719	298	0.51	2.14	0.62	1.36	0.48	1.45	0.47	0.53	0.60	1.58	0.50
6/26/01	177	543	718	298	0.51	2.15	0.62	1.97	0.48	0.65	0.47	0.53	0.60	1.58	0.51
7/3/01	184	550	718	296	0.51	2.15	0.62	5.53	3.08	0.65	0.47	0.53	0.60	41.79	0.51
7/10/01	191	557	718	299	0.51	2.15	0.62	1.10	0.48	0.65	0.47	0.53	0.60	1.58	0.51
7/17/01	198	564	718	300	0.51	2.15	0.62	1.87	0.48	0.65	0.47	0.53	0.60	1.58	0.51
7/24/01	205	571	718	301	0.51	2.15	0.62	2.33	0.48	1.66	0.47	0.53	0.60	1.58	0.51
7/31/01	212	578	718	295	0.51	29.14	0.62	1.98	0.48	0.65	0.47	0.53	0.60	1.58	0.51
8/7/01	219	585	718	302	0.51	2.15	0.62	8.36	0.48	0.65	0.47	0.53	0.60	1.58	0.51
8/14/01	226	592	1448	297	0.25	34.88	0.31	2.70	0.24	0.32	0.23	0.26	0.30	0.79	0.25
8/21/01	233	599	726	296	0.50	85.42	0.62	5.36	0.47	1.57	0.47	0.53	0.59	1.57	0.50
8/28/01	240	606	718	299	0.51	2.15	0.62	8.08	0.48	0.65	0.47	0.53	0.60	39.03	0.51
9/4/01	247	613	718	297	0.51	41.60	0.62	8.32	0.48	0.65	0.47	0.53	0.60	1.58	0.51

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Malathion	Oxy chlordane
9/11/01	254	620	722	297	0.51	112.62	0.62	6.04	0.47	0.64	2.26	0.53	0.60	78.89	0.50
9/18/01	261	627	785	292	0.47	48.15	0.57	2.75	0.44	0.59	7.24	0.49	0.55	1.45	0.46
9/25/01	268	634	722	289	0.51	35.43	0.62	2.30	0.47	1.55	0.47	0.53	0.60	1.58	0.50
10/2/01	275	641	676	292	0.54	85.60	0.66	13.32	0.51	2.46	0.50	0.57	0.64	1.68	0.54
10/9/01	282	648	671	284	0.55	30.35	0.67	0.54	0.51	0.69	4.74	0.57	0.64	1.69	0.54
10/16/01	289	655	696	287	0.53	34.96	0.64	3.17	0.49	2.66	0.49	0.55	0.62	1.63	0.52
10/23/01	296	662	642	294	0.57	28.01	0.70	5.25	0.53	0.72	19.56	0.60	0.67	48.01	0.56
10/30/01	303	669	642	284	0.57	209.93	0.70	8.09	0.53	0.72	0.53	0.60	0.67	37.76	0.56
11/6/01	310	676	642	284	0.57	2.40	0.70	2.12	0.53	2.51	0.53	0.60	0.67	1.77	0.57
11/13/01	317	683	646	280	0.57	62.28	0.69	1.81	0.53	1.53	0.52	0.59	0.66	1.76	0.56
3/5/02	64	795	950	284	0.39	46.95	0.47	1.30	0.36	0.49	0.36	0.40	0.45	1.20	0.38
3/12/02	71	802	923	282	0.40	12.79	0.48	1.64	0.37	0.50	0.37	0.42	0.47	1.23	0.39
3/19/02	78	809	718	281	0.51	12.94	0.62	0.50	92.04	0.65	0.47	0.53	0.60	1.58	0.51
3/26/02	85	816	718	279	0.51	12.85	0.62	0.50	0.48	0.65	0.47	0.53	0.60	1.58	0.51
4/2/02	92	823	718	290	0.51	12.76	0.62	1.16	0.48	0.65	0.47	0.53	0.60	3.17	0.51
4/9/02	99	830	718	290	0.51	22.91	0.62	1.00	0.48	0.65	0.47	0.53	0.60	1.58	0.51
4/16/02	106	837	718	297	0.51	46.86	0.62	4.02	0.48	0.65	12.13	0.53	0.60	1.58	0.51
4/23/02	113	844	704	284	0.52	68.49	0.63	1.29	0.49	0.66	1.29	0.54	0.61	1.62	0.52
4/30/02	120	851	774	287	0.47	51.21	0.58	2.22	0.44	0.60	0.44	0.50	0.55	1.47	0.47
5/7/02	127	858	773	294	0.47	29.07	0.58	2.68	0.44	0.60	0.44	0.50	0.56	1.47	0.47
5/14/02	134	865	718	287	0.51	64.11	0.62	1.43	0.48	0.65	0.47	0.53	0.60	1.58	0.51
5/21/02	141	872	714	285	0.51	68.14	0.63	1.50	0.48	0.65	0.47	0.54	0.60	4.22	0.51
5/28/02	148	879	718	295	0.51	2.15	0.62	1.04	0.48	0.65	0.47	0.53	0.60	1.58	0.51
6/4/02	155	886	718	297	0.51	13.69	0.62	1.16	0.48	0.65	0.47	0.53	0.60	20.93	0.51
6/11/02	162	893	740	301	0.49	2.08	0.60	1.93	0.46	0.63	0.46	0.52	0.58	1.54	0.49
6/18/02	169	900	704	296	0.52	20.41	0.63	2.00	0.49	0.66	0.48	0.54	0.61	1.62	0.52
6/25/02	176	907	723	302	0.51	2.13	0.62	2.70	0.47	0.64	0.47	0.53	0.59	1.57	0.50
7/2/02	183	914	740	302	0.49	2.08	0.60	1.62	0.46	0.63	0.46	0.52	0.58	1.54	0.49
7/9/02	190	921	725	301	0.50	24.30	0.62	2.00	0.47	0.64	0.47	0.53	0.59	12.98	0.50
7/16/02	197	928	718	298	0.51	40.10	0.62	3.16	0.48	0.65	0.47	0.53	0.60	1.58	0.50
7/23/02	204	935	718	300	0.51	2.15	0.62	1.64	0.48	0.65	0.47	0.53	0.60	1.58	0.51
7/30/02	211	942	718	302	0.51	24.91	0.62	1.94	0.48	0.65	0.47	0.53	0.60	13.92	0.51
8/6/02	218	949	719	296	0.51	28.34	0.62	2.60	0.48	0.65	0.47	0.53	0.60	14.23	0.50
8/13/02	225	956	718	302	0.51	28.04	0.62	2.20	0.48	0.65	0.47	0.53	0.60	1.58	0.51
8/20/02	232	963	718	300	0.51	37.19	0.62	2.23	1.59	0.65	0.47	0.53	0.60	13.34	0.51
8/27/02	239	970	718	297	0.51	31.21	0.62	1.96	0.48	0.65	0.47	0.53	0.60	16.54	0.51
9/3/02	246	977	718	298	0.51	2.15	0.62	1.10	0.48	0.65	0.47	0.53	0.60	1.58	0.51
9/10/02	253	984	718	299	0.51	20.53	0.62	2.05	0.48	0.65	0.47	0.53	0.60	14.52	0.51
9/17/02	260	991	718	294	0.51	27.57	0.62	2.13	0.48	0.65	0.47	0.53	0.60	1.58	0.51
9/24/02	267	998	718	293	0.51	38.52	0.62	1.78	0.48	0.65	0.47	0.53	0.60	16.88	0.51
10/1/02	274	1005	718	295	0.51	2.15	0.62	1.49	0.48	0.65	0.47	0.53	0.60	13.08	0.51
10/8/02	281	1012	718	287	0.51	2.14	0.62	0.50	0.48	0.65	0.47	0.53	0.60	1.58	0.50
10/15/02	288	1019	718	288	0.51	2.15	0.62	1.23	0.48	0.65	0.47	0.53	0.60	1.58	0.51
10/22/02	295	1026	718	283	0.51	36.08	0.62	1.96	3.36	0.65	1.99	0.53	0.60	1.58	0.51
10/29/02	302	1033	718	279	0.51	2.15	0.62	1.30	0.48	0.65	0.47	0.53	0.60	1.58	0.51
11/5/02	309	1040	718	282	0.51	2.15	0.62	0.50	0.48	0.65	0.47	0.53	0.60	1.58	0.51
11/12/02	316	1047	718	284	0.51	2.15	0.62	1.20	0.48	0.65	0.47	0.53	0.60	1.58	0.51
11/19/02	323	1054	719	280	0.51	2.14	0.62	0.50	0.48	0.65	0.47	0.53	0.60	1.58	0.50

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Malathion	Oxy chlordane
11/26/02	330	1061	719	279	0.51	26.61	0.62	1.53	2.78	0.65	0.47	0.53	0.60	1.58	0.50
3/31/03	90	1186	712	277	2.43	2.16	0.63	1.04	0.48	3.02	0.47	0.54	4.76	1.60	0.51
4/1/03	91	1187	804	286	3.63	1.92	0.56	1.29	0.43	3.71	0.42	0.48	0.53	1.41	0.45
4/2/03	92	1188	847	292	0.43	1.82	0.53	1.61	0.40	2.74	0.40	0.45	0.51	1.34	0.43
4/3/03	93	1189	712	287	0.51	2.16	0.63	1.66	0.48	2.63	0.47	0.54	0.60	1.60	0.51
4/8/03	98	1194	759	277	0.48	2.03	0.59	1.13	0.45	2.35	0.45	0.51	0.57	1.50	0.48
4/15/03	105	1201	712	293	0.51	2.16	0.63	1.50	3.10	2.70	0.47	0.54	0.60	1.60	0.51
6/3/03	154	1250	712	291	0.51	2.16	0.63	0.51	0.48	2.19	0.47	0.54	0.60	1.60	0.51
6/10/03	161	1257	712	297	0.51	2.16	0.63	0.51	0.48	2.19	0.47	0.54	0.60	1.60	0.51
6/17/03	168	1264	710	290	0.52	2.17	0.63	1.04	0.48	2.20	0.48	0.54	0.60	1.60	0.51
6/23/03	174	1270	715	298	0.51	2.16	0.62	0.50	0.48	2.17	0.47	0.54	0.60	1.59	0.51
6/24/03	175	1271	712	298	0.51	2.16	0.63	1.46	0.48	2.26	0.47	0.54	0.60	13.01	0.51
6/25/03	176	1272	712	299	0.51	2.16	0.63	1.50	0.48	2.35	0.47	0.54	0.60	1.60	0.51
6/26/03	177	1273	712	301	0.51	2.16	0.63	1.07	0.48	2.23	0.47	0.54	0.60	1.60	0.51
7/1/03	182	1278	712	297	0.51	2.16	0.63	1.71	1.33	2.39	0.47	0.54	0.60	1.60	0.51
7/8/03	189	1285	712	300	0.51	2.16	0.63	1.10	0.48	2.23	0.47	0.54	0.60	1.60	0.51
7/15/03	196	1292	712	298	0.51	2.16	0.63	0.51	0.48	2.14	0.47	0.54	0.60	1.60	0.51
7/22/03	203	1299	712	298	0.51	2.16	0.63	1.14	0.48	2.39	0.47	0.54	0.60	1.60	0.51
7/29/03	210	1306	712	296	0.51	2.16	0.63	1.08	0.48	2.37	0.47	0.54	0.60	1.60	0.51
8/5/03	217	1313	712	296	0.51	2.16	0.63	1.28	0.48	2.49	0.47	0.54	0.60	1.60	0.51
8/12/03	224	1320	712	299	0.51	2.16	0.63	1.45	0.48	2.22	0.47	0.54	0.60	1.60	0.51
8/19/03	231	1327	712	297	0.51	2.16	0.63	0.51	0.48	0.65	0.47	0.54	0.60	1.60	0.51
8/26/03	238	1334	712	298	0.51	2.16	0.63	1.60	0.48	2.18	0.47	0.54	0.60	1.60	0.51
9/2/03	245	1341	707	297	0.52	2.18	0.63	1.92	0.48	2.35	0.48	0.54	0.61	1.61	0.51
9/9/03	252	1348	712	292	0.51	2.16	0.63	1.53	0.48	2.23	0.47	0.54	0.60	1.60	0.51
9/16/03	259	1355	712	293	0.51	2.16	0.63	2.54	0.48	2.44	0.47	0.54	0.60	1.60	0.51
9/29/03	272	1368	712	289	0.51	2.16	0.63	0.51	0.48	2.18	0.47	0.54	0.60	1.60	0.51

blanks mean that the compound was not analy

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Trans-nonachlor	Mirex	BDE 47	BDE 100	BDE 99	BDE 154	Σchlor	ΣDDT	ΣHCH
4/18/00	109	109	786	282									
4/25/00	116	116	777	282									
5/2/00	123	123	773	288									
5/9/00	130	130	777	300									
5/16/00	137	137	1054	292									
5/23/00	144	144	794	293									
5/30/00	151	151	774	288									
6/6/00	158	158	767	290									
6/13/00	165	165	775	292									
6/20/00	172	172	789	296									
6/27/00	179	179	782	299									
7/4/00	186	186	876	300									
7/11/00	193	193	857	295									
7/18/00	200	200	777	300									
7/25/00	207	207	721	295									
8/1/00	214	214	716	301									
9/12/00	256	256	430	299									
9/19/00	263	263	418	296									
9/26/00	270	270	417	287									
10/3/00	277	277	423	296									
10/10/00	284	284	417	285									
10/17/00	291	291	416	291									
10/24/00	298	298	417	286									
10/31/00	305	305	434	285									
11/7/00	312	312	416	284									
11/14/00	319	319	427	282									
11/21/00	326	326	415	274									
11/28/00	333	333	427	281									
12/5/00	340	340	416	277									
12/12/00	347	347	418	275									
12/19/00	354	354	415	275									
5/15/01	135	501	718	289									
5/22/01	142	508	718	292	0.62	2.19	0.45	0.51	0.73	0.57	0.51	1.52	0.44
5/29/01	149	515	718	292	0.62	2.27	0.45	0.51	0.72	0.57	83.82	1.52	0.44
6/5/01	156	522	718	295	0.62	0.62	0.45	0.51	0.73	0.57	71.76	1.52	0.44
6/12/01	163	529	718	300	0.62	0.62	0.45	0.51	0.73	0.57	74.78	1.52	0.44
6/19/01	170	536	719	298	0.62	0.62	0.45	0.51	0.72	0.57	72.67	1.51	0.44
6/26/01	177	543	718	298	0.62	0.62	0.45	0.51	0.73	0.57	69.77	1.52	0.44
7/3/01	184	550	718	296	0.62	2.23	0.45	0.51	0.73	0.57	0.51	1.52	0.44
7/10/01	191	557	718	299	0.62	0.62	0.45	0.51	0.73	0.57	0.51	1.52	0.44
7/17/01	198	564	718	300	0.62	0.62	0.45	0.51	0.73	0.57	0.51	1.52	0.44
7/24/01	205	571	718	301	0.62	0.62	0.45	0.51	0.73	0.57	0.51	1.52	0.44
7/31/01	212	578	718	295	0.62	0.62	0.45	0.51	0.73	0.57	76.87	1.52	0.44
8/7/01	219	585	718	302	0.62	0.62	0.45	0.51	0.73	0.57	0.51	1.52	0.44
8/14/01	226	592	1448	297	0.31	0.31	0.22	0.25	0.36	0.28	0.25	0.75	0.22
8/21/01	233	599	726	296	0.61	0.61	0.45	0.50	0.72	0.57	0.50	1.50	0.44
8/28/01	240	606	718	299	0.62	0.62	0.45	0.51	0.73	0.57	77.32	1.52	0.44
9/4/01	247	613	718	297	0.62	0.62	0.45	0.51	6.09	0.57	0.51	1.52	0.44

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Trans-nonachlor	Mirex	BDE 47	BDE 100	BDE 99	BDE 154	Σchlor	ΣDDT	ΣHCH
9/11/01	254	620	722	297	0.62	0.62	0.45	0.50	0.72	0.57	0.50	1.51	0.44
9/18/01	261	627	785	292	0.57	0.57	0.41	0.46	0.66	0.53	0.46	1.39	1.63
9/25/01	268	634	722	289	0.62	0.62	0.45	0.50	0.72	0.57	0.50	1.51	5.68
10/2/01	275	641	676	292	0.66	1.92	0.48	0.54	0.77	0.61	65.62	1.61	0.47
10/9/01	282	648	671	284	0.66	0.66	0.48	0.54	0.78	0.61	81.53	1.62	0.48
10/16/01	289	655	696	287	0.64	2.07	0.47	0.52	0.75	0.59	74.33	1.56	3.18
10/23/01	296	662	642	294	0.69	0.69	0.51	0.57	0.81	0.64	68.15	1.69	0.50
10/30/01	303	669	642	284	0.69	2.21	0.51	0.57	0.81	0.64	84.57	1.69	12.56
11/6/01	310	676	642	284	0.69	1.95	5.70	0.57	8.22	0.64	73.42	1.70	0.77
11/13/01	317	683	646	280	0.69	0.69	0.50	0.56	0.81	0.64	49.76	1.68	0.49
3/5/02	64	795	950	284	0.47	0.47	0.34	0.38	1.28	0.43	79.78	1.15	0.34
3/12/02	71	802	923	282	0.48	0.48	0.35	0.39	1.33	0.45	0.39	1.18	0.35
3/19/02	78	809	718	281	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
3/26/02	85	816	718	279	0.62	0.62	0.45	0.51	0.73	0.57	0.51	1.52	0.44
4/2/02	92	823	718	290	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
4/9/02	99	830	718	290	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
4/16/02	106	837	718	297	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
4/23/02	113	844	704	284	0.63	0.63	0.46	0.52	0.74	0.59	0.52	1.55	8.71
4/30/02	120	851	774	287	0.58	0.58	0.42	0.47	0.67	0.53	0.47	1.41	0.91
5/7/02	127	858	773	294	0.58	0.58	0.42	0.47	0.67	0.53	0.47	1.41	0.41
5/14/02	134	865	718	287	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
5/21/02	141	872	714	285	0.62	0.62	0.45	0.51	0.73	0.58	0.51	1.52	0.45
5/28/02	148	879	718	295	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
6/4/02	155	886	718	297	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
6/11/02	162	893	740	301	0.60	0.60	0.44	0.49	0.70	0.56	0.49	1.47	0.43
6/18/02	169	900	704	296	0.63	0.63	0.46	0.52	0.74	0.59	0.52	1.55	0.45
6/25/02	176	907	723	302	0.62	0.62	0.45	0.50	0.72	0.57	0.50	1.51	0.44
7/2/02	183	914	740	302	0.60	0.60	0.44	0.49	0.70	0.56	0.49	1.47	0.43
7/9/02	190	921	725	301	0.62	0.62	0.45	0.50	0.72	0.57	0.50	1.50	0.44
7/16/02	197	928	718	298	0.62	0.62	0.45	0.51	0.72	0.57	0.50	1.51	0.44
7/23/02	204	935	718	300	0.62	0.62	0.45	0.51	0.72	0.57	0.51	1.52	0.44
7/30/02	211	942	718	302	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
8/6/02	218	949	719	296	0.62	0.53	0.45	0.51	0.72	0.57	0.50	1.51	0.44
8/13/02	225	956	718	302	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
8/20/02	232	963	718	300	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
8/27/02	239	970	718	297	0.62	0.53	0.97	0.51	0.72	0.57	0.51	1.52	0.44
9/3/02	246	977	718	298	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
9/10/02	253	984	718	299	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
9/17/02	260	991	718	294	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
9/24/02	267	998	718	293	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
10/1/02	274	1005	718	295	0.62	0.53	1.27	0.51	1.49	0.57	0.51	1.52	0.44
10/8/02	281	1012	718	287	0.62	0.53	0.45	0.51	0.72	0.57	0.50	1.51	0.44
10/15/02	288	1019	718	288	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
10/22/02	295	1026	718	283	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
10/29/02	302	1033	718	279	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	1.43
11/5/02	309	1040	718	282	0.62	0.53	0.45	0.51	2.40	0.57	0.51	1.52	0.44
11/12/02	316	1047	718	284	0.62	0.53	0.45	0.51	0.72	0.57	0.51	1.52	0.44
11/19/02	323	1054	719	280	0.62	0.53	0.45	0.51	0.72	0.57	0.50	1.51	0.44

APPENDIX AB - Analyte concentrations in particle phase (pg/m^3) at HP (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Trans-nonachlor	Mirex	BDE 47	BDE 100	BDE 99	BDE 154	Σchlor	ΣDDT	ΣHCH
11/26/02	330	1061	719	279	0.62	0.53	0.45	0.51	2.16	0.57	0.50	1.51	0.44
3/31/03	90	1186	712	277	0.63	2.42	0.46	0.51	0.73	0.58	0.51	1.53	0.45
4/1/03	91	1187	804	286	3.99	3.66	6.45	0.45	0.65	0.51	70.25	1.35	0.40
4/2/03	92	1188	847	292	0.53	2.15	0.38	0.43	0.61	0.49	62.60	1.28	0.38
4/3/03	93	1189	712	287	0.63	2.42	0.46	0.51	0.73	0.58	54.14	1.53	0.45
4/8/03	98	1194	759	277	0.59	2.12	0.43	0.48	0.69	0.54	79.28	1.43	0.42
4/15/03	105	1201	712	293	0.63	2.36	0.46	0.51	0.73	0.58	98.81	1.53	0.45
6/3/03	154	1250	712	291	0.63	0.53	0.46	0.51	0.73	0.58	70.64	1.53	0.45
6/10/03	161	1257	712	297	0.63	0.53	0.46	0.51	0.73	0.58	94.83	1.53	0.45
6/17/03	168	1264	710	290	0.63	2.18	0.46	0.51	0.73	0.58	81.70	1.53	0.45
6/23/03	174	1270	715	298	0.62	2.14	0.45	0.51	0.73	0.58	96.15	1.52	0.45
6/24/03	175	1271	712	298	0.63	2.19	0.46	0.51	0.73	0.58	0.00	1.53	0.45
6/25/03	176	1272	712	299	0.63	2.21	0.46	0.51	0.73	0.58	75.34	1.53	0.45
6/26/03	177	1273	712	301	0.63	2.11	0.46	0.51	0.73	0.58	77.87	1.53	0.45
7/1/03	182	1278	712	297	0.63	2.26	0.46	0.51	0.73	0.58	79.54	1.53	0.45
7/8/03	189	1285	712	300	0.63	0.53	0.46	0.51	0.73	0.58	84.41	1.53	0.45
7/15/03	196	1292	712	298	0.63	2.12	0.46	0.51	0.73	0.58	85.63	1.53	0.45
7/22/03	203	1299	712	298	0.63	2.28	0.46	0.51	0.73	0.58	85.20	1.53	0.45
7/29/03	210	1306	712	296	0.63	2.22	0.46	0.51	0.73	0.58	93.03	1.53	0.45
8/5/03	217	1313	712	296	0.63	2.23	0.46	0.51	0.73	0.58	88.69	1.53	0.45
8/12/03	224	1320	712	299	0.63	2.11	0.46	0.51	0.73	0.58	94.43	1.53	0.45
8/19/03	231	1327	712	297	0.63	0.53	0.46	0.51	0.73	0.58	94.26	1.53	0.45
8/26/03	238	1334	712	298	0.63	2.16	0.46	0.51	0.73	0.58	0.51	1.53	0.45
9/2/03	245	1341	707	297	0.63	2.26	0.46	0.51	0.74	0.58	89.57	1.54	0.45
9/9/03	252	1348	712	292	0.63	2.16	0.46	0.51	0.73	0.58	94.46	1.53	0.45
9/16/03	259	1355	712	293	0.63	2.23	0.46	0.51	0.73	0.58	83.26	1.53	0.45
9/29/03	272	1368	712	289	0.63	2.11	0.46	0.51	0.73	0.58	77.14	1.53	0.45

blanks mean that the compound was not analy

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin	Simazine	Trifluralin	DDD	DDE	DDT
4/11/01	101	467	702	284.8	2.47	2.21	4.99	4.23	2.78	9.87	45.41	6.18	0.76	5.64	0.90	4.95	1.55	3.80
4/18/01	108	474	619	277.8	2.80	2.51	5.65	4.80	3.15	11.19	50.84	7.01	0.86	6.40	1.02	5.61	1.76	4.31
4/25/01	115	481	626	280.6	2.77	2.48	33.41	4.75	3.12	11.06	58.40	6.93	0.85	6.32	1.01	5.55	1.74	4.26
5/16/01	136	502	915	286.3	1.89	1.70	87.20	3.25	58.70	7.57	82.37	4.75	0.58	4.33	0.69	3.80	1.19	2.92
5/23/01	143	509	789	291.0	2.20	1.97	180.75	402.32	123.45	8.78	384.92	5.50	0.67	118.39	0.80	4.40	1.38	3.38
5/30/01	150	516	782	288.0	33.13	60.05	387.40	3.80	143.30	8.86	406.51	5.55	0.68	186.49	0.81	4.44	1.39	3.41
6/6/01	157	523	778	293.8	2.23	2.00	46.88	3.82	2.51	8.91	111.60	5.58	0.68	5.10	0.81	4.47	1.40	3.43
6/13/01	164	530	713	297.5	2.43	2.18	57.82	4.17	63.02	9.72	44.38	6.09	0.74	5.56	0.88	4.87	1.53	3.74
6/20/02	171	537	714	297.2	2.43	2.18	27.98	4.17	2.74	9.71	43.45	6.08	0.74	5.55	0.88	4.87	1.52	3.74
6/27/01	178	544	756	299.6	2.29	2.06	24.40	413.33	2.58	9.16	39.50	5.74	151.36	5.24	0.83	4.59	1.44	3.53
7/11/01	192	558	749	295.6	2.31	2.07	31.97	3.97	2.61	9.25	102.48	5.79	0.71	5.29	0.84	4.64	1.45	3.56
7/17/01	198	564	750	294.6	2.31	2.07	4.67	3.96	2.60	9.23	32.37	5.79	0.71	5.28	0.84	4.63	1.45	3.56
7/25/01	206	572	742	300.8	2.34	2.09	29.12	4.01	2.63	9.34	2.46	5.85	0.71	5.34	0.85	4.68	1.47	3.60
8/8/01	220	586	741	302.1	2.34	2.10	4.73	453.90	2.64	9.35	2.46	5.86	0.72	5.35	0.85	4.69	1.47	3.60
8/15/01	227	593	716	294.5	2.42	2.17	4.89	4.15	2.73	9.68	2.55	6.07	0.74	5.54	0.88	4.85	1.52	3.73
8/22/01	234	600	902	296.6	1.92	1.72	3.88	3.29	2.16	7.68	28.40	4.81	0.59	4.39	0.70	3.85	1.21	2.96
8/29/01	241	607	603	296.6	2.87	2.58	5.81	4.93	3.24	11.49	3.02	7.20	0.88	6.57	1.04	5.76	1.80	4.43
9/5/01	248	614	765	292.1	2.27	2.03	33.64	3.89	2.55	9.06	2.38	5.68	0.69	5.18	0.82	4.54	1.42	3.49
9/12/01	255	621	743	293.0	2.33	2.09	27.38	4.00	2.63	9.33	2.45	5.84	0.71	5.33	0.85	4.68	1.46	3.59
9/19/01	262	628	982	293.8	1.77	1.58	21.12	3.03	1.99	7.06	1.86	4.42	0.54	4.03	0.64	3.54	1.11	2.72
9/26/01	269	635	980	287.2	1.77	1.59	22.41	3.03	1.99	7.07	1.86	4.43	0.54	4.04	0.64	3.54	1.11	2.72
10/3/01	276	642	1116	294.0	1.55	1.39	32.61	2.66	1.75	6.21	1.63	3.89	0.48	3.55	0.56	3.11	0.98	2.39
10/10/01	283	649	1156	290.3	1.50	1.34	19.64	2.57	1.69	5.99	1.58	3.75	0.46	3.43	0.54	3.00	0.94	2.31
10/17/01	290	656	758	284.9	2.29	2.05	4.62	3.92	2.58	9.14	2.41	5.73	0.70	5.23	0.83	4.58	1.44	3.52
10/24/01	296	662	983	296.2	1.76	1.58	22.52	3.02	1.99	7.05	1.85	4.42	0.54	61.19	0.64	3.53	1.11	2.71
10/31/01	304	670	982	286.2	1.76	1.58	3.56	3.03	1.99	7.05	1.86	4.42	0.54	4.03	0.64	3.54	1.11	2.72
11/7/01	311	677	982	284.2	1.77	1.58	30.26	3.03	1.99	7.06	1.86	4.42	0.54	44.98	0.64	3.54	1.11	2.72
11/14/01	318	684	982	283.5	1.76	1.58	3.56	3.03	1.99	7.05	1.86	4.42	0.54	4.03	0.64	3.54	1.11	2.72
11/21/01	325	691	983	288.0	1.76	1.58	3.56	3.03	1.99	7.05	1.86	4.42	0.54	4.03	0.64	3.54	1.11	2.72
1/3/02	3	734	978	270.6	1.77	1.59	3.58	3.04	2.00	7.09	1.86	4.44	0.54	4.05	0.64	3.55	1.11	2.73
2/22/02	53	784	840	279.5	2.06	1.85	4.17	3.54	2.32	8.24	2.17	5.17	0.63	4.71	0.75	4.13	1.29	3.18
3/6/02	65	796	922	282.9	1.88	1.69	3.80	3.22	2.12	7.52	1.98	4.71	0.58	4.30	0.68	3.77	1.18	2.89
3/13/02	72	803	972	282.3	1.78	1.60	3.60	3.06	2.01	7.13	1.88	4.47	0.55	4.08	0.65	3.57	1.12	2.75
3/19/02	78	809	1011	280.2	1.71	1.54	3.46	2.94	1.93	6.86	1.80	4.30	0.52	3.92	0.62	3.44	1.08	2.64
3/28/02	87	818	708	280.0	2.45	2.20	4.94	4.20	2.76	9.79	2.57	6.13	0.75	5.60	0.89	4.91	1.54	3.77
4/2/02	92	823	704	284.4	2.46	2.21	4.97	4.22	2.77	9.84	2.59	6.17	0.75	5.63	0.89	4.93	1.55	3.79
4/8/02	98	829	640	289.1	2.71	2.43	40.59	4.64	3.05	10.83	144.93	6.78	0.83	216.90	0.98	5.43	1.70	4.17
4/16/02	106	837	560	297.2	50.18	2.78	1610.73	326.66	290.12	12.37	5021.71	7.75	0.95	1124.03	1.13	6.20	1.94	4.77
4/23/02	113	844	699	280.8	2.48	2.22	33.04	4.25	2.79	9.91	40.56	6.21	0.76	5.67	0.90	4.97	1.56	3.82
4/30/02	120	851	718	286.1	221.45	2.17	410.29	4.14	120.24	9.66	1095.09	6.05	0.74	570.95	0.88	4.84	1.52	3.72
5/7/02	127	858	716	294.6	82.69	2.17	309.74	299.56	258.77	9.68	1292.85	6.06	319.92	597.42	0.88	4.85	1.52	3.73
5/14/02	134	865	712	289.0	41.11	21.05	572.04	4.18	184.84	9.74	721.13	6.10	0.75	438.97	0.89	4.88	1.53	3.75
5/21/02	141	872	815	285.8	2.13	8.74	174.85	3.65	60.14	8.50	529.42	5.33	0.65	94.71	0.77	4.26	1.34	3.27
5/28/02	148	879	821	294.5	2.11	1.89	132.13	3.62	37.88	8.44	111.28	5.29	0.65	120.64	0.77	4.23	1.33	3.25
6/4/02	155	886	710	299.3	2.44	2.19	141.66	4.19	28.73	9.76	119.23	6.11	0.75	5.58	0.89	4.89	1.53	3.76
6/11/02	162	893	878	298.6	1.97	1.77	104.47	3.38	29.24	7.89	49.39	4.94	0.60	60.99	0.72	3.95	1.24	3.04
6/18/02	169	900	814	294.6	2.13	1.91	41.60	3.65	2.40	8.51	2.24	5.33	0.65	4.86	2.63	4.26	1.34	3.28
6/25/02	176	907	1281	301.2	1.35	1.21	24.35	2.32	1.52	5.41	21.81	3.39	0.41	3.09	1.72	2.71	0.85	2.08

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin	Simazine	Trifluralin	DDD	DDE	DDT
7/2/02	183	914	705	300.6	2.46	2.20	33.82	4.22	2.77	9.83	45.67	6.16	0.75	5.62	3.08	4.93	1.54	3.78
7/9/02	190	921	735	296.5	2.36	2.12	25.66	4.05	2.66	9.43	42.54	5.91	0.72	5.39	2.90	4.73	1.48	3.63
7/16/02	197	928	722	301.4	2.40	2.15	4.85	4.11	2.70	9.59	794.12	6.01	0.73	5.48	0.87	4.81	1.51	3.69
7/23/02	204	935	1187	294.8	1.46	1.31	2.95	2.50	1.65	40.48	1.54	3.66	0.45	3.34	1.95	2.93	0.92	2.25
7/30/02	211	942	942	302.0	1.84	1.65	21.48	3.16	2.07	7.36	1.94	4.61	0.56	4.21	2.31	3.69	1.16	2.83
8/6/02	218	949	940	292.3	1.84	1.65	3.73	3.16	2.08	7.37	1.94	4.62	0.56	4.22	0.67	3.70	1.16	2.84
8/13/02	225	956	924	300.4	1.88	1.68	3.79	3.22	2.11	7.50	1.97	4.70	0.57	4.29	0.68	3.76	1.18	2.89
8/20/02	232	963	940	295.2	1.84	1.65	3.72	3.16	2.08	7.37	1.94	4.62	0.56	4.21	0.67	3.69	1.16	2.84
8/27/02	239	970	958	292.6	1.81	1.62	3.66	3.10	2.04	7.23	1.90	4.53	0.55	4.14	0.66	3.63	1.14	2.79
9/3/02	246	977	931	296.9	1.86	1.67	3.76	3.19	2.10	7.45	1.96	4.67	0.57	4.26	0.68	3.73	1.17	2.87
9/10/02	253	984	934	293.2	1.86	1.66	3.75	3.18	2.09	7.42	1.95	4.65	0.57	4.24	0.67	3.72	1.17	2.86
9/17/02	260	991	951	292.5	1.82	1.63	3.68	3.13	2.05	7.29	1.92	4.56	0.56	4.17	0.66	3.65	1.14	2.81
9/24/02	267	998	939	293.1	1.85	1.66	3.73	3.17	2.08	7.38	1.94	4.62	0.56	4.22	0.67	3.70	1.16	2.84
10/1/02	274	1005	934	296.5	1.85	1.66	3.75	3.18	2.09	7.41	1.95	4.65	0.57	4.24	0.67	3.72	1.16	2.86
10/8/02	281	1012	896	291.1	1.93	1.74	3.91	3.32	2.18	7.73	2.03	4.85	0.59	4.42	0.70	3.88	1.21	2.98
10/15/02	288	1019	996	285.4	1.74	1.56	3.51	2.98	1.96	6.95	1.83	4.36	0.53	3.98	0.63	3.49	1.09	2.68
10/22/03	295	1026	942	285.0	1.84	1.65	3.72	3.16	2.07	7.36	1.94	4.61	0.56	4.21	0.67	3.69	1.16	2.83
10/29/02	302	1033	946	280.1	1.83	1.64	3.70	3.14	2.07	7.33	1.93	4.59	0.56	4.19	0.67	3.67	1.15	2.82
11/5/02	309	1040	947	282.1	1.83	1.64	3.70	3.14	2.06	7.32	1.93	4.59	0.56	4.18	0.67	3.67	1.15	2.82
11/12/02	316	1047	947	279.1	1.83	1.64	3.70	3.14	2.06	7.32	1.93	4.59	0.56	4.18	0.67	3.67	1.15	2.82
11/19/02	323	1054	944	280.4	1.84	1.65	3.71	3.15	2.07	7.34	1.93	4.60	0.56	4.20	0.67	3.68	1.15	2.83
11/26/02	330	1061	961	273.6	1.80	1.62	3.64	3.09	2.03	7.21	1.90	4.52	0.55	4.12	0.66	3.61	1.13	2.78
12/19/02	352	1083	953	281.0	1.82	1.63	3.68	3.12	2.05	7.27	1.91	4.56	0.56	4.16	1.41	3.65	1.14	2.80
1/21/03	21	1117	942	266.1	1.84	1.65	3.72	3.15	2.07	7.35	1.93	4.61	0.56	4.20	0.67	3.69	1.15	2.83
4/15/03	105	1201	970	282.9	1.79	1.60	3.61	3.06	2.01	7.14	1.88	4.47	0.55	4.08	0.65	3.58	1.12	2.75
4/22/03	112	1208	727	282.3	2.39	45.33	112.33	4.09	2.69	9.54	816.74	5.98	0.73	5.45	0.87	4.78	1.50	3.67
4/29/03	120	1216	742	280.2	561.91	2.10	4.72	4.01	2.63	9.34	253.86	5.85	0.71	5.34	16.62	4.68	1.47	3.60
5/6/03	127	1223	709	280.0	117.79	2.19	449.17	4.19	148.27	9.77	1044.60	6.12	0.75	5.58	0.89	4.90	1.53	3.76
5/13/03	133	1229	735	284.4	2.36	2.11	1500.53	4.04	195.14	9.43	3513.73	5.91	0.72	5.39	0.86	4.73	1.48	3.63
5/22/03	142	1238	725	297.2	385.12	27.52	2057.50	4.10	506.44	9.56	5091.76	5.99	0.73	5.46	0.87	4.79	1.50	3.68
5/27/03	147	1243	708	280.8	2.45	2.19	4.94	4.20	2.76	9.78	2.57	6.13	0.75	77.15	0.89	4.90	1.54	3.77
6/3/03	154	1250	708	286.1	2.45	2.19	4.94	4.20	2.76	9.78	33.57	6.13	0.75	5.59	0.89	4.90	1.54	3.77
6/12/03	163	1259	722	294.6	2.40	2.15	4.85	4.12	2.70	9.59	120.83	6.01	0.73	91.14	0.87	4.81	1.51	3.69
6/18/03	169	1265	721	289.0	2.41	2.16	147.55	4.13	2.71	9.62	2.53	6.03	0.74	5.50	0.87	4.82	1.51	3.70
6/22/03	172	1268	687	285.8	2.52	2.26	5.10	4.33	2.84	10.09	2.65	6.32	0.77	5.77	0.92	5.06	1.58	3.89
7/1/03	182	1278	724	294.5	2.39	2.15	52.60	4.11	2.70	9.57	130.41	6.00	0.73	5.47	3.15	4.80	1.50	3.69
7/8/03	189	1285	707	299.3	2.45	2.20	4.95	4.21	2.76	9.81	116.39	6.14	0.75	5.61	4.29	4.92	1.54	3.78
7/15/03	196	1292	732	298.6	2.37	2.12	4.79	4.06	2.67	9.47	2.49	5.93	0.72	5.41	0.86	4.75	1.49	3.65
7/22/03	203	1299	730	294.6	2.37	2.13	4.79	4.07	2.67	9.49	2.50	5.95	168.60	5.43	4.16	4.76	1.49	3.66
7/29/03	210	1306	702	301.2	2.47	2.22	4.99	4.24	2.78	9.88	2.60	6.19	0.76	5.65	2.98	4.95	1.55	3.80
8/5/03	217	1313	707	300.6	2.45	2.20	4.95	4.20	2.76	9.80	2.58	6.14	0.75	5.60	2.90	4.91	1.54	3.77
8/12/03	224	1320	707	296.5	2.45	2.20	4.95	4.21	2.76	9.81	2.58	6.14	0.75	5.61	3.33	4.92	1.54	3.78
8/19/03	231	1327	720	301.4	2.41	2.16	4.86	4.13	2.71	9.62	2.53	6.03	0.74	5.50	3.32	4.83	1.51	3.71
8/26/03	238	1334	712	294.8	2.43	2.18	4.92	4.17	2.74	9.73	24.06	6.10	0.74	5.56	3.45	4.88	1.53	3.75
9/2/03	245	1341	730	302.0	2.37	2.13	4.79	4.07	2.67	9.49	2.50	5.94	0.73	5.42	0.86	4.76	1.49	3.65
9/9/03	252	1348	707	292.3	2.45	2.20	4.95	4.20	2.76	9.80	2.58	6.14	0.75	5.60	3.18	4.91	1.54	3.78
9/16/03	259	1355	717	300.4	2.42	2.17	4.89	4.15	2.73	9.67	2.54	6.06	0.74	5.53	3.07	4.85	1.52	3.72

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	chthnl	clrps	clrps. Oxon	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate	Fipronil	g-chlordane
4/11/01	101	467	702	284.8	0.63	0.82	0.45	1.21	0.48	0.25	0.43	0.36	0.52	2.20	0.64	0.51	0.49	0.49
4/18/01	108	474	619	277.8	0.72	0.93	0.51	1.37	0.54	5.49	0.48	0.41	0.59	2.49	1.60	0.58	0.55	0.55
4/25/01	115	481	626	280.6	0.71	0.92	0.51	1.36	0.53	11.41	0.48	0.40	0.58	2.46	0.71	0.57	0.55	0.55
5/16/01	136	502	915	286.3	0.49	0.63	0.35	0.93	0.37	4.81	0.33	0.28	0.40	1.68	0.49	0.39	0.37	0.37
5/23/01	143	509	789	291.0	0.56	0.73	0.40	1.08	0.42	19.87	0.38	0.32	0.46	15.52	0.57	0.45	0.43	0.43
5/30/01	150	516	782	288.0	0.57	0.74	0.41	1.09	0.43	899.92	0.38	0.32	0.47	14.66	0.57	0.46	0.44	0.44
6/6/01	157	523	778	293.8	0.57	0.74	0.41	1.09	0.43	5.26	0.39	0.32	0.47	1.98	0.57	0.46	0.44	0.44
6/13/01	164	530	713	297.5	0.62	0.81	0.45	1.19	0.47	90.58	3.37	0.35	0.51	2.16	0.63	0.50	0.48	0.48
6/20/02	171	537	714	297.2	0.62	0.81	0.45	1.19	0.47	6.04	0.42	0.35	0.51	2.16	0.63	0.50	0.48	0.48
6/27/01	178	544	756	299.6	0.59	0.76	0.42	1.13	0.44	283.47	0.40	0.33	0.48	2.04	0.59	0.47	0.45	0.45
7/11/01	192	558	749	295.6	0.59	0.77	0.43	1.14	0.45	68.81	0.40	0.34	0.49	2.06	0.60	0.48	0.46	0.46
7/17/01	198	564	750	294.6	0.59	0.77	0.42	1.13	0.45	8.94	0.40	0.34	0.49	2.05	0.60	0.48	0.46	0.46
7/25/01	206	572	742	300.8	0.60	0.78	0.43	1.15	0.45	221.16	0.40	0.34	0.49	2.08	0.60	0.48	0.46	0.46
8/8/01	220	586	741	302.1	0.60	0.78	0.43	1.15	0.45	348.58	0.94	0.34	0.49	2.08	0.60	0.48	0.46	0.46
8/15/01	227	593	716	294.5	0.62	0.81	0.45	1.19	0.47	4.81	0.42	0.35	0.51	2.15	0.62	0.50	0.48	0.48
8/22/01	234	600	902	296.6	0.49	0.64	0.35	0.94	0.37	134.61	0.33	0.28	0.41	1.71	0.49	0.85	0.38	0.38
8/29/01	241	607	603	296.6	0.74	0.96	0.53	1.41	0.55	13.80	0.50	0.42	0.61	2.56	0.74	0.59	0.57	0.57
9/5/01	248	614	765	292.1	0.58	0.75	0.42	1.11	0.44	4.47	0.39	0.33	0.48	2.02	0.58	0.47	0.45	0.45
9/12/01	255	621	743	293.0	0.60	0.78	0.43	1.15	0.45	13.07	0.40	0.34	0.49	2.07	0.60	0.48	0.46	0.46
9/19/01	262	628	982	293.8	0.45	0.59	0.32	0.87	0.34	3.77	0.31	0.26	0.37	1.57	0.45	0.37	0.35	0.35
9/26/01	269	635	980	287.2	0.45	0.59	0.33	0.87	0.34	8.83	0.31	0.26	0.37	12.48	0.46	0.37	0.35	0.35
10/3/01	276	642	1116	294.0	0.40	0.52	0.29	0.76	0.30	343.47	0.27	0.23	0.33	1.38	0.40	1.21	0.31	0.31
10/10/01	283	649	1156	290.3	0.39	0.50	0.28	0.74	0.29	6.11	0.26	0.22	0.32	1.33	0.39	0.31	0.30	0.30
10/17/01	290	656	758	284.9	0.59	0.76	0.42	1.12	0.44	4.18	0.40	0.33	0.48	16.15	0.59	0.47	0.45	0.45
10/24/01	296	662	983	296.2	0.45	0.59	0.32	0.87	0.34	38.12	0.31	0.26	0.37	1.57	0.45	0.36	0.35	0.35
10/31/01	304	670	982	286.2	0.45	0.59	0.32	0.87	0.34	3.99	0.31	0.26	0.37	12.61	0.45	0.36	0.35	0.35
11/7/01	311	677	982	284.2	0.45	0.59	0.32	0.87	0.34	9.24	0.31	0.26	0.37	24.94	0.45	0.37	2.39	0.35
11/14/01	318	684	982	283.5	0.45	0.59	0.32	0.87	0.34	0.18	0.31	0.26	0.37	19.13	0.45	0.36	0.35	0.35
11/21/01	325	691	983	288.0	0.45	0.59	0.32	0.87	0.34	0.18	0.31	0.26	0.37	1.57	0.45	0.36	0.35	0.35
1/3/02	3	734	978	270.6	0.46	0.59	0.33	0.87	0.34	5.08	0.31	0.26	0.37	20.49	0.46	0.37	0.35	0.35
2/22/02	53	784	840	279.5	0.53	0.69	0.38	1.01	0.40	4.68	0.36	0.30	0.44	22.31	0.53	0.43	0.41	0.41
3/6/02	65	796	922	282.9	0.48	0.63	0.35	0.92	0.36	0.19	0.33	0.27	0.40	1.67	0.48	0.39	0.37	0.37
3/13/02	72	803	972	282.3	0.46	0.59	0.33	0.88	0.34	0.18	0.31	0.26	0.38	1.59	0.46	0.37	0.35	0.35
3/19/02	78	809	1011	280.2	0.44	0.57	0.32	0.84	0.33	0.17	0.30	0.25	0.36	1.52	0.44	0.35	0.34	0.34
3/28/02	87	818	708	280.0	0.63	0.81	0.45	1.20	0.47	0.25	0.42	0.36	0.52	2.18	0.63	0.51	0.48	0.48
4/2/02	92	823	704	284.4	0.63	0.82	0.45	1.21	0.47	0.25	0.43	0.36	0.52	2.19	0.63	0.51	0.49	0.49
4/8/02	98	829	640	289.1	0.70	0.90	0.50	1.33	0.52	0.27	0.47	0.39	0.57	2.41	0.70	0.56	0.53	0.54
4/16/02	106	837	560	297.2	0.80	1.03	0.57	1.52	0.60	18.70	1.09	0.45	0.65	2.75	0.80	0.64	2.34	0.61
4/23/02	113	844	699	280.8	0.64	0.82	0.46	1.22	0.48	0.25	0.43	0.36	0.52	2.20	0.64	0.51	0.49	0.49
4/30/02	120	851	718	286.1	0.62	0.80	0.44	1.19	0.47	29.17	0.42	0.35	0.51	31.44	0.62	0.50	0.48	0.48
5/7/02	127	858	716	294.6	0.62	0.80	0.45	1.19	8.07	37.49	1.40	0.35	0.51	47.22	0.62	0.50	0.48	0.48
5/14/02	134	865	712	289.0	0.63	0.81	0.45	1.20	0.47	20.27	0.42	0.35	0.51	35.14	0.63	0.50	0.48	0.48
5/21/02	141	872	815	285.8	0.55	0.71	0.39	1.04	0.41	0.21	0.37	0.31	0.45	30.16	0.55	0.44	0.42	0.42
5/28/02	148	879	821	294.5	0.54	0.70	0.39	1.04	0.41	0.21	0.37	0.31	0.45	1.88	0.54	0.44	0.42	0.42
6/4/02	155	886	710	299.3	0.63	0.81	0.45	1.20	0.47	18.22	0.42	0.35	0.52	2.17	0.63	0.50	0.48	0.48
6/11/02	162	893	878	298.6	0.51	0.66	0.36	0.97	0.38	436.36	0.34	0.29	0.42	1.75	0.51	0.41	0.39	0.39
6/18/02	169	900	814	294.6	0.55	0.71	0.39	1.04	0.41	15.32	0.86	0.31	0.45	14.12	0.55	0.44	0.42	0.42
6/25/02	176	907	1281	301.2	0.35	0.45	0.25	0.66	0.26	106.01	0.60	0.20	0.29	1.20	0.35	0.28	0.27	0.27

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	chthnl	clrps	clrps. Oxon	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate	Fipronil	g-chlordane
7/2/02	183	914	705	300.6	0.63	0.82	0.45	1.21	0.47	106.34	0.88	0.36	0.52	2.19	0.63	0.51	0.48	0.49
7/9/02	190	921	735	296.5	0.61	0.78	0.43	1.16	0.46	140.87	0.41	0.34	0.50	2.10	0.61	0.49	0.47	0.47
7/16/02	197	928	722	301.4	0.62	0.80	0.44	1.18	0.46	35.16	0.42	0.35	0.51	13.83	0.62	0.50	0.47	0.47
7/23/02	204	935	1187	294.8	0.38	0.49	0.27	0.72	0.28	8.37	0.55	0.21	0.31	1.30	0.38	0.30	0.29	0.29
7/30/02	211	942	942	302.0	0.47	0.61	0.34	0.90	0.35	77.14	0.32	0.27	0.39	1.64	0.47	0.38	0.36	0.36
8/6/02	218	949	940	292.3	0.47	0.61	0.34	0.91	0.36	49.42	0.32	0.27	0.39	18.53	0.48	0.38	0.36	0.36
8/13/02	225	956	924	300.4	0.48	0.62	0.34	0.92	0.36	47.51	0.32	0.27	0.40	1.67	0.48	0.39	0.37	0.37
8/20/02	232	963	940	295.2	0.47	0.61	0.34	0.90	0.36	13.60	0.32	0.27	0.39	12.91	0.47	0.38	0.36	0.36
8/27/02	239	970	958	292.6	0.47	0.60	0.33	0.89	0.35	32.59	0.31	0.26	0.38	14.01	0.47	0.37	0.36	0.36
9/3/02	246	977	931	296.9	0.48	0.62	0.34	0.91	0.36	2029.77	0.32	0.27	0.39	1.66	0.48	0.39	0.37	0.37
9/10/02	253	984	934	293.2	0.48	0.62	0.34	0.91	0.36	0.19	0.32	0.27	0.39	10.60	0.48	0.38	0.37	0.37
9/17/02	260	991	951	292.5	0.47	0.61	0.34	0.89	0.35	21.33	0.32	0.26	0.38	12.06	0.47	0.38	0.36	0.36
9/24/02	267	998	939	293.1	0.47	0.61	0.34	0.91	0.36	10.76	0.32	0.27	0.39	14.12	0.48	0.38	0.36	0.36
10/1/02	274	1005	934	296.5	0.48	0.62	0.34	0.91	0.36	0.19	0.32	0.27	0.39	12.53	0.48	0.38	0.37	0.37
10/8/02	281	1012	896	291.1	0.50	0.64	0.36	0.95	0.37	10.06	0.33	0.28	0.41	14.32	0.50	0.40	0.38	0.38
10/15/02	288	1019	996	285.4	0.45	0.58	0.32	0.85	0.34	0.18	0.30	0.25	0.37	1.55	0.45	0.36	0.34	0.34
10/22/03	295	1026	942	285.0	0.47	0.61	0.34	0.90	0.35	0.19	0.32	0.27	0.39	1.64	0.47	0.38	0.36	0.36
10/29/02	302	1033	946	280.1	0.47	0.61	0.34	0.90	0.35	0.18	0.32	0.27	0.39	1.63	0.47	0.38	0.36	0.36
11/5/02	309	1040	947	282.1	0.47	0.61	0.34	0.90	0.35	0.18	0.32	0.27	0.39	1.63	0.47	0.38	0.36	0.36
11/12/02	316	1047	947	279.1	0.47	0.61	0.34	0.90	0.35	0.18	0.32	0.27	0.39	1.63	0.47	0.38	0.36	0.36
11/19/02	323	1054	944	280.4	0.47	0.61	0.34	0.90	0.35	0.19	0.32	0.27	0.39	24.87	0.47	0.38	0.36	0.36
11/26/02	330	1061	961	273.6	0.46	0.60	0.33	0.89	0.35	0.18	0.31	0.26	0.38	18.44	0.46	0.37	0.36	0.36
12/19/02	352	1083	953	281.0	0.47	0.61	0.33	0.89	0.35	0.18	0.31	0.26	0.38	1.62	0.47	0.38	0.36	0.36
1/21/03	21	1117	942	266.1	0.47	0.61	0.34	0.90	0.35	0.19	0.32	0.27	0.39	1.64	0.47	0.38	0.36	0.36
4/15/03	105	1201	970	282.9	0.46	0.59	0.33	0.88	0.34	0.18	0.31	15.71	0.38	1.59	0.46	0.37	0.35	0.35
4/22/03	112	1208	727	282.3	0.61	0.79	0.44	1.17	0.46	0.24	0.41	13.50	0.50	2.12	0.61	0.49	0.47	0.47
4/29/03	120	1216	742	280.2	0.60	0.78	0.43	1.15	0.45	0.24	0.40	42.34	0.49	2.08	0.60	0.48	0.46	0.46
5/6/03	127	1223	709	280.0	0.63	0.81	0.45	1.20	0.47	0.25	0.42	7.19	0.52	2.17	0.63	0.51	0.48	0.48
5/13/03	133	1229	735	284.4	0.61	0.78	0.43	1.16	0.45	0.24	0.41	14.74	0.50	2.10	0.61	0.49	0.47	0.47
5/22/03	142	1238	725	297.2	0.61	0.79	0.44	1.17	0.46	0.24	0.41	6.07	0.50	2.13	0.62	0.49	0.47	0.47
5/27/03	147	1243	708	280.8	0.63	0.81	0.45	1.20	0.47	0.25	0.42	0.36	0.52	2.17	0.63	0.51	0.48	0.48
6/3/03	154	1250	708	286.1	0.63	0.81	0.45	1.20	0.47	0.25	0.42	9.91	0.52	2.17	0.63	0.51	0.48	0.48
6/12/03	163	1259	722	294.6	0.62	0.80	0.44	1.18	1.43	0.24	0.42	109.41	0.51	2.13	0.62	0.50	0.47	0.47
6/18/03	169	1265	721	289.0	0.62	0.80	0.44	1.18	0.46	0.24	0.42	12.28	0.51	2.14	0.62	0.50	0.47	0.48
6/22/03	172	1268	687	285.8	0.65	0.84	0.46	1.24	0.49	0.25	0.44	0.37	0.53	2.24	0.65	0.52	0.50	0.50
7/1/03	182	1278	724	294.5	0.62	0.80	0.44	1.18	0.46	0.24	0.41	15.73	0.51	2.13	0.62	0.49	0.47	0.47
7/8/03	189	1285	707	299.3	0.63	0.82	0.45	1.20	0.47	0.25	0.42	18.69	0.52	2.18	0.63	0.51	0.48	0.48
7/15/03	196	1292	732	298.6	0.61	0.79	0.44	1.16	0.46	0.24	0.41	0.34	0.50	2.11	0.61	0.49	0.47	0.47
7/22/03	203	1299	730	294.6	0.61	0.79	0.44	1.17	0.46	0.24	0.41	116.22	0.50	2.11	0.61	0.49	0.47	0.47
7/29/03	210	1306	702	301.2	0.64	0.82	0.45	1.21	0.48	0.25	0.43	6.40	0.52	2.20	0.64	0.51	0.49	0.49
8/5/03	217	1313	707	300.6	0.63	0.81	0.45	1.20	0.47	0.25	0.42	93.52	0.52	2.18	0.63	0.51	0.48	0.48
8/12/03	224	1320	707	296.5	0.63	0.82	0.45	1.20	0.47	0.25	0.42	12.69	0.52	2.18	0.63	0.51	0.48	0.48
8/19/03	231	1327	720	301.4	0.62	0.80	0.44	1.18	0.46	0.24	0.42	9.67	0.51	2.14	0.62	0.50	0.47	0.48
8/26/03	238	1334	712	294.8	0.63	0.81	0.45	1.20	0.47	0.25	0.42	29.48	0.51	2.16	0.63	0.50	0.48	0.48
9/2/03	245	1341	730	302.0	0.61	0.79	0.44	1.17	0.46	0.24	0.41	0.34	0.50	2.11	0.61	0.49	0.47	0.47
9/9/03	252	1348	707	292.3	0.63	0.82	0.45	1.20	0.47	0.25	0.42	21.73	0.52	2.18	0.63	0.51	0.48	0.48
9/16/03	259	1355	717	300.4	0.62	0.80	0.44	1.19	0.47	0.24	0.42	138.74	0.51	2.15	0.62	0.50	0.48	0.48

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	g-HCH	HEPT	HEPTX	Malathion	Mirex	Oxy chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154	Σ chlor	Σ DDT	Σ HCH
4/11/01	101	467	702	284.8	0.48	0.55	0.61	1.62	0.54	0.52	0.64	0.46	0.52	0.74	0.59	0.49	1.55	0.45
4/18/01	108	474	619	277.8	0.55	0.62	0.69	1.84	0.61	0.59	0.72	0.52	0.59	0.84	0.67	0.55	1.76	0.51
4/25/01	115	481	626	280.6	0.54	0.61	0.69	1.82	0.60	0.58	0.71	0.52	0.58	0.83	0.66	0.55	1.74	0.51
5/16/01	136	502	915	286.3	0.37	0.42	0.47	1.24	0.41	0.40	0.49	0.36	0.40	0.57	0.45	0.37	1.19	0.35
5/23/01	143	509	789	291.0	0.43	0.49	0.54	1.44	0.48	0.46	0.56	2.70	0.46	0.66	0.52	0.43	1.38	0.40
5/30/01	150	516	782	288.0	0.43	0.49	0.55	1.45	0.48	0.46	0.57	5.47	0.47	2.58	0.53	0.44	1.39	0.41
6/6/01	157	523	778	293.8	0.43	0.49	0.55	1.46	0.49	0.47	0.57	0.42	0.47	0.67	0.53	0.44	1.40	0.41
6/13/01	164	530	713	297.5	0.47	0.54	0.60	1.59	0.53	0.51	0.63	3.27	0.51	0.73	0.58	0.48	1.53	0.45
6/20/02	171	537	714	297.2	0.47	0.54	0.60	1.59	0.53	0.51	0.63	2.55	0.51	0.73	0.58	0.48	1.52	0.45
6/27/01	178	544	756	299.6	0.45	0.51	0.57	1.50	0.50	0.48	0.59	10.91	0.48	5.02	0.55	0.45	1.44	0.42
7/11/01	192	558	749	295.6	0.45	0.51	0.57	1.52	0.51	0.48	0.60	4.24	0.49	0.69	0.55	0.46	1.45	0.43
7/17/01	198	564	750	294.6	0.45	0.51	0.57	1.52	0.50	0.48	0.59	4.42	0.48	0.69	0.55	0.46	1.45	0.42
7/25/01	206	572	742	300.8	0.46	0.52	0.58	1.53	0.51	0.49	0.60	4.43	0.49	2.01	0.56	0.46	1.47	0.43
8/8/01	220	586	741	302.1	0.46	0.52	0.58	1.54	0.51	0.49	0.60	8.13	0.49	2.88	0.56	0.46	1.47	0.43
8/15/01	227	593	716	294.5	0.47	0.54	0.60	1.59	0.53	0.51	0.62	3.45	0.51	0.73	0.58	0.48	1.52	0.45
8/22/01	234	600	902	296.6	0.37	0.42	0.48	4.38	0.42	0.40	0.49	2.73	0.40	0.58	0.46	0.38	1.21	0.35
8/29/01	241	607	603	296.6	0.56	0.64	0.71	7.25	0.63	0.60	0.74	8.54	0.60	3.75	0.68	0.57	1.80	0.53
9/5/01	248	614	765	292.1	0.44	0.50	0.56	1.49	0.50	0.47	0.58	9.31	0.48	7.23	0.54	0.45	1.42	0.42
9/12/01	255	621	743	293.0	0.45	0.52	0.58	1.53	0.51	0.49	0.60	3.63	0.49	3.69	0.55	0.46	1.46	0.43
9/19/01	262	628	982	293.8	0.34	0.39	0.44	1.16	0.39	0.37	0.45	2.08	0.37	0.53	0.42	0.35	1.11	0.32
9/26/01	269	635	980	287.2	0.34	0.39	0.44	1.16	0.39	0.37	0.46	5.27	0.37	2.46	0.42	0.35	1.11	0.33
10/3/01	276	642	1116	294.0	0.30	0.34	0.38	1.02	0.34	0.33	0.40	10.58	1.99	11.34	0.37	0.31	0.98	0.29
10/10/01	283	649	1156	290.3	0.29	0.33	0.37	0.98	0.33	0.31	0.39	2.84	0.31	0.45	0.36	0.30	0.94	0.28
10/17/01	290	656	758	284.9	0.45	0.51	0.57	1.50	0.50	0.48	0.59	2.30	0.48	0.69	0.54	0.45	1.44	0.42
10/24/01	296	662	983	296.2	0.34	0.39	0.44	1.16	0.39	0.37	0.45	3.05	0.37	1.26	0.42	0.35	1.11	0.32
10/31/01	304	670	982	286.2	0.34	0.39	0.44	1.16	0.39	0.37	0.45	2.64	0.37	0.53	0.42	0.35	1.11	0.32
11/7/01	311	677	982	284.2	0.34	0.39	0.44	1.16	0.39	0.37	0.45	9.10	10.11	8.59	15.30	0.35	1.11	0.32
11/14/01	318	684	982	283.5	0.34	0.39	0.44	1.16	0.39	0.37	0.45	4.55	0.37	1.49	0.42	0.35	1.11	0.32
11/21/01	325	691	983	288.0	0.34	0.39	0.44	1.16	0.39	0.37	0.45	14.25	14.35	14.99	22.43	0.35	1.11	0.32
1/3/02	3	734	978	270.6	0.35	0.39	0.44	1.16	0.39	0.37	0.46	6.53	4.77	6.04	0.42	0.35	1.11	0.33
2/22/02	53	784	840	279.5	0.40	0.46	0.51	1.35	0.45	0.43	0.53	3.62	1.42	4.97	0.49	0.41	1.29	0.38
3/6/02	65	796	922	282.9	0.37	0.42	0.47	1.23	0.41	0.39	0.48	0.35	0.39	0.56	0.45	0.37	1.18	0.35
3/13/02	72	803	972	282.3	0.35	0.39	0.44	1.17	0.39	0.37	0.46	5.35	0.37	3.27	0.42	0.35	1.12	0.33
3/19/02	78	809	1011	280.2	0.33	0.38	0.42	1.13	0.37	0.36	0.44	0.32	0.36	0.52	0.41	0.34	1.08	0.32
3/28/02	87	818	708	280.0	0.48	0.54	0.61	1.61	0.54	0.51	0.63	0.46	0.51	0.74	0.58	0.48	1.54	0.45
4/2/02	92	823	704	284.4	0.48	0.54	0.61	1.61	0.54	0.52	0.63	0.46	0.52	0.74	0.59	0.49	1.55	0.45
4/8/02	98	829	640	289.1	0.53	0.60	0.67	1.78	0.59	0.57	0.70	0.51	0.57	0.81	0.64	0.54	1.70	0.50
4/16/02	106	837	560	297.2	0.60	0.68	0.77	2.03	0.68	0.65	0.80	12.50	0.65	18.34	0.74	0.61	1.94	0.57
4/23/02	113	844	699	280.8	0.48	0.55	0.61	1.63	0.54	0.52	0.64	0.46	0.52	0.74	0.59	0.49	1.56	0.46
4/30/02	120	851	718	286.1	0.47	0.53	0.60	1.58	0.53	0.51	0.62	5.92	0.51	3.00	0.57	0.48	1.52	0.44
5/7/02	127	858	716	294.6	0.47	0.54	0.60	1.59	0.53	0.51	0.62	9.52	1.59	11.19	0.58	0.48	1.52	0.45
5/14/02	134	865	712	289.0	0.48	0.54	0.60	1.60	7.29	0.51	0.63	4.93	0.51	2.68	0.58	0.48	1.53	0.45
5/21/02	141	872	815	285.8	0.41	0.47	0.53	1.40	0.46	0.45	0.55	8.05	0.45	5.25	0.51	0.42	1.34	0.39
5/28/02	148	879	821	294.5	0.41	0.47	0.52	1.39	0.46	0.44	0.54	10.34	0.44	9.25	0.50	0.42	1.33	0.39
6/4/02	155	886	710	299.3	0.48	0.54	0.60	1.60	0.53	0.51	0.63	0.46	0.51	0.73	0.58	0.48	1.53	0.45
6/11/02	162	893	878	298.6	4.36	0.44	0.49	1.29	0.43	0.41	0.51	1.81	0.41	2.69	0.47	0.39	1.24	2.18
6/18/02	169	900	814	294.6	0.42	0.47	0.53	1.40	0.47	0.45	0.55	0.40	0.45	0.64	0.51	0.42	1.34	0.39
6/25/02	176	907	1281	301.2	0.26	0.30	0.34	3.65	0.30	0.28	0.35	3.18	0.28	3.02	0.32	0.27	0.85	0.25

APPENDIX AC - Analyte concentrations in particle phase (pg/m^3) at LD (2001-2003)

Sampling date	Abs Jul	Rel Jul	Vol	Temp	g-HCH	HEPT	HEPTX	Malathion	Mirex	Oxy chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154	Σ chlor	Σ DDT	Σ HCH
7/2/02	183	914	705	300.6	0.48	0.54	0.61	1.61	0.54	0.51	0.63	0.46	0.52	0.74	0.58	0.49	1.54	0.45
7/9/02	190	921	735	296.5	0.46	0.52	0.58	1.55	0.52	0.49	0.61	0.44	0.50	0.71	0.56	0.47	1.48	0.43
7/16/02	197	928	722	301.4	0.47	0.53	0.59	1.57	0.52	0.50	0.62	0.45	0.50	0.72	0.57	0.47	1.51	0.44
7/23/02	204	935	1187	294.8	0.28	0.32	0.36	0.96	0.32	0.31	0.38	0.27	0.31	0.44	0.35	0.29	0.92	0.27
7/30/02	211	942	942	302.0	0.36	0.41	0.46	1.21	0.40	0.39	0.47	0.34	0.39	0.55	0.44	0.36	1.16	0.34
8/6/02	218	949	940	292.3	0.36	0.41	0.46	1.21	0.40	0.39	0.47	0.35	0.39	0.55	0.44	0.36	1.16	0.34
8/13/02	225	956	924	300.4	0.37	0.41	0.46	16.65	0.41	0.39	0.48	0.35	0.39	0.56	0.45	0.37	1.18	0.34
8/20/02	232	963	940	295.2	0.36	0.41	0.46	1.21	0.40	0.39	0.47	0.35	0.39	0.55	0.44	0.36	1.16	0.34
8/27/02	239	970	958	292.6	0.35	0.40	0.45	1.19	0.40	0.38	0.47	1.35	0.38	0.54	0.43	0.36	1.14	0.33
9/3/02	246	977	931	296.9	0.36	0.41	0.46	1.22	0.41	0.39	0.48	0.99	0.39	0.56	0.44	0.37	1.17	0.34
9/10/02	253	984	934	293.2	0.36	0.41	0.46	1.22	0.41	0.39	0.48	1.35	0.39	0.56	0.44	0.37	1.17	0.34
9/17/02	260	991	951	292.5	0.36	0.40	0.45	1.20	0.40	0.38	0.47	2.39	0.38	0.55	0.43	0.36	1.14	0.34
9/24/02	267	998	939	293.1	0.36	0.41	0.46	1.21	0.40	0.39	0.48	0.35	0.39	0.55	0.44	0.36	1.16	0.34
10/1/02	274	1005	934	296.5	0.36	0.41	0.46	1.22	0.41	0.39	0.48	4.29	0.39	1.64	0.44	0.37	1.16	0.34
10/8/02	281	1012	896	291.1	0.38	0.43	0.48	1.27	0.42	0.40	0.50	0.36	0.41	0.58	0.46	0.38	1.21	0.36
10/15/02	288	1019	996	285.4	0.34	0.38	0.43	1.14	0.38	0.36	0.45	7.38	0.37	0.52	0.41	0.34	1.09	0.32
10/22/03	295	1026	942	285.0	0.36	0.41	0.46	1.21	0.40	0.39	0.47	4.12	0.39	0.55	0.44	0.36	1.16	0.34
10/29/02	302	1033	946	280.1	0.36	0.41	0.45	1.20	0.40	0.38	0.47	0.34	0.38	0.55	0.44	0.36	1.15	0.34
11/5/02	309	1040	947	282.1	0.36	0.40	0.45	1.20	0.40	0.38	0.47	6.75	0.38	0.55	0.44	0.36	1.15	0.34
11/12/02	316	1047	947	279.1	0.36	0.40	0.45	1.20	0.40	0.38	0.47	18.91	0.38	10.83	0.44	0.36	1.15	0.34
11/19/02	323	1054	944	280.4	0.36	0.41	0.46	1.21	0.40	0.38	0.47	13.41	0.39	9.53	0.44	0.36	1.15	0.34
11/26/02	330	1061	961	273.6	0.35	0.40	0.45	1.18	0.39	0.38	0.46	13.28	0.38	9.01	0.43	0.36	1.13	0.33
12/19/02	352	1083	953	281.0	0.35	0.40	0.45	1.19	0.40	0.38	0.47	10.84	2.29	6.84	0.43	0.36	1.14	0.33
1/21/03	21	1117	942	266.1	0.36	0.41	0.46	1.21	0.40	0.38	0.47	8.40	2.99	7.36	0.44	0.36	1.15	0.34
4/15/03	105	1201	970	282.9	0.35	0.40	0.44	1.17	0.39	0.37	0.46	6.05	2.26	5.26	0.42	0.35	1.12	0.33
4/22/03	112	1208	727	282.3	0.47	0.53	0.59	1.57	0.52	0.50	0.61	5.49	2.42	5.05	0.57	0.47	1.50	0.44
4/29/03	120	1216	742	280.2	0.46	0.52	0.58	1.53	0.51	0.49	0.60	13.44	1.90	9.11	0.56	0.46	1.47	0.43
5/6/03	127	1223	709	280.0	0.48	0.54	0.61	1.60	0.53	0.51	0.63	9.83	2.35	8.02	0.58	0.48	1.53	0.45
5/13/03	133	1229	735	284.4	0.46	0.52	0.58	1.55	0.52	0.49	0.61	8.14	0.50	7.99	0.56	0.47	1.48	0.43
5/22/03	142	1238	725	297.2	0.47	0.53	0.59	1.57	0.52	0.50	0.62	4.10	0.50	4.48	0.57	0.47	1.50	0.44
5/27/03	147	1243	708	280.8	0.48	0.54	0.61	1.61	0.53	0.51	0.63	2.51	0.51	0.73	0.58	0.48	1.54	0.45
6/3/03	154	1250	708	286.1	0.48	0.54	0.61	1.61	0.53	0.51	0.63	7.04	0.51	6.46	0.58	0.48	1.54	0.45
6/12/03	163	1259	722	294.6	0.47	0.53	0.59	1.57	0.52	0.50	0.62	6.01	0.50	7.32	0.57	0.47	1.51	0.44
6/18/03	169	1265	721	289.0	0.47	0.53	0.60	1.58	0.53	0.50	0.62	5.25	0.51	4.02	0.57	0.48	1.51	0.44
6/22/03	172	1268	687	285.8	0.49	0.56	0.63	1.66	0.55	0.53	0.65	0.47	0.53	0.76	0.60	0.50	1.58	0.46
7/1/03	182	1278	724	294.5	0.47	0.53	0.59	1.57	0.52	0.50	0.62	0.45	0.50	6.10	0.57	0.47	1.50	0.44
7/8/03	189	1285	707	299.3	0.48	0.54	0.61	1.61	0.54	0.51	0.63	8.53	0.51	4.80	0.58	0.48	1.54	0.45
7/15/03	196	1292	732	298.6	0.46	0.52	0.59	1.55	0.52	0.50	0.61	0.44	0.50	0.71	0.56	0.47	1.49	0.44
7/22/03	203	1299	730	294.6	0.46	0.53	0.59	1.56	0.52	0.50	0.61	6.30	0.50	5.23	0.56	0.47	1.49	0.44
7/29/03	210	1306	702	301.2	0.48	0.55	0.61	1.62	0.54	0.52	0.64	8.71	0.52	6.43	0.59	0.49	1.55	0.45
8/5/03	217	1313	707	300.6	0.48	0.54	0.61	1.61	0.54	0.51	0.63	8.29	0.51	7.32	0.58	0.48	1.54	0.45
8/12/03	224	1320	707	296.5	0.48	0.54	0.61	1.61	0.54	0.51	0.63	6.92	0.51	5.39	0.58	0.48	1.54	0.45
8/19/03	231	1327	720	301.4	0.47	0.53	0.60	1.58	0.53	0.50	0.62	6.17	0.51	6.42	0.57	0.48	1.51	0.44
8/26/03	238	1334	712	294.8	0.47	0.54	0.60	1.60	0.53	0.51	0.63	6.12	0.51	6.04	0.58	0.48	1.53	0.45
9/2/03	245	1341	730	302.0	0.46	0.52	0.59	1.56	0.52	0.50	0.61	0.44	0.50	0.71	0.56	0.47	1.49	0.44
9/9/03	252	1348	707	292.3	0.48	0.54	0.61	1.61	0.54	0.51	0.63	3.20	0.51	0.74	0.58	0.48	1.54	0.45
9/16/03	259	1355	717	300.4	0.47	0.54	0.60	1.59	0.53	0.51	0.62	4.76	0.51	4.84	0.58	0.48	1.52	0.44

APPENDIX AD - Analyte concentrations in particle phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Vol	RH	Temp	Acetochlor	Alachlor	Atrazine	CEAT	CIAT	Cyanazine	Metolachlor	Metribuzin	Pendimethalin	Simazine	Trifluralin	DDD	DDE
4/2/02	92	823	715	67.77	290	2.42	2.17	4.89	4.16	2.73	9.69	9.09	6.07	0.74	5.54	0.41	4.86	1.52
4/9/02	99	830	715	77.07	291	2.42	2.17	132.95	4.16	2.73	9.69	801.04	6.07	0.74	488.21	0.41	4.86	1.52
4/16/02	106	837	670	68.89	297	2.59	2.32	700.54	4.44	370.75	10.34	1408.51	6.48	926.66	363.23	0.44	5.18	1.62
4/23/02	113	844	415	55.21	281	83.67	45.75	223.06	7.17	4.71	16.70	634.83	10.46	1.28	9.55	0.71	8.37	2.62
4/30/02	120	851	711	70.89	287	40.15	37.59	96.68	4.18	2.75	9.74	408.81	6.10	0.75	5.57	0.41	4.88	1.53
5/7/02	127	858	705	71.34	295	43.17	27.41	195.56	4.22	144.00	9.83	792.58	6.16	131.67	201.90	0.42	4.93	1.54
5/14/02	134	865	740	63.10	286	2.34	33.49	99.19	4.02	2.64	9.36	210.42	5.86	0.72	5.35	0.40	4.69	1.47
5/22/02	142	873	736	59.92	286	2.35	2.11	225.14	4.04	78.95	9.41	399.95	5.90	0.72	5.38	0.40	4.72	1.48
7/9/02	190	921	698	67.91	301	2.48	2.23	16.20	4.26	2.80	9.92	61.92	6.22	0.76	5.67	0.42	4.97	1.56
7/16/02	197	928	719	55.85	298	2.41	2.16	4.87	4.14	2.72	9.64	10.76	6.04	0.74	5.51	0.41	4.83	1.51
7/23/02	204	935	735	75.95	300	2.36	2.11	4.76	4.04	2.66	9.42	17.30	5.90	0.72	5.39	0.40	4.72	1.48
7/30/02	211	942	716	65.92	301	2.42	2.17	4.89	4.15	2.73	9.67	22.89	6.06	0.74	5.53	0.41	4.85	1.52
9/24/02	267	998	641	68.53	292	2.70	2.42	5.46	4.64	3.05	10.81	2.84	6.77	0.83	6.18	0.46	5.42	1.70
10/1/02	274	1005	661	78.17	295	2.62	2.35	5.29	4.50	2.95	10.48	2.76	6.57	0.80	5.99	0.45	5.25	1.65
10/8/02	281	1012	638	73.63	287	2.72	2.44	5.49	4.66	3.06	10.86	2.86	6.80	0.83	6.21	0.46	5.44	1.71
10/15/02	288	1019	649	84.80	288	2.67	2.39	5.39	4.58	3.01	10.67	2.81	6.69	0.82	6.10	0.45	5.35	1.68
10/22/02	295	1026	666	80.12	283	2.60	2.33	5.26	4.46	2.93	10.41	2.74	6.52	0.80	5.95	0.44	5.22	1.63
10/29/02	302	1033	657	90.07	279	2.64	2.37	5.33	4.53	2.97	10.55	2.78	6.61	0.81	6.03	0.45	5.29	1.66
11/6/02	310	1041	655	66.75	282	2.65	2.37	5.35	4.54	2.98	10.58	2.78	6.63	0.81	6.05	0.45	5.30	1.66
11/12/02	317	1048	646	82.50	283	2.69	2.41	5.42	4.60	3.03	10.73	2.82	6.72	0.82	6.14	0.46	5.38	1.69
11/19/02	323	1054	643	75.50	280	2.70	2.42	5.45	4.63	3.04	10.78	2.84	6.76	0.83	6.17	0.46	5.41	1.69
11/26/02	330	1061	643	75.73	279	2.70	2.42	5.45	4.63	3.04	10.78	2.84	6.76	0.83	6.17	0.46	5.41	1.69
4/1/03	91	1187	903	71.93	290	1.92	1.72	3.88	3.29	2.16	7.67	2.02	4.81	0.59	4.39	1.32	3.85	1.20
4/7/03	97	1193	927	93.37	291	1.87	1.68	129.52	3.21	2.11	7.48	1.97	4.68	0.57	4.27	0.32	3.75	1.17
4/15/03	104	1200	871	57.83	297	1.99	1.78	4.02	3.41	2.24	7.95	293.08	4.98	0.61	4.55	2.27	3.99	1.25
4/22/03	112	1208	857	66.45	281	2.02	1.81	18.66	3.47	2.28	8.08	615.99	5.07	0.62	4.62	2.04	4.05	1.27
4/29/03	119	1215	898	63.72	287	1.93	1.73	348.85	3.31	2.17	7.72	516.84	4.83	0.59	165.65	1.40	3.87	1.21
5/6/03	126	1222	898	94.40	295	85.59	1.73	197.80	3.31	2.17	7.71	375.81	4.83	0.59	4.41	0.33	3.87	1.21
5/13/03	133	1229	777	62.54	286	141.95	2.00	753.76	3.83	331.60	8.92	2190.31	5.59	0.68	5.10	0.38	4.47	1.40
5/20/03	140	1236	764	54.51	294	128.76	2.03	906.53	3.89	203.44	9.07	2483.88	5.68	0.69	5.18	0.39	4.54	1.42
5/27/03	147	1243	777	91.74	295	2.23	2.00	4.51	3.83	2.51	8.92	2.35	5.59	0.68	5.10	0.38	4.47	1.40
6/3/03	154	1250	766	85.06	294	2.26	2.03	11.89	3.88	2.55	9.05	31.84	5.67	0.69	5.17	0.38	4.54	1.42
6/10/03	161	1257	759	76.02	301	2.28	2.05	182.09	3.92	2.57	9.13	191.76	5.72	0.70	5.22	0.39	4.58	1.43
6/17/03	168	1264	760	92.98	302	2.28	2.05	114.97	3.91	2.57	9.12	2.40	5.72	0.70	5.22	0.39	4.57	1.43
6/24/03	175	1271	758	62.76	301	2.29	2.05	4.62	3.92	63.20	9.15	2.41	5.73	0.70	5.23	1.28	4.59	1.44
7/1/03	182	1278	773	70.22	298	2.24	2.01	330.77	3.85	58.57	8.96	515.27	5.62	154.88	5.12	0.97	4.49	1.41
7/8/03	189	1285	635	73.34	301	2.73	2.45	5.52	4.68	3.08	10.92	699.75	6.84	227.49	6.24	0.46	5.47	1.71
7/15/03	196	1292	622	85.17	295	2.79	2.50	53.76	4.78	3.14	11.15	2.93	6.98	0.85	6.37	0.47	5.59	1.75
7/22/03	203	1299	625	83.79	301	2.77	2.49	5.60	4.76	3.12	11.08	257.29	6.94	0.85	6.34	2.32	5.56	1.74
7/29/03	210	1306	644	84.84	299	2.69	2.41	5.44	4.61	3.03	10.76	2.83	6.74	0.82	6.15	0.46	5.39	1.69
8/5/03	217	1313	628	89.79	298	2.76	2.48	5.57	4.73	3.11	11.03	2.90	6.91	0.84	6.31	0.47	5.53	1.73
8/12/03	224	1320	644	95.69	297	2.69	2.41	5.44	4.62	3.03	10.76	2.83	6.74	0.82	6.15	1.16	5.40	1.69
8/19/03	231	1327	627	82.80	294	2.77	2.48	5.59	4.74	3.12	11.06	2.91	6.93	0.85	6.32	0.47	5.54	1.74
8/26/03	238	1334	591	81.72	292	2.94	2.63	5.93	5.03	3.31	11.73	3.09	7.35	0.90	6.71	0.50	5.88	1.84
9/2/03	245	1341	627	87.94	295	2.76	2.48	5.58	4.74	3.12	11.05	2.91	6.92	0.85	6.32	0.47	5.54	1.74
9/9/03	252	1348	596	68.33	287	2.91	2.61	5.87	4.99	3.28	11.62	3.06	7.28	0.89	6.65	1.21	5.83	1.83
9/16/03	259	1355	567	71.11	283	3.06	2.74	6.17	5.24	3.44	12.21	3.21	7.65	0.93	6.98	1.67	6.12	1.92

APPENDIX AD - Analyte concentrations in particle phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Vol	RH	Temp	DDT	a-chlordane	a-endosulfan	a-HCH	Aldrin	b-endosulfan	CHTHNL	CIR9S	Chlorpyrifos Oxon	Cis-nonachlor	Diazinon	Dieldrin	endosulfan sulfate
4/2/02	92	823	715	67.77	290	3.73	0.62	0.81	0.45	1.19	0.47	0.71	0.42	0.00	0.51	2.15	0.62	0.50
4/9/02	99	830	715	77.07	291	3.73	0.62	0.81	0.45	1.19	0.47	0.71	0.42	0.00	0.51	2.15	0.62	1.40
4/16/02	106	837	670	68.89	297	3.98	0.67	0.86	0.48	1.27	0.50	143.67	0.45	0.00	0.55	2.30	0.67	0.53
4/23/02	113	844	415	55.21	281	6.43	1.07	1.39	0.77	2.05	0.81	1.22	0.72	0.00	0.88	3.71	1.08	0.86
4/30/02	120	851	711	70.89	287	3.75	0.63	0.81	0.45	1.20	0.47	0.71	0.42	0.00	0.51	2.17	0.63	17.74
5/7/02	127	858	705	71.34	295	3.79	0.63	0.82	0.45	1.21	29.13	43.43	0.43	0.00	0.52	2.19	0.63	4.50
5/14/02	134	865	740	63.10	286	3.61	0.60	0.78	0.43	1.15	0.45	13.89	0.41	0.00	0.49	2.08	0.60	3.28
5/22/02	142	873	736	59.92	286	3.63	0.61	0.78	0.43	1.16	0.45	80.79	0.41	0.00	0.50	2.09	0.61	0.49
7/9/02	190	921	698	67.91	301	3.82	0.64	0.83	0.46	1.22	0.48	40.23	0.43	0.00	0.52	2.21	0.64	2.06
7/16/02	197	928	719	55.85	298	3.71	0.62	0.80	0.44	1.18	0.47	7.25	0.42	0.00	0.51	2.14	0.62	0.50
7/23/02	204	935	735	75.95	300	3.63	0.61	0.78	0.43	1.16	0.45	77.88	0.41	0.00	0.50	2.10	0.61	1.86
7/30/02	211	942	716	65.92	301	3.73	0.62	0.80	0.44	1.19	0.47	9.49	0.42	0.00	0.51	2.15	0.62	0.50
9/24/02	267	998	641	68.53	292	4.16	0.69	0.90	0.50	1.33	0.52	0.79	0.47	0.00	0.57	2.40	0.70	0.56
10/1/02	274	1005	661	78.17	295	4.04	0.67	0.87	0.48	1.29	0.51	0.76	0.45	0.00	0.55	2.33	0.68	0.54
10/8/02	281	1012	638	73.63	287	4.18	0.70	0.90	0.50	1.33	0.52	0.79	0.47	0.00	0.57	2.41	0.70	0.56
10/15/02	288	1019	649	84.80	288	4.11	0.69	0.89	0.49	1.31	0.52	0.78	0.46	0.00	0.56	2.37	0.69	0.55
10/22/02	295	1026	666	80.12	283	4.01	0.67	0.87	0.48	1.28	0.50	0.76	0.45	0.00	0.55	2.31	0.67	0.54
10/29/02	302	1033	657	90.07	279	4.07	0.68	0.88	0.49	1.30	0.51	0.77	0.46	0.00	0.56	2.35	0.68	0.55
11/6/02	310	1041	655	66.75	282	4.08	0.68	0.88	0.49	1.30	0.51	0.77	0.46	0.00	0.56	2.35	0.68	0.55
11/12/02	317	1048	646	82.50	283	4.13	0.69	0.89	0.49	1.32	0.52	0.78	0.46	0.00	0.57	2.39	0.69	0.56
11/19/02	323	1054	643	75.50	280	4.15	0.69	0.90	0.50	1.32	0.52	0.79	0.47	0.00	0.57	2.40	0.70	0.56
11/26/02	330	1061	643	75.73	279	4.15	0.69	0.90	0.50	1.32	0.52	5.37	0.47	0.00	0.57	2.40	0.70	0.56
4/1/03	91	1187	903	71.93	290	2.95	0.49	0.64	0.35	0.94	3.51	0.56	0.33	0.00	0.41	1.71	0.49	0.40
4/7/03	97	1193	927	93.37	291	2.88	0.48	0.62	0.34	0.92	0.36	0.54	0.32	0.00	0.39	1.66	0.48	0.39
4/15/03	104	1200	871	57.83	297	3.06	0.51	0.66	0.37	0.98	4.01	24.96	0.34	0.00	0.42	1.77	0.51	0.41
4/22/03	112	1208	857	66.45	281	3.11	0.52	0.67	0.37	0.99	3.52	41.80	0.35	0.00	0.43	1.80	0.52	0.42
4/29/03	119	1215	898	63.72	287	2.97	0.50	2.94	0.35	0.95	5.70	220.40	0.33	0.00	0.41	1.72	0.50	0.40
5/6/03	126	1222	898	94.40	295	2.97	0.50	0.64	0.35	0.95	0.37	0.56	0.33	0.00	0.41	1.71	0.50	0.40
5/13/03	133	1229	777	62.54	286	3.44	0.57	0.74	0.41	1.10	0.43	10.63	0.39	0.00	0.47	1.98	0.57	0.46
5/20/03	140	1236	764	54.51	294	3.49	0.58	0.75	0.42	1.11	0.44	0.66	0.39	0.00	0.48	2.02	0.58	0.47
5/27/03	147	1243	777	91.74	295	3.44	0.57	0.74	0.41	1.10	0.43	0.65	0.39	0.00	0.47	1.98	0.57	0.46
6/3/03	154	1250	766	85.06	294	3.49	0.58	0.75	0.42	1.11	0.44	67.47	0.39	0.00	0.48	2.01	0.58	0.47
6/10/03	161	1257	759	76.02	301	3.52	0.59	0.76	0.42	1.12	0.44	63.59	0.40	0.00	0.48	2.03	0.59	0.47
6/17/03	168	1264	760	92.98	302	3.51	0.59	0.76	0.42	1.12	0.44	0.66	0.39	0.00	0.48	2.03	0.59	0.47
6/24/03	175	1271	758	62.76	301	3.52	0.59	0.76	0.42	1.12	4.98	231.46	0.40	0.00	0.48	2.03	0.59	1.41
7/1/03	182	1278	773	70.22	298	3.45	0.58	0.75	0.41	1.10	0.43	122.58	0.39	0.00	0.47	1.99	0.58	0.46
7/8/03	189	1285	635	73.34	301	4.21	0.70	0.91	0.50	1.34	0.53	37.55	0.47	0.00	0.58	2.43	0.70	0.56
7/15/03	196	1292	622	85.17	295	4.29	0.72	0.93	0.51	1.37	0.54	0.81	0.48	0.00	0.59	2.48	0.72	0.58
7/22/03	203	1299	625	83.79	301	4.27	0.71	0.92	0.51	1.36	0.53	39.93	0.48	0.00	0.59	2.46	0.71	0.57
7/29/03	210	1306	644	84.84	299	4.14	0.69	0.89	0.49	1.32	0.52	0.78	0.47	0.00	0.57	2.39	0.69	0.56
8/5/03	217	1313	628	89.79	298	4.25	0.71	0.92	0.51	1.36	1.48	117.54	0.48	0.00	0.58	2.45	0.71	0.57
8/12/03	224	1320	644	95.69	297	4.15	0.69	0.90	0.50	1.32	0.52	0.78	0.47	0.00	0.57	2.39	0.69	0.56
8/19/03	231	1327	627	82.80	294	4.26	0.71	0.92	0.51	1.36	4.75	19.72	0.48	0.00	0.58	2.46	0.71	0.57
8/26/03	238	1334	591	81.72	292	4.52	0.75	37.56	0.54	1.44	214.43	322.23	0.51	0.00	0.62	2.61	0.76	7.04
9/2/03	245	1341	627	87.94	295	4.26	0.71	0.92	0.51	1.36	5.10	13.33	0.48	0.00	0.58	2.46	0.71	0.57
9/9/03	252	1348	596	68.33	287	4.48	0.75	0.97	0.53	1.43	0.56	28.38	0.50	0.00	0.61	2.58	0.75	0.60
9/16/03	259	1355	567	71.11	283	4.70	0.79	1.02	0.56	1.50	3.07	24.85	0.53	0.00	0.64	2.72	0.79	3.93

APPENDIX AD - Analyte concentrations in particle phase (pg/m^3) at DV (2002-2003)

Sampling date	Abs Jul	Rel Jul	Vol	RH	Temp	Fipronil	g-chlordane	g-HCH	HEPT	HEPTX	Malathion	Mirex	Oxy chlordane	Trans-nonachlor	BDE 47	BDE 100	BDE 99	BDE 154
4/2/02	92	823	715	67.77	290	0.48	0.48	0.47	0.54	0.60	1.59	0.53	0.51	0.62	0.45	0.51	0.73	0.58
4/9/02	99	830	715	77.07	291	0.48	0.48	0.47	0.54	0.60	1.59	0.53	0.51	0.62	0.45	0.51	0.73	0.58
4/16/02	106	837	670	68.89	297	0.51	0.51	0.50	0.57	0.64	1.70	0.57	0.54	0.67	0.48	0.54	0.78	0.62
4/23/02	113	844	415	55.21	281	0.82	0.83	27.17	0.92	1.04	2.74	0.91	0.87	1.08	0.78	0.88	1.25	0.99
4/30/02	120	851	711	70.89	287	0.48	0.48	0.48	0.54	0.60	1.60	0.53	0.51	0.63	0.46	0.51	0.73	0.58
5/7/02	127	858	705	71.34	295	0.49	0.49	0.48	0.54	0.61	1.61	0.54	0.51	0.63	0.46	0.52	0.74	0.58
5/14/02	134	865	740	63.10	286	0.46	0.46	7.08	0.52	0.58	1.54	0.51	0.49	0.60	0.44	0.49	0.70	0.56
5/22/02	142	873	736	59.92	286	0.46	0.47	0.46	0.52	0.58	1.54	0.51	0.49	0.61	0.44	0.49	0.71	0.56
7/9/02	190	921	698	67.91	301	0.49	0.49	0.48	0.55	0.62	1.63	0.54	0.52	0.64	0.47	0.52	0.75	0.59
7/16/02	197	928	719	55.85	298	0.48	0.48	0.47	0.53	0.60	1.58	0.53	0.50	0.62	0.45	0.51	0.72	0.57
7/23/02	204	935	735	75.95	300	0.46	0.47	0.46	0.52	0.58	1.55	0.52	0.49	0.61	0.44	0.49	0.71	0.56
7/30/02	211	942	716	65.92	301	0.48	0.48	0.47	0.54	0.60	1.59	0.53	0.51	0.62	0.45	0.51	0.73	0.58
9/24/02	267	998	641	68.53	292	0.53	0.53	0.53	0.60	0.67	1.77	0.59	0.57	0.70	0.51	0.57	0.81	0.64
10/1/02	274	1005	661	78.17	295	0.52	0.52	0.51	0.58	0.65	1.72	0.57	0.55	0.67	0.49	0.55	0.79	0.62
10/8/02	281	1012	638	73.63	287	0.54	0.54	0.53	0.60	0.67	1.78	0.59	0.57	0.70	0.51	0.57	0.82	0.65
10/15/02	288	1019	649	84.80	288	0.53	0.53	0.52	0.59	0.66	1.75	0.58	0.56	0.69	0.50	0.56	0.80	0.64
10/22/02	295	1026	666	80.12	283	0.51	0.51	0.51	0.58	0.64	1.71	0.57	0.54	0.67	0.49	0.55	0.78	0.62
10/29/02	302	1033	657	90.07	279	0.52	0.52	0.51	0.58	0.65	1.73	0.58	0.55	0.68	0.49	0.55	0.79	0.63
11/6/02	310	1041	655	66.75	282	0.52	0.52	0.52	0.59	0.66	1.74	0.58	0.55	0.68	0.50	0.56	0.79	0.63
11/12/02	317	1048	646	82.50	283	0.53	0.53	0.52	0.59	0.67	1.76	0.59	0.56	0.69	0.50	0.56	0.81	0.64
11/19/02	323	1054	643	75.50	280	0.53	0.53	0.53	0.60	0.67	1.77	0.59	0.56	0.69	0.51	0.57	0.81	0.64
11/26/02	330	1061	643	75.73	279	0.53	0.53	0.53	0.60	0.67	1.77	0.59	0.56	0.69	0.51	0.57	0.81	0.64
4/1/03	91	1187	903	71.93	290	0.38	0.38	0.37	0.42	0.48	1.26	0.42	0.40	0.49	0.36	0.40	0.58	0.46
4/7/03	97	1193	927	93.37	291	0.37	0.37	0.36	0.41	0.46	1.23	0.41	0.39	0.48	0.35	0.39	0.56	0.44
4/15/03	104	1200	871	57.83	297	0.39	0.39	0.39	0.44	0.49	1.31	0.43	0.42	0.51	0.37	0.42	0.60	0.47
4/22/03	112	1208	857	66.45	281	0.40	0.40	0.39	0.45	0.50	1.33	0.44	0.42	0.52	0.38	0.42	0.61	0.48
4/29/03	119	1215	898	63.72	287	0.80	0.38	0.38	0.43	0.48	1.27	0.42	0.40	0.50	0.36	0.41	0.58	0.46
5/6/03	126	1222	898	94.40	295	0.38	0.38	0.38	0.43	0.48	1.27	0.42	0.40	0.50	0.36	0.41	0.58	0.46
5/13/03	133	1229	777	62.54	286	0.44	0.44	0.44	0.49	0.55	1.46	0.49	0.47	0.57	2.11	0.47	0.67	0.53
5/20/03	140	1236	764	54.51	294	0.45	0.45	0.44	0.50	0.56	1.49	0.50	0.47	0.58	0.42	0.48	0.68	0.54
5/27/03	147	1243	777	91.74	295	0.44	0.44	0.44	0.49	0.55	1.46	0.49	0.47	0.57	0.42	0.47	0.67	0.53
6/3/03	154	1250	766	85.06	294	0.45	0.45	0.44	0.50	0.56	1.49	0.49	0.47	0.58	0.42	0.48	0.68	0.54
6/10/03	161	1257	759	76.02	301	0.45	0.45	0.45	0.51	0.57	1.50	0.50	0.48	0.59	0.43	0.48	0.69	0.54
6/17/03	168	1264	760	92.98	302	0.45	0.45	0.45	0.50	0.57	1.50	0.50	0.48	0.59	0.43	0.48	0.69	0.54
6/24/03	175	1271	758	62.76	301	0.45	0.45	0.45	0.51	0.57	1.50	0.50	0.48	0.59	0.43	0.48	0.69	0.54
7/1/03	182	1278	773	70.22	298	0.44	0.44	0.44	0.50	0.56	1.47	0.49	0.47	0.58	0.42	0.47	0.67	0.53
7/8/03	189	1285	635	73.34	301	0.54	0.54	0.53	0.60	0.68	1.79	0.60	0.57	0.70	0.51	0.57	0.82	0.65
7/15/03	196	1292	622	85.17	295	0.55	0.55	0.54	0.62	0.69	1.83	0.61	0.58	0.72	2.70	0.59	0.84	0.66
7/22/03	203	1299	625	83.79	301	0.55	0.55	0.54	0.61	0.69	1.82	0.61	0.58	0.71	0.52	0.58	0.83	0.66
7/29/03	210	1306	644	84.84	299	0.53	0.53	0.52	0.60	0.67	1.77	0.59	0.56	0.69	0.50	0.56	0.81	0.64
8/5/03	217	1313	628	89.79	298	0.54	0.55	0.54	0.61	0.68	1.81	0.60	0.58	0.71	0.52	0.58	0.83	0.66
8/12/03	224	1320	644	95.69	297	13.03	0.53	0.53	0.60	0.67	1.77	0.59	0.56	0.69	0.50	0.57	0.81	0.64
8/19/03	231	1327	627	82.80	294	9.22	0.55	0.54	0.61	0.69	1.81	0.60	0.58	0.71	0.52	0.58	0.83	0.66
8/26/03	238	1334	591	81.72	292	6.55	0.58	0.57	0.65	0.73	1.93	0.64	0.61	0.76	0.55	0.62	0.88	0.70
9/2/03	245	1341	627	87.94	295	0.55	0.55	0.54	0.61	0.68	1.81	0.60	0.58	0.71	0.52	0.58	0.83	0.66
9/9/03	252	1348	596	68.33	287	0.57	0.57	0.57	0.64	0.72	1.91	0.64	0.61	0.75	0.54	0.61	0.87	0.69
9/16/03	259	1355	567	71.11	283	8.83	0.60	0.60	0.68	0.76	2.00	0.67	0.64	0.79	0.57	0.64	0.92	0.73

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	4/3/00	4/5/00	4/8/00	4/11/00	4/14/00	4/15/00	4/16/00	4/17/00	4/18/00	4/21/00	4/22/00	4/25/00	4/26/00	4/27/00	5/10/00	5/13/00	5/16/00	5/19/00
Volume (mL)	170	1,104	2,875	114	245	2,150	1,223	2,044	290	2,025	50	1,154	445	50	1,740	1,860	71	250
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13.6	22.8	BDL	145.0
Alachlor	BDL	448.9	66.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	15.2	37.2	BDL	78.2
Atrazine	108.7	141.6	60.6	BDL	145.8	30.9	109.2	36.8	BDL	131.5	BDL	30.9	BDL	BDL	336.2	895.6	BDL	775.0
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	49.3	20.9	BDL	BDL	BDL	BDL	BDL	BDL	47.1	BDL	BDL	131.6
Cyanazine																		
Metolachlor	191.9	607.3	49.5	BDL	326.5	27.9	38.8	24.2	BDL	56.2	BDL	38.8	BDL	BDL	92.9	305.6	BDL	997.9
Metribuzin																		
Pendimethalin	BDL	82.7	33.8	BDL	BDL	21.7	BDL	BDL	BDL	29.6	BDL	BDL	BDL	BDL	BDL	35.6	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	48.4	84.3	17.9	BDL	BDL	BDL	BDL	BDL	BDL	236.4	68.3	BDL	499.7
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.8	BDL	BDL	BDL
Aldrin																		
β–Endosulfan	BDL	BDL	1.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.9	1.8	BDL	BDL
Chlorothalonil	BDL	58.6	34.3	BDL	BDL	BDL	58.6	17.3	46.3	24.9	BDL	29.5	14.8	BDL	108.1	85.6	110.8	57.2
Chlorpyrifos	BDL	BDL	2.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	25.7	6.9	BDL	BDL	6.7	12.2	BDL	BDL	7.5	BDL	BDL	33.3	BDL	14.6	BDL	BDL	BDL
Cis-nonachlor																		
Diazinon																		
Dieldrin																		
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.8	BDL	BDL	BDL
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	46.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane																		
Trans-nonachlor																		
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	5/20/00	5/21/00	5/22/00	5/23/00	5/24/00	5/27/00	5/28/00	6/2/00	6/5/00	6/6/00	6/12/00	6/26/00	6/27/00	6/28/00	6/29/00	7/3/00	7/10/00	7/14/00
Volume (mL)	2,395	2,640	1,340	110	1,375	1,030	580	1,430	3,340	630	2,108	455	3,800	1,175	825	2,300	555	1,330
Acetochlor	35.0	16.6	BDL	164.5	BDL	15.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	23.5	9.5	BDL	189.6	BDL	32.8	BDL	28.3	13.9	BDL	BDL	54.3	15.5	19.8	ND	80.1	133.1	439.7
Atrazine	199.3	40.9	21.8	360.5	117.4	484.7	115.8	244.9	42.7	BDL	91.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	24.9	BDL	BDL	BDL	30.9	75.8	BDL	67.9	BDL	BDL	36.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine																		
Metolachlor	277.8	41.0	25.6	568.1	133.1	190.1	137.9	74.9	118.3	51.8	51.2	180.7	40.9	40.9	45.7	491.8	80.0	372.8
Metribuzin																		
Pendimethalin	25.5	BDL	BDL	BDL	BDL	79.3	BDL	24.9	20.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	79.5	21.1	BDL	BDL	173.3	165.8	BDL	266.0	27.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.2	BDL	BDL	1.6	BDL	1.3	BDL	BDL	BDL	BDL	30.6
a-HCH	2.4	2.3	BDL	BDL	3.4	8.3	BDL	4.5	1.6	BDL	3.9	BDL	BDL	BDL	BDL	BDL	BDL	22.4
Aldrin																		
β–Endosulfan	BDL	1.7	3.2	BDL	BDL	BDL	BDL	2.9	BDL	BDL	1.8	6.4	1.8	BDL	BDL	1.5	BDL	81.0
Chlorothalonil	55.9	95.9	106.7	64.5	27.1	145.3	82.6	89.7	47.2	12.4	254.4	206.4	75.0	32.0	127.0	144.9	79.4	2011.2
Chlorpyrifos	2.1	BDL	BDL	BDL	BDL	BDL	BDL	3.8	1.2	BDL	BDL	BDL	1.3	BDL	BDL	BDL	BDL	28.8
Chlrpyrfs Oxon	73.0	BDL	BDL	BDL	BDL	5.6	BDL	16.5	BDL	BDL	BDL	56.2	5.1	BDL	BDL	19.6	BDL	20.9
Cis-nonachlor																		
Diazinon																		
Dieldrin																		
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.4	BDL	BDL	BDL	BDL	BDL	BDL	14.2
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	2.4	2.3	BDL	BDL	3.4	8.3	BDL	4.5	1.6	BDL	3.9	BDL	BDL	BDL	BDL	BDL	BDL	22.4
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	BDL	BDL	358.2	17.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane																		
Trans-nonachlor																		
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	7/16/00	7/19/00	7/24/00	7/25/00	7/26/00	7/28/00	7/30/00	7/31/00	8/2/00	8/3/00	8/4/00	8/6/00	8/12/00	8/13/00	8/14/00	8/17/00	8/27/00	8/28/00
Volume (mL)	320	9,280	460	2,675	3,150	4,410	1,945	3,175	1,075	435	2,550	1,060	715	7,100	910	175	780	585
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine																		
Metolachlor	BDL	24.6	BDL	17.6	8.0	5.6	BDL	4.7	BDL	BDL	BDL	BDL	BDL	4.3	BDL	BDL	BDL	BDL
Metribuzin																		
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	1.9	BDL	BDL	BDL	3.4	BDL	2.3	BDL	BDL	1.4	BDL	BDL	1.3	BDL	BDL	BDL	BDL
a-HCH	BDL	1.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																		
β–Endosulfan	BDL	4.2	BDL	BDL	BDL	8.0	3.4	13.1	BDL	BDL	2.4	BDL	BDL	0.9	BDL	BDL	3.5	BDL
Chlorothalonil	124.9	194.6	193.7	31.4	54.2	140.6	134.0	533.5	197.8	37.4	53.2	79.3	133.6	61.3	25.6	388.1	271.6	172.3
Chlorpyrifos	BDL	2.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.0	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	1.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor																		
Diazinon																		
Dieldrin																		
Endo sulfate	BDL	1.0	BDL	BDL	BDL	1.2	BDL	3.5	BDL	BDL	2.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	1.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane																		
Trans-nonachlor																		
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	8/29/00	8/30/00	9/2/00	9/3/00	9/14/00	9/18/00	9/19/00	9/22/00	9/23/00	9/24/00	9/25/00	9/26/00	11/9/00	11/25/00	4/1/01	4/6/01	4/8/01	4/9/01
Volume (mL)	105	4,080	13,500	2,560	2,500	170	208	140	950	1,240	13,600	500	540	2,475	330	60	272	690
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	86.1
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	78.4
Cyanazine															BDL	BDL	BDL	BDL
Metolachlor	BDL	8.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	280.3	164.2
Metribuzin																		
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL				
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																		
β–Endosulfan	BDL	BDL	BDL	BDL	1.8	BDL	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL	2.2
Chlorothalonil	364.7	103.2	33.8	58.7	877.6	200.6	976.4	216.6	62.4	64.3	25.1	65.5	50.2	7.7	61.0	BDL	BDL	44.8
Chlorpyrifos	BDL	BDL	BDL	BDL	3.1	BDL	BDL	BDL	BDL	BDL	1.4	BDL	BDL	BDL	BDL	BDL	BDL	3.1
Chlrpyrfs Oxon	BDL	BDL	BDL	23.0	9.0	BDL	87.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor															BDL	BDL	BDL	BDL
Diazinon															BDL	BDL	BDL	BDL
Dieldrin																		
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.9
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	BDL	1.9	BDL	18.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane															BDL	BDL	BDL	BDL
Trans-nonachlor															BDL	BDL	BDL	BDL
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	4/10/01	4/11/01	4/13/01	4/15/01	4/16/01	4/17/01	4/24/01	5/12/01	5/18/01	5/19/01	5/20/01	5/21/01	5/22/01	5/25/01	5/26/01	6/1/01	6/2/01	6/4/01
Volume (mL)	1,920	2,680	370	680	960	1,265	1,530	620	4,900	170	2,475	1,550	2,270	4,975	8,990	5,205	1,160	3,610
Acetochlor	BDL	BDL	BDL	BDL	84.9	BDL	75.7	BDL	26.6	BDL	41.9	BDL	BDL	BDL	BDL	19.8	BDL	BDL
Alachlor	BDL	BDL	BDL	121.4	BDL	BDL	58.3	213.9	19.4	BDL	25.6	BDL	30.0	BDL	BDL	24.8	106.8	BDL
Atrazine	20.0	13.3	77.4	193.1	BDL	BDL	334.4	521.7	41.3	BDL	37.9	45.9	42.8	BDL	14.6	40.3	80.9	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	19.4	BDL	88.3	BDL	BDL	94.9	144.6	16.4	BDL	BDL	BDL	26.0	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	70.2	29.8	196.4	191.7	93.5	BDL	77.0	331.4	65.3	BDL	105.3	61.4	47.3	BDL	14.1	32.5	75.4	23.0
Metribuzin																		
Pendimethalin	BDL	BDL	BDL	BDL	BDL	95.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine																		
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	1.3	BDL	0.4	BDL	BDL	BDL	BDL	BDL	0.8	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	1.4	BDL	0.5	BDL	BDL	BDL	1.5	1.2	1.2	1.0	0.9	0.5
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																		
β–Endosulfan	0.6	1.2	BDL	BDL	BDL	BDL	1.8	BDL	BDL	BDL	BDL	0.6	2.1	1.8	1.1	1.1	1.2	0.4
Chlorothalonil	13.7	15.3	BDL	32.9	BDL	6.5	65.9	57.2	14.8	BDL	21.9	40.6	55.7	BDL	23.6	63.6	11.2	5.6
Chlorpyrifos	3.4	2.1	BDL	BDL	20.9	8.9	3.7	BDL	1.0	BDL	BDL	1.5	2.5	1.8	0.8	2.8	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	32.8	56.6	BDL	39.3	BDL	BDL	BDL	BDL	BDL	BDL	74.6	9.7	12.9	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10.1
Dieldrin																		
Endo sulfate	BDL	0.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.0	0.7	0.4	0.6	BDL	BDL
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	1.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	1.5	1.2	BDL	BDL	BDL	BDL	4.8	7.1	4.1	BDL	2.0	2.3	2.3	1.2	1.7	BDL	BDL	1.4
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	6/6/01 3,160	6/7/01 505	6/16/01 8,725	7/1/01 440	7/4/01 1,005	7/18/01 5,065	8/14/01 6,400	8/23/01 5,600	8/30/01 3,395	9/10/01 250	9/19/01 2,750	9/24/01 7,040	9/27/01 400	9/30/01 540	10/5/01 900	10/6/01 650	10/14/01 1,730	10/16/01 400
Acetochlor	24.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	18.4	BDL	7.7	486.0	42.0	18.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	17.5	BDL	29.3	80.5	25.7	4.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	23.6	BDL	11.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	108.1	BDL	39.3	371.0	99.9	25.8	BDL	11.0	14.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metribuzin																		
Pendimethalin	35.8	BDL	11.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	48.6	90.6	BDL	BDL
Simazine																		
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD																		
44'-DDE																		
44'-DDT																		
α–Chlordane	BDL	BDL	BDL	3.3	BDL	1.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	1.9	BDL	0.9	5.2	1.8	2.2	2.0	3.5	2.0	4.3	0.4	0.6	BDL	1.7	1.6	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																		
β–Endosulfan	1.6	BDL	1.2	7.7	2.0	3.0	2.6	6.4	3.6	BDL	0.6	0.8	BDL	BDL	1.2	BDL	BDL	BDL
Chlorothalonil	75.6	BDL	123.1	509.9	44.3	121.2	158.0	204.1	348.2	37.6	164.9	91.5	87.6	27.9	71.2	72.8	33.0	488.6
Chlorpyrifos	1.8	BDL	2.7	BDL	BDL	1.0	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	18.0	BDL	2.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	39.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin																		
Endo sulfate	0.7	BDL	0.4	BDL	BDL	1.3	2.0	3.4	2.6	BDL	BDL	0.9	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil																		
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	4.4	BDL	BDL	BDL	BDL	0.9	0.8	BDL	0.8	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor																		
Hptchlr epoxide																		
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																		
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47																		
BDE 100																		
BDE 99																		
BDE 154																		

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	3/2/02 3,000	3/3/02 1,325	3/9/02 910	3/12/02 1,340	3/13/02 230	3/17/02 4,730	3/18/02 257	3/19/02 1,610	3/20/02 2,225	3/26/02 4,280	3/30/02 1,900	3/31/02 1,890	4/9/02 1,530	4/11/02 1,275	4/12/02 230	4/14/02 260	4/17/02 1,540	4/18/02 180
Acetochlor	BDL	BDL	80.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	32.8	BDL	53.7	BDL	BDL	218.0	50.1	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10.8	BDL	BDL	41.0	39.8	BDL	150.8	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	12.5	21.3	6.1	22.8	BDL	98.6	20.9	81.1	121.3	85.2	356.2
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	29.5	BDL	35.8	BDL	BDL	BDL	98.7	222.6
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	32.1	46.0	BDL	BDL	BDL	BDL	26.8	BDL	70.4	59.3	24.1	114.1	134.0	284.4	285.3	54.9	273.1
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	25.9	BDL	39.2	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	1.2	2.5	6.3	2.9	14.0	1.0	11.1	2.4	1.5	1.3	2.1	1.7	1.9	2.4	12.1	BDL	2.2	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	0.2	BDL	BDL	0.6	0.7	0.6	0.8	BDL	BDL	BDL	BDL	1.0	BDL
a-HCH	BDL	BDL	BDL	2.1	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	2.3	BDL	4.3	BDL	BDL	BDL	1.9	0.6	BDL	2.4	BDL	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	5.3	14.6	20.2	73.2	333.7	11.3	BDL	56.9	199.1	30.5	64.4	130.4	71.1	6.1	BDL	36.4	76.0	74.2
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	201.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	45.0	BDL	BDL	BDL	BDL	BDL	BDL	9.6	24.2	BDL	BDL	10.1	BDL	BDL	BDL	BDL
Dieldrin	1.0	2.0	3.1	BDL	BDL	0.7	BDL	1.8	1.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3	2.3	0.5	1.1	1.6	1.5	BDL	BDL	BDL	2.6	BDL
Fipronil	1.2	4.6	4.1	38.1	59.5	1.1	BDL	11.1	5.5	1.1	2.3	7.4	BDL	BDL	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.0	1.6	BDL	BDL	BDL	BDL	BDL	3.0	BDL
Heptachlor	BDL	BDL	24.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	2.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	4/21/02	4/24/02	4/25/02	4/27/02	4/28/02	5/1/02	5/2/02	5/4/02	5/9/02	5/13/02	5/17/02	5/18/02	6/5/02	6/6/02	6/13/02	6/14/02	6/16/02	6/19/02
Volume (mL)	1,520	485	270	5,380	1,715	2,470	370	1,800	160	3,725	2,410	490	330	2,770	525	150	555	145
Acetochlor	90.7	124.5	BDL	84.6	60.4	141.0	204.9	61.0	356.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	48.0	35.3	BDL	85.3	41.4	76.9	128.6	14.7	BDL	6.2	14.3	BDL	148.0	8.5	BDL	BDL	BDL	BDL
Atrazine	159.9	63.3	105.3	34.1	69.6	206.4	316.4	50.7	228.5	60.8	64.2	88.7	468.5	54.5	105.0	143.8	80.8	197.4
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	38.4	BDL	BDL	12.7	28.8	62.6	166.4	24.6	261.2	20.0	BDL	BDL	159.1	BDL	BDL	BDL	73.4	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	395.8	585.3	516.2	85.4	97.3	127.4	213.3	74.2	228.2	63.5	122.1	128.9	257.7	38.5	116.6	156.5	46.6	167.2
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	147.4	15.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	43.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	19.2	21.6	BDL	156.7	24.6	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.0	BDL	BDL	0.7	BDL	BDL	BDL	BDL
Chlorothalonil	73.5	110.7	80.1	38.3	60.5	71.5	55.6	6.1	61.4	65.9	52.2	BDL	257.1	117.1	490.4	63.7	29.4	1086.5
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	8.2	BDL	48.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	41.4	BDL
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	0.4	BDL	1.0	BDL	BDL	BDL	0.5	BDL	BDL	BDL	1.1	BDL	BDL	BDL	BDL
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	5.5	BDL	BDL	1.1	BDL	1.0	BDL	6.3	BDL	1.0	1.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	6/21/02 680	7/9/02 260	7/13/02 1,030	7/14/02 890	7/22/02 2,555	7/24/02 19,960	7/26/02 290	8/19/02 380	8/23/02 790	8/27/02 445	8/28/02 6,445	8/31/02 3,670	9/1/02 6,570	9/14/02 175	9/26/02 2,610	10/9/02 5,120	10/10/02 7,125	10/11/02 5,378
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	30.0	BDL	BDL	36.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	78.2	30.2	10.3	25.3	6.1	1.4	BDL	BDL	14.9	24.3	2.5	3.6	BDL	BDL	6.0	3.5	1.4	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	128.6	30.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	14.4	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	0.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL	BDL	0.7	2.4	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	0.3	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	2.4	1.0	BDL	BDL	BDL	BDL	0.8	1.8	0.3	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	187.5	302.9	199.9	635.6	234.0	59.1	462.9	27.2	62.6	319.6	34.9	37.1	29.9	508.4	34.0	37.6	14.7	11.3
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	71.9	147.6	41.8	51.4	BDL	3.1	BDL	BDL	BDL	88.4	7.0	12.5	5.7	BDL	BDL	10.0	5.9	7.1
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.1	BDL
Endo sulfate	3.0	BDL	2.1	3.4	2.5	0.8	BDL	BDL	BDL	BDL	0.7	0.7	0.5	BDL	1.3	0.5	BDL	BDL
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	0.6	BDL	BDL	BDL	BDL	0.6	BDL	BDL	BDL	1.1	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	10/15/02	10/16/02	10/17/02	10/19/02	10/20/02	10/25/02	10/28/02	10/29/02	10/30/02	11/5/02	11/11/02	11/12/02	11/15/02	11/16/02	11/17/02	11/21/02	11/26/02	11/31/02
Volume (mL)	4,610	855	130	105	120	3,340	1,085	4,595	1,550	3,510	3,940	3,890	640	5,620	2,645	770	352	155
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	BDL	BDL	BDL	5.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	1.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	22.5	7.2	5.7	BDL	4.1	BDL	BDL	BDL	BDL
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	116.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	10.3	BDL	10.1	BDL	BDL	BDL	BDL	114.7	BDL
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil	0.8	BDL	BDL	BDL	59.8	1.4	BDL	BDL	2.0	BDL	3.4	BDL	5.7	0.8	BDL	BDL	10.5	35.8
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date	4/6/03	4/7/03	4/8/03	4/9/03	4/10/03	4/25/03	4/26/03	5/5/03	5/9/03	5/10/03	5/15/03	5/16/03	5/17/03	5/18/03	5/21/03	5/22/03	5/23/03	5/25/03
Volume (mL)	1,375	2,845	4,280	1,285	1,780	1,740	170	130	1,220	980	4,940	2,425	1,075	423	2,520	835	290	5,765
Acetochlor	BDL	BDL	BDL	BDL	BDL	136.6	BDL	BDL	64.0	BDL	219.4	93.2	66.4	BDL	118.9	87.1	BDL	15.4
Alachlor	BDL	BDL	BDL	BDL	BDL	57.3	BDL	BDL	BDL	BDL	21.1	BDL	BDL	BDL	42.0	BDL	BDL	15.4
Atrazine	BDL	BDL	BDL	BDL	BDL	77.2	BDL	798.3	158.6	66.1	80.8	84.6	58.1	BDL	45.5	103.0	228.9	23.4
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	25.8	BDL	5.4	10.3	BDL	BDL	14.2	BDL	BDL	3.4
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	62.7	BDL	BDL	BDL	BDL	262.2	526.4	803.4	152.9	91.2	333.5	181.4	105.1	216.8	237.8	209.8	390.0	50.0
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.7	6.7	BDL	BDL	75.8	23.8	BDL	2.8
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	64.7	130.9	BDL	BDL	BDL	BDL	BDL	55.0
Trifluralin	BDL	0.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	0.3
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	9.8	4.1	BDL	BDL	BDL	BDL	BDL	BDL	14.9	BDL	3.0	BDL	BDL	BDL	7.9	BDL	42.5	2.8
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	0.6	BDL	BDL	BDL	0.7	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	1.1	BDL	BDL	0.2
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.8	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	2.4	1.2	0.7	2.5	BDL	2.0	BDL	BDL	2.5	BDL	1.1	1.5	BDL	BDL	2.1	4.9	11.0	1.0
Chlorothalonil	15.9	13.2	2.0	7.7	BDL	21.1	49.6	BDL	41.8	12.1	11.5	20.8	13.0	24.2	42.4	40.8	55.6	29.8
Chlorpyrifos	5.0	3.4	1.3	BDL	2.6	BDL	BDL	BDL	BDL	BDL	2.6	2.8	BDL	BDL	5.5	6.9	17.1	1.5
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	21.1	BDL	BDL	74.4	BDL	10.8	19.8	BDL	BDL	136.2	BDL	BDL	20.7
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3	BDL	BDL	BDL	BDL	BDL	BDL	1.1
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.2	BDL	BDL	BDL	BDL	BDL	1.1	BDL	BDL	1.1
Fipronil	5.3	10.7	2.3	7.1	BDL	3.6	BDL	BDL	11.1	6.9	1.2	5.3	BDL	25.6	BDL	BDL	BDL	BDL
γ–Chlordane	1.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	2.1	BDL	BDL	5.0	BDL	2.0	1.7	BDL	BDL	3.6	BDL	BDL	1.3
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	56.4	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	5/27/03 1,210	5/28/03 1,870	5/29/03 300	5/31/03 730	6/3/03 560	6/4/03 1,180	6/6/03 2,960	6/7/03 3,480	6/8/03 320	6/12/03 100	6/13/03 450	6/14/03 2,990	6/20/03 2,350	6/21/03 1,315	6/27/03 3,550	7/2/03 9,790	7/3/03 1,720	7/7/03 2,050
Acetochlor	BDL	BDL	BDL	BDL	66.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	11.4	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	73.4	39.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.3	BDL	BDL
Atrazine	55.4	BDL	324.4	642.2	217.7	BDL	23.8	18.4	BDL	BDL	BDL	30.5	BDL	BDL	31.7	10.1	38.2	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	96.0	47.0	BDL	68.5	184.5	79.1	21.4	16.6	BDL	BDL	BDL	18.9	25.7	40.1	14.6	51.6	29.4	22.8
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21.8	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.3	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	9.7	BDL	BDL	19.3	22.7	14.1	BDL	BDL	BDL	BDL	BDL	7.1	10.1	11.4	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	0.5	BDL	BDL	BDL	1.0	BDL	BDL	BDL	BDL	BDL	BDL	0.6	BDL	1.1	0.4	0.6	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	2.5	2.1	BDL	5.1	5.4	3.5	1.1	1.0	BDL	BDL	BDL	2.1	1.9	2.6	2.4	0.8	2.0	2.4
Chlorothalonil	73.3	12.0	60.7	58.5	188.2	56.7	17.3	16.1	41.0	189.2	57.3	76.5	117.2	45.7	250.3	45.6	87.1	64.2
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	5.8	1.8	1.7	BDL	BDL	BDL	BDL	4.1	7.2	BDL	1.1	3.9	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	16.9	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	21.4	18.7	BDL	61.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21.3	BDL	BDL	119.2	10.0	BDL	BDL
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	3.1	BDL	2.4	0.7	0.9	BDL	BDL	BDL	2.8	1.7	BDL	2.6	0.7	2.0	2.3
Fipronil	5.3	BDL	BDL	BDL	9.4	BDL	BDL	BDL	BDL	BDL	BDL	2.1	BDL	5.4	BDL	BDL	5.0	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	2.3	1.9	BDL	BDL	BDL	BDL	0.8	BDL	BDL	BDL	BDL	BDL	3.1	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21.6	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	81.9	BDL	BDL	4.2	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	7/9/03 6,740	7/13/03 560	7/18/03 4,250	7/22/03 1,590	7/23/03 835	7/28/03 3,600	7/30/03 850	8/1/03 1,005	8/2/03 165	8/3/03 150	8/4/03 245	8/5/03 6,375	8/7/03 1,290	8/10/03 2,640	8/11/03 1,810	8/16/03 3,855	8/26/03 1,880	8/27/03 6,930
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	13.4	BDL	25.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	1116.2	BDL	BDL	BDL	BDL	806.1	BDL	3430.3	3919.8	2941.1	BDL	456.0	BDL	BDL	BDL	BDL	BDL
Metolachlor	19.6	93.6	28.6	41.4	71.4	15.6	53.6	BDL	BDL	BDL	BDL	1.0	BDL	BDL	BDL	BDL	BDL	0.8
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	57.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	11.7	5.1	0.5	BDL	BDL	1.1	7.2	3.2	23.8	14.8	10.3	0.4	2.2	0.8	1.3	0.6	1.2	0.4
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	5.0	BDL	BDL	12.2	14.2	5.8	17.4	18.0	89.8	85.1	BDL	3.5	13.6	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	0.7	BDL	0.6	BDL	1.4	0.9	BDL	1.1	BDL	BDL	BDL	0.9	0.8	0.7	0.6	1.2	1.2	1.2
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	2.5	5.6	2.0	3.5	6.9	3.0	3.9	4.0	BDL	BDL	BDL	2.3	2.9	2.1	2.1	2.4	3.0	3.9
Chlorothalonil	59.7	130.4	154.7	133.4	79.7	102.4	113.9	77.6	140.9	130.4	86.4	60.1	263.7	173.8	94.2	166.0	195.9	60.3
Chlorpyrifos	1.2	11.1	1.7	3.8	8.5	2.2	6.5	7.6	BDL	BDL	BDL	2.6	5.6	2.6	BDL	2.0	BDL	1.1
Chlrpyrfs Oxon	BDL	BDL	BDL	26.3	48.3	BDL	BDL	BDL	BDL	BDL	BDL	11.1	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	23.7	BDL	BDL	BDL	BDL	42.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	26.1	BDL	38.6	44.5
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	2.0	BDL	2.0	2.4	2.9	1.8	3.0	3.4	BDL	BDL	BDL	1.2	2.5	2.4	2.1	2.0	2.8	2.9
Fipronil	2.2	11.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3	BDL	3.8	5.3	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	51.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13.2	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	2.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the compound was not analyzed for

APPENDIX AE - Levels in precipitation (ng/L) at HP (2000-2003)

Sampling date Volume (mL)	8/29/03 1,300	8/30/03 5,310	9/1/03 2,850	9/2/03 360	9/3/03 4,740	9/4/03 12,600	9/12/03 5,200	9/15/03 11,030	Max 19,960	Min 50	Median 1,320	# Samples analyzed in	% detection	
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	356.5	11.4	66.6	244	15	
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	486.0	5.3	39.6	244	21	68.0
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	895.6	4.7	77.3	244	39	40.0
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		244	0	72.0
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	261.2	3.4	35.8	244	15	62.0
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3,919.8	456.0	2,028.7	176	3	
Metolachlor	BDL	BDL	BDL	BDL	BDL	BDL	0.9	BDL	997.9	0.8	63.5	244	59	242.0
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	8.8	8.8	8.8	136	1	
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	147.4	2.8	30.2	244	11	
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	499.7	17.9	66.5	204	10	
Trifluralin	1.9	0.5	1.0	7.4	0.5	0.2	0.5	BDL	23.8	0.1	1.6	244	18	
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	89.8	2.8	11.8	136	18	
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	13.9	13.9	13.9	136	1	
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.3	0.4	1.3	244	2	
α–Endosulfan	1.1	0.6	0.6	BDL	1.1	0.8	0.4	0.2	30.6	0.2	1.0	244	28	
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	22.4	0.3	2.1	244	7	
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	
β–Endosulfan	3.5	2.4	2.0	BDL	2.7	1.8	1.1	0.3	81.0	0.3	2.1	244	42	
Chlorothalonil	381.2	269.4	176.2	104.3	99.4	81.3	42.3	2.5	2,011.2	1.6	63.6	244	86	
Chlorpyrifos	BDL	1.4	BDL	BDL	BDL	0.7	1.5	0.7	28.8	0.5	2.5	244	25	
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	4.4	BDL	BDL	201.3	1.3	18.0	244	14	
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		176	0	
Diazinon	70.2	38.7	49.3	158.9	22.7	11.1	12.1	BDL	158.9	3.1	23.2	176	27	
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.1	0.1	1.3	136	7	
Endo sulfate	4.2	3.3	2.8	BDL	2.5	1.3	1.0	0.3	14.2	0.3	1.9	244	30	
Fipronil	BDL	BDL	BDL	BDL	BDL	0.8	BDL	BDL	59.8	0.8	5.2	136	31	
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.7	1.5	1.6	244	1	
γ–HCH	BDL	BDL	BDL	BDL	BDL	0.7	BDL	BDL	22.4	0.3	1.8	244	20	
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	24.8	10.2	21.6	136	2	
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	56.4	56.4	56.4	136	1	
Malathion	BDL	BDL	BDL	82.8	BDL	BDL	6.4	BDL	358.2	1.9	18.2	244	5	
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.3	2.3	2.3	176	1	
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		176	0	
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.6	0.5	1.5	136	1	
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		136	0	

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	4/9/01	4/10/01	4/11/01	4/13/01	4/15/01	4/16/01	4/17/01	4/24/01	5/20/01	5/21/01	5/22/01	5/25/01	5/26/01	5/27/01	5/29/01	6/1/01	6/2/01
Volume (mL)	1,480	210	600	330	1,310	710	110	680	2,610	610	1,820	1,050	775	440	110	2,270	1,440
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	120.1	36.3	125.1	BDL	91.8	BDL	BDL	BDL	BDL	78.9
Alachlor	BDL	BDL	BDL	BDL	45.5	BDL	BDL	95.6	BDL	BDL	BDL	51.5	64.7	BDL	BDL	BDL	29.7
Atrazine	43.9	BDL	BDL	91.7	100.7	20.9	BDL	308.3	49.5	89.2	20.5	182.2	81.7	157.8	706.1	13.1	106.5
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	68.6	BDL	BDL	BDL	85.8	BDL	BDL	208.0	43.6	141.3	BDL	121.5	BDL	BDL	BDL	BDL	59.9
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	40.5	BDL	BDL	93.6	30.5	35.9	BDL	178.7	47.4	59.5	BDL	126.1	54.4	52.2	471.1	17.5	164.5
Metribuzin	BDL	BDL	BDL	397.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	129.5	BDL	BDL	235.3	BDL	BDL	87.0	157.7	BDL	BDL	BDL	BDL	BDL
Simazine																	
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	17.4	0.7	BDL	BDL	BDL	BDL	BDL	BDL	2.4	BDL
44'-DDD																	
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	1.3	BDL	BDL	BDL	BDL	BDL	BDL	1.7	0.5	BDL	0.5	BDL	BDL	BDL	BDL	0.5	0.7
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																	
β–Endosulfan	2.5	BDL	3.3	BDL	0.8	BDL	BDL	1.5	0.4	BDL	1.3	1.1	BDL	BDL	BDL	0.5	1.1
Chlorothalonil	47.5	BDL	128.4	24.2	30.0	BDL	BDL	94.8	29.0	63.2	71.8	57.8	41.7	31.0	BDL	30.3	46.5
Chlorpyrifos	2.2	BDL	BDL	BDL	BDL	13.1	BDL	7.6	2.2	BDL	2.2	2.1	BDL	9.9	BDL	1.4	BDL
Chlrpyrfs Oxon	14.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	190.6	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	118.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin																	
Endo sulfate	BDL	BDL	5.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.5	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil																	
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	1.8	BDL	BDL	BDL	BDL	BDL	BDL	5.5	1.4	BDL	1.6	BDL	BDL	BDL	BDL	1.1	1.8
Heptachlor																	
Hptchlr epoxide																	
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																	
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47																	
BDE 100																	
BDE 99																	
BDE 154																	

blanks mean that the compound was not analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	6/4/01	6/5/01	6/6/01	6/7/01	6/16/01	6/17/01	6/23/01	7/1/01	7/4/01	7/17/01	7/18/01	7/19/01	7/25/01	7/28/01	8/10/01	8/11/01	8/12/01
Volume (mL)	440	410	5,400	910	6,680	190	2,056	820	410	3,450	3,950	10,000	3,900	2,400	2,180	10,000	1,700
Acetochlor	218.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	670.9	79.0	6.8	42.2	BDL	BDL	28.6	30.5	41.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	253.3	BDL	BDL	137.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	500.0	129.7	11.5	128.9	BDL	185.4	17.3	42.7	73.0	17.6	BDL	BDL	4.7	BDL	9.5	2.2	11.8
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	195.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine																	
Trifluralin	BDL	BDL	BDL	BDL	BDL	9.8	1.4	2.3	BDL	BDL	BDL	BDL	BDL	BDL	0.8	0.3	BDL
44'-DDD																	
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	1.0	BDL
α–Endosulfan	BDL	BDL	BDL	1.1	BDL	15.1	BDL	4.1	4.3	2.1	0.5	BDL	1.9	0.9	BDL	1.9	3.9
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin																	
β–Endosulfan	BDL	BDL	BDL	1.2	BDL	21.2	0.5	2.4	6.4	4.5	0.9	BDL	2.6	0.7	7.7	5.8	4.5
Chlorothalonil	19.2	47.8	3.7	22.3	26.0	915.3	89.2	236.2	BDL	173.0	70.5	BDL	92.8	19.6	502.9	140.6	17.6
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	44.6	BDL	BDL	BDL	4.1	0.5	BDL	BDL	1.3	8.0	3.4	4.0
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	72.2	BDL	BDL	BDL	BDL	BDL	472.9	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin																	
Endo sulfate	BDL	BDL	BDL	BDL	BDL	10.8	BDL	BDL	BDL	2.0	BDL	BDL	0.9	BDL	5.3	3.4	2.7
Fipronil																	
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	16.4	BDL	BDL	BDL	0.7	BDL	BDL	BDL	BDL	1.3	0.5	BDL
Heptachlor																	
Hptchlr epoxide																	
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex																	
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47																	
BDE 100																	
BDE 99																	
BDE 154																	

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	8/13/01	8/18/01	8/23/01	9/14/01	9/19/01	9/20/01	9/21/01	10/5/01	10/14/01	11/24/01	11/25/01	1/3/02	2/26/02	2/28/02	3/2/02	3/9/02	3/12/02
Volume (mL)	5,130	900	2,300	1,000	50	1,000	50	1,000	2,300	110	50	50	62	1,050	390	452	424
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	892.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	24.3	8.8	18.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metribuzin	BDL	BDL	BDL	BDL	1269.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine												BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	13.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	32.3	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD												BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	0.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	1.1	3.8	1.9	2.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin												BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	2.0	14.2	4.0	4.7	BDL	BDL	BDL	1.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	100.3	994.8	534.6	205.1	155.8	30.0	BDL	69.7	BDL	1405.1	BDL	BDL	BDL	BDL	BDL	122.3	27.2
Chlorpyrifos	1.0	4.1	1.4	4.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	18.0	BDL	BDL	BDL	BDL	47.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin												BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	1.7	5.4	2.7	3.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil												BDL	BDL	BDL	BDL	8.5	4.7
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	0.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor												BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide												BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	9.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex												BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47												BDL	BDL	BDL	BDL	BDL	BDL
BDE 100												BDL	BDL	BDL	BDL	BDL	BDL
BDE 99												BDL	BDL	BDL	BDL	BDL	BDL
BDE 154												BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the compound was not analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	3/13/02	3/16/02	3/17/02	3/18/02	3/19/02	3/25/02	3/29/02	4/2/02	4/11/02	4/12/02	4/14/02	4/15/02	4/21/02	4/25/02	4/27/02	4/28/02	5/1/02
Volume (mL)	504	1,682	391	302	928	5,200	2,050	230	730	430	230	280	1,170	820	4,400	1,870	850
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	30.3	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	244.4	236.6	BDL	BDL	BDL	33.0	60.4
Atrazine	BDL	BDL	BDL	BDL	40.7	7.2	15.0	150.8	BDL	158.9	182.1	276.3	75.5	47.8	13.0	23.2	96.1
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	228.3	59.8	BDL	BDL	BDL	88.0
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	BDL	BDL	BDL	11.9	28.8	216.4	BDL	153.3	343.3	1500.1	96.5	74.7	12.7	33.3	80.2
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	40.6	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	25.5	BDL	BDL	BDL	BDL	BDL	BDL	56.0	BDL	26.1	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	54.1	BDL	BDL	BDL	BDL
Trifluralin	BDL	3.3	BDL	BDL	BDL	0.5	1.9	BDL	BDL	BDL	BDL	BDL	BDL	2.7	0.4	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	0.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.7	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	BDL	BDL	BDL
Chlorothalonil	BDL	29.5	BDL	187.5	303.4	24.4	51.7	151.6	BDL	BDL	BDL	30.6	35.6	147.0	3.7	40.1	52.1
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.7	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	628.3	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	BDL	BDL	BDL	2.4	22.4	BDL	BDL	BDL	BDL	BDL	BDL	44.9	6.0	14.2	46.2
Dieldrin	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil	3.8	1.5	3.3	BDL	2.2	3.0	4.0	9.6	2.1	3.5	BDL	6.4	1.3	10.5	BDL	3.3	1.5
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.0	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	17.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	20.1
Mirex	BDL	BDL	158.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	0.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	48.6	BDL	2.3	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	9.8	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	47.0	BDL	1.4	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.9	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	5/2/02	5/4/02	5/6/02	5/12/02	5/13/02	5/17/02	5/18/02	6/5/02	6/6/02	6/12/02	6/13/02	6/14/02	6/15/02	6/27/02	6/30/02	7/13/02	7/19/02
Volume (mL)	2,150	95	100	1,450	1,850	300	2,830	1,100	3,500	1,000	800	1,650	550	520	60	540	2,440
Acetochlor	48.7	BDL	577.6	63.9	57.6	954.4	79.8	BDL	19.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	37.7	BDL	BDL	78.3	52.0	201.1	35.4	56.9	27.5	143.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	102.5	351.1	288.5	273.0	155.6	898.0	127.1	64.7	245.0	151.9	44.0	21.9	152.5	102.7	BDL	87.1	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	54.1	BDL	BDL	69.2	45.3	353.4	BDL	62.6	42.0	73.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	54.1	623.6	553.3	355.0	157.3	998.5	304.0	91.3	200.5	220.1	55.9	BDL	161.7	158.4	1160.3	BDL	30.5
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	23.7	BDL	BDL	49.5	34.8	163.0	33.6	81.1	48.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	82.8	81.2	292.0	44.0	BDL	68.3	68.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	1.2	BDL	BDL	BDL	BDL	BDL	0.8	8.2	3.8	BDL	BDL	BDL	BDL	24.6	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	0.8	BDL	1.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.7
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	1.1	BDL	BDL	4.7	3.9	4.3	3.1	2.7	4.4	4.3	1.1	BDL	2.7	1.9	BDL	BDL	2.1
Chlorothalonil	47.8	BDL	BDL	166.4	85.1	395.6	58.2	133.3	94.0	308.0	394.8	53.9	319.6	190.6	192.7	BDL	261.9
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	365.0	BDL	BDL	BDL	BDL	BDL	BDL	241.2
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	38.1	BDL	BDL	BDL	66.6	BDL	BDL	BDL	36.7	104.3	146.8	23.5	103.7	180.6	BDL	BDL	73.4
Dieldrin	2.0	BDL	BDL	BDL	BDL	BDL	1.5	3.4	1.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	1.5	BDL	BDL	3.3	2.9	BDL	0.8	2.6	1.5	2.8	2.7	BDL	BDL	BDL	BDL	BDL	4.3
Fipronil	1.9	BDL	BDL	BDL	BDL	BDL	BDL	1.3	0.4	BDL	14.7	BDL	2.4	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	1.1	BDL	BDL	2.9	2.1	BDL	1.5	BDL	1.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	38.3	41.9	BDL	BDL	BDL	48.9	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	9.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.2	23.3	BDL	10.7	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	11.4	BDL	BDL	BDL	1.4	BDL	BDL	5.5	1.0	BDL	BDL	0.5	BDL	BDL	BDL	2.9	2.3
BDE 100	0.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	5.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
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APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	7/24/02	7/27/02	8/5/02	8/24/02	8/27/02	8/28/02	8/31/02	9/1/02	9/14/02	9/15/02	9/16/02	9/25/02	9/26/02	10/1/02	10/10/02	10/11/02	10/12/02
Volume (mL)	375	4,300	1,230	480	870	4,050	7,150	21,850	3,200	2,010	2,900	230	980	4,150	1,350	3,100	930
Acetochlor	BDL	BDL	31.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	57.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	19.0	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	16.6	65.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	1.1	BDL	BDL	BDL	0.8	BDL	BDL	0.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	1.3	BDL	BDL	0.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	1.1	0.3	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	1.3	10.2	4.3	1.1	1.0	0.2	0.0	0.3	1.3	0.3	BDL	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	178.7	78.7	241.9	395.9	143.1	80.0	22.3	3.6	54.9	99.8	32.7	38.1	23.2	15.5	38.9	3.6	BDL
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	31.6	122.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	14.6	112.0	BDL	63.2	35.3	9.2	BDL	9.7	17.8	BDL	BDL	BDL	8.9	58.5	BDL	BDL
Dieldrin	BDL	0.6	BDL	BDL	BDL	1.0	0.5	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	5.7	1.6	8.0	6.2	3.9	1.6	0.4	0.1	0.8	1.7	0.9	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil	13.4	1.1	4.0	BDL	6.5	BDL	0.7	BDL	BDL	3.1	BDL	24.6	5.9	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	5.3	BDL	BDL	0.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	1.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	52.8	10.5	21.1	36.0	BDL	4.2	BDL	BDL	5.8	8.1	BDL	BDL	16.3	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	18.2	1.5	BDL	BDL	2.1	2.4	0.7	0.3	1.3	2.1	BDL	BDL	2.3	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	11.3	0.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
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APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	10/15/02	10/16/02	10/17/02	10/20/02	10/25/02	10/28/02	10/29/02	10/30/02	11/5/02	11/11/02	11/16/02	11/17/02	11/21/02	11/22/02	11/26/02	11/30/02	12/19/02
Volume (mL)	1,380	1,030	130	120	3,900	300	6,500	4,950	2,380	1,100	2,800	1,150	5,100	90	340	510	750
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlorothalonil	BDL	BDL	BDL	BDL	BDL	BDL	2.4	BDL	32.2	12.9	21.8	BDL	BDL	BDL	BDL	BDL	8.6
Chlorpyrifos	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	129.7	BDL	BDL	78.5	5.5	3.4	15.8	BDL	BDL	16.4	BDL	BDL	82.1	58.0	BDL
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Fipronil	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	1/28/03	2/10/03	4/17/13	4/18/03	4/25/03	5/2/03	5/5/03	5/7/03	5/9/03	5/10/03	5/15/03	5/16/03	5/18/03	5/21/03	5/22/03	5/23/03	5/25/03
Volume (mL)	100	730	1,352	328	1,325	540	300	1,180	455	280	2,650	3,757	110	4,350	1,410	1,250	2,620
Acetochlor	BDL	BDL	BDL	BDL	65.5	248.1	201.4	62.5	BDL	BDL	14.8	BDL	BDL	BDL	32.2	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	98.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	13.7	41.2	BDL	214.1	62.8	72.1	BDL	158.6	18.4	6.1	BDL	BDL	27.3	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	210.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	298.1	BDL	141.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	BDL	BDL	19.0	840.8	105.3	87.0	BDL	143.0	29.4	13.6	226.3	BDL	31.8	19.7	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	18.9	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	BDL	2.3	8.3	5.6	4.9	7.6	3.1	BDL	10.5	1.3	2.5	97.0	BDL	7.1	3.1	1.1
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	3.4	BDL	BDL
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	BDL	BDL	1.0	1.8	BDL	BDL	BDL	BDL	BDL	0.2	8.6	BDL	3.0	BDL	BDL
Chlorothalonil	BDL	9.7	27.2	36.3	17.1	79.5	86.5	34.7	BDL	63.9	4.2	8.6	513.2	BDL	74.9	10.4	2.5
Chlorpyrifos	BDL	2.5	BDL	BDL	2.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	11.0	BDL	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	98.3	BDL	BDL	48.6	171.0	477.3	68.3	BDL	199.0	BDL	17.5	873.5	BDL	191.2	34.1	17.8
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4.1	BDL	16.7	1.7	1.2	43.2	BDL	3.5	BDL	BDL
Fipronil	BDL	BDL	BDL	BDL	3.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	BDL	BDL	35.5	4.4	BDL	1.9	BDL	BDL	BDL	BDL	22.9	BDL	5.4	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	57.4	BDL	BDL	10.0	BDL	BDL	BDL	BDL	49.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	144.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date	5/27/03	5/28/03	5/29/03	5/30/03	6/3/03	6/5/03	6/7/03	6/11/03	6/12/03	6/14/03	6/17/03	6/18/03	6/19/03	6/20/03	6/21/03	7/2/03	7/3/03
Volume (mL)	270	1,780	300	750	1,100	820	2,250	650	220	30	780	2,800	2,560	670	425	1,830	2,430
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	14.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	7.5	180.4	16.7	155.2	43.7	15.2	49.0	133.1	BDL	BDL	BDL	9.5	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	198.1	BDL	53.4	41.5	16.6	74.6	189.3	1192.3	BDL	BDL	13.2	38.0	BDL	20.5	12.5
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	59.1	BDL	BDL	BDL	BDL	37.9	BDL	BDL	BDL	BDL	12.6	BDL	BDL	BDL	7.3
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	25.2	1.6	12.5	BDL	1.6	3.3	1.1	14.9	16.2	BDL	BDL	0.8	1.4	3.2	4.3	2.4	4.5
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	12.4	BDL	BDL	BDL	BDL	11.2	17.4	BDL	BDL	BDL	1.5	5.6	BDL	2.0	2.1
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	11.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	5.1	BDL	15.3	BDL	5.2	BDL	2.5	13.7	26.2	BDL	BDL	BDL	2.3	8.5	BDL	BDL	2.8
Chlorothalonil	190.1	5.2	469.4	BDL	30.4	89.6	22.4	562.7	182.3	472.7	12.2	5.6	32.4	61.9	98.1	56.3	94.3
Chlorpyrifos	BDL	BDL	BDL	BDL	7.8	9.1	3.5	30.1	33.3	BDL	BDL	3.2	4.1	12.2	BDL	BDL	4.9
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	373.0	BDL	BDL	80.0	38.3	210.7	BDL	BDL	BDL	12.9	22.5	BDL	BDL	23.6	27.7
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	18.7	BDL	16.6	BDL	BDL	6.1	2.3	11.0	22.9	BDL	BDL	BDL	2.0	7.4	BDL	BDL	2.5
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	26.1	BDL	5.8	BDL	BDL	16.4	BDL	BDL	BDL	BDL	2.4	8.8	BDL	BDL	3.5
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	4.0
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	3.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	35.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	42.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
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APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date Volume (mL)	7/6/03 230	7/9/03 3,970	7/10/03 280	7/13/03 980	7/14/03 460	7/18/03 160	7/22/03 780	7/29/03 360	7/30/03 1,600	7/31/03 85	8/4/03 100	8/5/03 1,680	8/7/03 1,800	8/10/03 3,000	8/16/03 2,224	8/26/03 760	8/27/03 370
Acetochlor	BDL	BDL	221.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	BDL	BDL	311.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	9.6	609.4	BDL	64.5	BDL	36.8	89.8	BDL	BDL	BDL	BDL	16.3	BDL	BDL	42.4	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	181.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	0.6	109.2	BDL	112.2	26.7	5.4	15.5	1.4	34.5	26.9	1.8	2.1	0.8	1.1	3.8	9.3
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.2	BDL	25.7	65.9
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	19.3	BDL	9.9	BDL	BDL	11.6	BDL	46.6	BDL	BDL	3.1	1.3	2.0	7.0	11.0
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	BDL	31.4	BDL	15.1	BDL	BDL	20.6	BDL	78.0	BDL	BDL	5.8	2.0	4.0	10.3	17.9
Chlorothalonil	BDL	7.5	5569.1	BDL	473.7	175.1	94.4	451.5	21.0	1645.3	109.0	9.8	147.0	37.8	324.2	953.7	552.7
Chlorpyrifos	BDL	BDL	40.4	BDL	18.5	BDL	BDL	22.7	BDL	BDL	BDL	BDL	5.2	3.0	3.5	10.8	BDL
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	1266.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	231.7
Dieldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Endo sulfate	BDL	BDL	26.6	BDL	11.4	BDL	BDL	14.6	BDL	64.5	BDL	BDL	3.9	1.9	3.1	8.2	16.0
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.6	BDL	BDL	BDL
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	30.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.3	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

blanks mean that the
compound was not
analyzed for

APPENDIX AF - Levels in precipitation (ng/L) at LD (2001-2003)

Sampling date Volume (mL)	8/29/03 310	8/30/03 2,965	9/2/03 880	9/12/03 3,620	9/14/03 110	Max 21,850	Min 30	Median 930	# Samples analyzed in	% detection	
Acetochlor	BDL	BDL	BDL	BDL	BDL	954.4	14.8	65.5	177	13	
Alachlor	BDL	BDL	BDL	BDL	BDL	244.4	27.5	57.3	177	11	45.0
Atrazine	BDL	BDL	BDL	BDL	BDL	898.0	6.1	79.0	177	38	71.0
CEAT	BDL	BDL	BDL	BDL	BDL	210.1	210.1	210.1	177	1	56.0
CIAT	BDL	BDL	BDL	BDL	BDL	892.8	19.0	85.8	177	13	
Cyanazine	BDL	BDL	BDL	BDL	BDL	0.0	0.0		177	0	
Metolachlor	BDL	BDL	35.9	BDL	BDL	1,500.1	2.2	57.7	177	49	
Metribuzin	BDL	BDL	BDL	BDL	BDL	1,269.6	40.6	397.8	177	2	
Pendimethalin	BDL	BDL	BDL	BDL	BDL	235.3	7.3	49.5	177	12	
Simazine	BDL	BDL	BDL	BDL	BDL	292.0	44.0	68.3	132	5	
Trifluralin	6.3	0.9	3.2	0.5	18.4	112.2	0.3	3.1	177	40	
44'-DDD	BDL	BDL	BDL	BDL	BDL	0.0	0.0		132	0	
44'-DDE	BDL	BDL	BDL	BDL	BDL	65.9	6.2	25.7	177	2	
44'-DDT	BDL	BDL	BDL	BDL	BDL	0.0	0.0		177	0	
α–Chlordane	BDL	BDL	BDL	BDL	BDL	2.4	0.4	0.6	177	3	
α–Endosulfan	12.5	BDL	5.9	BDL	BDL	46.6	0.5	2.0	177	25	
a-HCH	BDL	BDL	BDL	BDL	BDL	11.0	0.2	1.1	177	3	
Aldrin	BDL	BDL	BDL	BDL	BDL	2.7	2.7	2.7	132	1	
β–Endosulfan	20.3	1.9	11.1	1.6	BDL	78.0	0.0	2.7	177	44	
Chlorothalonil	95.3	64.1	1495.2	20.8	530.5	5,569.1	2.4	64.1	177	76	
Chlorpyrifos	BDL	BDL	10.1	BDL	BDL	44.6	0.5	4.1	177	23	
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	628.3	14.0	190.6	177	5	
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	0.0	0.0		177	0	
Diazinon	BDL	BDL	BDL	BDL	BDL	1,266.4	2.4	46.9	177	32	
Dieldrin	BDL	BDL	BDL	BDL	BDL	3.4	0.2	1.0	132	7	
Endo sulfate	18.5	1.9	10.1	1.5	BDL	64.5	0.1	3.3	177	34	
Fipronil	BDL	BDL	BDL	BDL	BDL	24.6	0.4	3.3	132	24	
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	3.3	3.3	3.3	177	1	
γ–HCH	BDL	BDL	BDL	BDL	BDL	35.5	0.5	2.4	177	18	
Heptachlor	BDL	BDL	BDL	BDL	BDL	48.9	1.3	40.1	132	3	
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	17.6	17.6	17.6	132	1	
Malathion	BDL	BDL	BDL	BDL	BDL	52.8	4.0	10.0	177	9	
Mirex	BDL	BDL	BDL	BDL	BDL	158.9	158.9	158.9	132	1	
Oxychlordane	BDL	BDL	BDL	BDL	BDL	57.4	3.0		177	2	
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	0.0	0.0		177	0	
BDE 47	BDL	BDL	16.4	BDL	BDL	144.5	0.3	2.3	132	17	
BDE 100	BDL	BDL	BDL	BDL	BDL	9.8	0.7	5.2	132	2	
BDE 99	BDL	BDL	BDL	BDL	BDL	47.0	0.9	8.4	132	5	
BDE 154	BDL	BDL	BDL	BDL	BDL	1.9	1.9	1.9	132	1	

blanks mean that the compound was not analyzed for

APPENDIX AG - Levels in precipitation (ng/L) at DV (2002-2003)

Sampling date	4/9/02	4/21/02	4/28/02	5/2/02	5/4/02	5/12/02	5/13/02	5/14/02	5/17/02	6/5/02	6/6/02	6/13/02	6/16/02	6/18/02	7/9/02	7/23/02	7/24/02	8/5/02	8/24/02
Volume (mL)	3,928	1,423	12,738	5,435	899	6,624	1,652	157	4,826	2,534	5,003	1,247	463	183	1,178	7,510	1,645	250	2,828
Acetochlor	11.9	55.2	12.4	66.0	80.9	52.7	20.7	BDL	44.3	BDL	7.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	BDL	BDL	26.6	36.7	BDL	20.0	BDL	BDL	26.0	26.1	13.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	46.8	245.7	21.4	48.3	142.8	197.0	74.6	376.6	136.3	81.3	75.6	40.8	BDL	354.0	BDL	6.7	BDL	BDL	BDL
CEAT	BDL	295.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	40.8	151.6	13.3	41.1	BDL	56.6	73.9	BDL	43.3	76.1	62.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	158.7	186.1	23.5	104.8	183.8	246.8	69.7	BDL	476.7	95.8	103.8	BDL	BDL	BDL	81.7	1.6	BDL	BDL	BDL
Metribuzin	BDL	160.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	91.5	11.7	41.6	BDL	69.7	BDL	BDL	80.0	29.4	20.6	BDL	BDL	BDL	BDL	13.5	BDL	BDL	BDL
Simazine	31.3	134.5	11.6	15.7	79.9	87.4	47.7	BDL	40.9	36.2	40.6	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	1.6	3.2	0.6	1.0	5.4	0.9	3.4	27.0	2.0	2.6	2.3	4.3	9.2	23.4	6.0	0.7	2.6	BDL	2.1
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	BDL	0.3	BDL	BDL	2.1	BDL	BDL	0.9	BDL	0.9	BDL	BDL	BDL	BDL	1.1	BDL	BDL	1.2
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	0.9	BDL	0.3	0.5	BDL	3.1	BDL	BDL	2.3	0.7	2.7	BDL	BDL	BDL	BDL	2.1	BDL	BDL	3.1
Chlorothalonil	55.6	90.5	19.8	39.7	13.8	136.4	76.2	BDL	135.4	257.8	257.4	43.1	405.2	740.3	262.1	278.8	124.2	254.1	209.4
Chlorpyrifos	7.5	3.2	0.9	1.4	4.1	3.1	2.9	22.8	3.5	2.5	1.6	3.2	7.7	BDL	5.8	0.7	2.2	17.3	7.6
Chlrpyrfs Oxon	BDL	BDL	9.2	31.6	BDL	18.9	BDL	BDL	45.1	BDL	BDL	BDL	BDL	BDL	BDL	23.8	BDL	BDL	BDL
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	BDL	10.6	24.0	BDL	29.2	BDL	742.5	BDL	52.5	26.8	BDL	BDL	BDL	BDL	25.6	78.2	591.0	BDL
Dieldrin	1.0	2.3	0.5	0.8	0.0	0.9	0.0	0.0	1.2	0.0	1.2	0.0	0.0	0.0	0.0	0.8	0.0	0.0	2.3
Endo sulfate	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	4.1
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.1
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
γ–HCH	3.4	BDL	1.3	1.5	BDL	3.0	BDL	BDL	4.0	1.9	1.8	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	2.4	BDL	12.0	BDL	BDL	21.7	BDL	BDL	BDL	BDL	BDL	BDL	10.3	6.0	BDL	8.0
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

APPENDIX AG - Levels in precipitation (ng/L) at DV (2002-2003)

Sampling date Volume (mL)	8/27/02 210	8/28/02 13,250	9/1/02 21,300	9/15/02 3,730	9/26/02 5,042	10/10/02 17,295	10/17/02 260	10/29/02 5,055	10/30/02 1,638	11/5/02 4,320	11/11/02 3,160	11/12/02 4,780	4/25/03 1,274	5/7/03 896	5/8/03 130	5/9/03 750	5/16/03 9,527	5/21/03 1,818	5/22/03 1,142	5/27/03 380	5/29/03 215	5/31/03 841
Acetochlor	BDL	BDL	BDL	BDL	5.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	148.5	506.3	BDL	BDL	BDL	49.9	BDL	BDL	BDL	70.4
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	50.9	BDL	BDL	BDL	30.1	BDL	BDL	BDL	72.1
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	36.1	863.7	BDL	104.8	16.2	BDL	BDL	BDL	339.9	519.6
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	203.9	BDL	BDL	10.9	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	124.1	570.8	995.3	120.0	59.8	198.2	39.7	BDL	BDL	579.9
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	BDL	5.3	3.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1134.4	509.7	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	BDL	0.9	0.3	2.4	1.0	0.4	BDL	2.0	5.3	1.2	2.7	1.6	5.5	8.8	BDL	BDL	0.7	4.8	6.7	18.0	32.1	8.4
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	62.9	BDL
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	BDL	1.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Endosulfan	BDL	3.2	1.2	2.1	0.2	0.2	BDL	0.7	BDL	BDL	BDL	BDL	5.6	8.4	53.9	9.4	0.9	9.0	6.5	18.5	32.7	8.8
a-HCH	BDL	3.3	1.3	BDL	BDL	1.3	BDL	2.9	BDL	0.9	BDL	1.2	BDL	2.9	BDL	BDL	0.5	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	BDL	2.4	0.9	6.1	0.7	0.1	BDL	0.2	BDL	0.5	0.9	0.6	6.2	9.5	BDL	10.3	1.0	11.1	7.2	20.3	36.0	11.0
Chlorothalonil	765.9	54.3	11.4	44.1	9.1	8.5	133.6	5.4	69.5	22.6	11.0	8.8	46.8	637.6	421.4	110.5	261.8	444.2	89.1	213.6	665.9	786.7
Chlorpyrifos	BDL	5.6	2.8	3.9	1.7	0.6	BDL	4.1	13.6	1.2	3.4	5.7	BDL	12.7	BDL	BDL	1.1	9.8	9.7	BDL	BDL	12.5
Chlrpyrfs Oxon	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	11.2	BDL	BDL	BDL	26.2
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	24.7	10.3	41.6	34.7	12.4	775.5	BDL	145.8	57.1	BDL	53.1	BDL	184.2	BDL	43.8	48.5	121.1	BDL	49.6	BDL	169.6
Dieldrin	0.0	1.0	0.7	0.0	0.0	0.6	0.0	1.5	0.0	0.0	2.1	2.3	BDL	7.1	BDL	BDL	0.8	3.3	BDL	BDL	BDL	BDL
Endo sulfate	BDL	0.9	0.5	1.5	0.6	0.3	BDL	BDL	BDL	BDL	BDL	BDL	7.0	11.2	BDL	11.9	1.0	5.1	7.9	23.1	41.0	11.1
Fipronil	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	17.9	29.2	14.1	0.7	3.0	3.3	7.7	BDL	3.8
γ–Chlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.8	BDL	BDL	BDL	2.9	BDL	BDL	BDL	BDL
γ–HCH	BDL	BDL	0.6	BDL	0.6	0.8	BDL	1.9	BDL	0.7	BDL	1.5	3.8	11.0	32.2	6.5	1.3	4.6	4.3	11.3	21.3	7.4
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	5.9	7.4	5.0	44.3	2.6	113.1	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	22.4	BDL	BDL	BDL	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.4	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

APPENDIX AG - Levels in precipitation (ng/L) at DV (2002-2003)

Sampling date	6/3/03	6/4/03	6/6/03	6/11/03	6/12/03	6/17/03	6/18/03	6/19/03	6/20/03	6/21/03	7/2/03	7/6/03	7/9/03	7/13/03	7/22/03	7/23/03	7/28/03	8/5/03	8/6/03	8/7/03	8/10/03	8/12/03
Volume (mL)	3,530	2,346	9,890	2,170	486	5,710	2,448	1,965	5,965	3,845	11,360	2,410	4,210	4,470	2,380	1,015	6,140	6,207	1,410	2,545	1,348	1,090
Acetochlor	14.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	17.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Alachlor	15.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Atrazine	102.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	34.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
CIAT	25.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Metolachlor	50.6	21.7	7.0	44.1	143.8	12.8	17.5	BDL	BDL	19.0	73.4	26.2	78.2	18.2	39.8	38.4	22.6	2.8	BDL	BDL	17.5	BDL
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pendimethalin	22.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trifluralin	2.1	3.5	0.9	12.1	15.2	1.3	3.8	3.6	1.2	2.1	1.2	3.1	2.5	2.1	7.0	15.3	3.4	49.5	5.3	2.7	5.6	6.7
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
44'-DDE	BDL	BDL	BDL	BDL	29.3	2.5	5.9	10.0	2.8	5.0	BDL	6.4	3.8	3.5	7.4	8.4	2.3	44.8	9.6	3.1	7.6	14.1
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
α–Chlordane	BDL	BDL	0.6	2.5	BDL	1.0	BDL	2.8	0.9	1.4	0.5	1.4	0.8	0.7	1.4	BDL	0.5	0.9	BDL	BDL	BDL	BDL
α–Endosulfan	2.2	4.0	1.0	4.2	15.2	1.3	3.4	3.9	1.4	2.7	0.8	2.8	2.2	2.2	3.9	7.2	1.8	48.1	4.9	2.4	4.7	5.7
a-HCH	BDL	BDL	BDL	BDL	BDL	0.5	BDL	BDL	BDL	BDL	0.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
β–Endosulfan	2.6	4.6	1.1	5.8	16.9	1.4	3.4	4.6	1.5	4.3	0.9	3.4	5.8	3.3	12.8	9.3	4.3	148.0	6.8	2.6	5.5	6.5
Chlorothalonil	1212.0	474.9	187.6	803.0	1468.1	120.8	264.5	796.5	236.2	733.2	177.5	1342.8	804.4	1103.9	1805.0	589.7	532.2	1955.2	3312.6	233.4	865.9	1660.0
Chlorpyrifos	3.2	7.0	1.1	9.1	21.0	1.9	4.5	5.1	BDL	4.5	1.0	BDL	4.9	BDL	9.0	BDL	2.4	135.5	BDL	BDL	BDL	BDL
Chlrpyrfs Oxon	BDL	9.3	BDL	BDL	BDL	BDL	BDL	10.0	BDL	8.8	BDL	BDL	BDL	15.5	41.4	BDL	BDL	1752.7	47.7	BDL	BDL	37.6
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.1	BDL	BDL	0.7	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Diazinon	BDL	45.3	7.5	126.0	BDL	13.8	BDL	146.7	44.6	196.5	9.4	136.9	149.9	42.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Dieldrin	1.7	2.5	0.7	3.4	BDL	1.1	2.3	3.0	1.0	2.0	0.6	1.7	1.9	1.1	1.5	BDL	1.2	9.8	BDL	BDL	BDL	BDL
Endo sulfate	2.8	4.2	1.1	5.1	18.7	1.6	3.8	5.3	1.7	3.2	1.0	4.0	3.3	2.3	5.8	7.5	1.9	28.1	6.5	3.0	6.3	8.4
Fipronil	3.1	1.5	0.3	14.8	BDL	0.7	1.3	1.4	BDL	BDL	0.3	BDL	BDL	6.8	3.5	5.5	1.0	14.6	4.3	BDL	4.6	7.2
γ–Chlordane	1.5	2.2	0.5	2.4	BDL	0.9	2.1	2.6	0.9	1.4	0.5	1.3	0.8	0.7	1.3	3.0	0.5	1.0	BDL	BDL	BDL	2.8
γ–HCH	2.7	2.8	1.0	5.0	10.0	1.0	3.0	4.0	1.4	2.9	1.2	BDL	1.7	2.0	2.3	3.7	1.9	34.7	BDL	1.3	BDL	BDL
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Malathion	BDL	BDL	BDL	BDL	BDL	BDL	15.9	BDL	BDL	BDL	6.3	BDL	24.9	15.0	14.9	24.4	6.3	BDL	BDL	BDL	16.9	BDL
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Oxychlordane	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Trans-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.6	BDL	BDL	1.0	0.9	1.7	BDL	0.6	BDL	BDL	BDL	BDL	BDL
BDE 47	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 99	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

APPENDIX AG - Levels in precipitation (ng/L) at DV (2002-2003)

Sampling date Volume (mL)	8/17/03 1,790	8/26/03 275	8/28/03 806	9/1/03 4,570	9/2/03 495	9/3/03 1,675	9/14/03 3,660	9/15/03 278	Max 21,300	Min 130	Median 2,346	# Samples analyzed in	% detection
Acetochlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	506.3	5.2	47.1	73	22
Alachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	72.1	13.9	26.3	73	14
Atrazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	863.7	6.7	92.0	73	30
CEAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	295.3	295.3	295.3	73	1
CIAT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	203.9	10.9	50.0	73	16
Cyanazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
Metolachlor	17.8	BDL	BDL	4.8	BDL	12.0	BDL	BDL	995.3	1.6	55.2	73	55
Metribuzin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	160.8	160.8	160.8	73	1
Pendimethalin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1,134.4	3.3	29.4	73	18
Simazine	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	134.5	11.6	40.7	73	14
Trifluralin	4.9	25.1	9.7	1.9	14.7	4.6	2.1	23.4	49.5	0.3	3.3	73	90
44'-DDD	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
44'-DDE	10.1	30.3	17.1	4.6	BDL	7.5	2.8	BDL	62.9	2.3	7.5	73	33
44'-DDT	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
α–Chlordane	1.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	6.1	0.5	1.0	73	22
α–Endosulfan	6.8	34.8	30.0	10.9	12.4	5.7	1.8	20.7	53.9	0.2	3.6	73	71
a-HCH	BDL	BDL	BDL	BDL	BDL	BDL	0.5	BDL	3.3	0.3	1.0	73	16
Aldrin	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
β–Endosulfan	10.8	46.3	32.5	28.9	17.6	8.7	2.4	22.1	148.0	0.1	4.3	73	78
Chlorothalonil	2280.6	2101.8	797.6	3112.0	286.8	670.9	74.9	218.5	3,312.6	5.4	257.6	73	96
Chlorpyrifos	5.8	BDL	BDL	BDL	BDL	BDL	BDL	BDL	135.5	0.6	4.1	73	66
Chlrpyrfs Oxon	34.4	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1,752.7	8.8	25.0	73	22
Cis-nonachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.1	0.7	0.9	73	3
Diazinon	270.5	BDL	146.4	BDL	BDL	BDL	BDL	BDL	775.5	7.5	49.6	73	51
Dieldrin	2.9	BDL	BDL	BDL	BDL	BDL	BDL	BDL	9.8	0.0	1.0	73	48
Endo sulfate	8.0	28.2	14.0	5.5	15.6	6.2	2.5	BDL	41.0	0.3	4.7	73	63
Fipronil	25.8	24.4	7.7	1.6	11.4	3.5	1.6	43.9	43.9	0.3	3.8	73	45
γ–Chlordane	1.7	BDL	BDL	0.7	BDL	1.8	0.8	BDL	5.8	0.5	1.3	73	33
γ–HCH	3.3	BDL	BDL	BDL	BDL	BDL	BDL	BDL	34.7	0.5	2.7	73	59
Heptachlor	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
Hptchlr epoxide	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
Malathion	36.0	BDL	BDL	8.7	BDL	13.8	8.1	BDL	113.1	2.4	12.0	73	34
Mirex	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
Oxychlordane	2.5	BDL	BDL	BDL	BDL	BDL	BDL	BDL	2.5	0.9	1.7	73	3
Trans-nonachlor	2.2	BDL	BDL	0.9	BDL	BDL	BDL	BDL	2.2	0.6	1.0	73	10
BDE 47	2.3	BDL	BDL	1.2	BDL	BDL	BDL	BDL	2.3	0.3	1.2	73	5
BDE 100	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0
BDE 99	3.3	17.0	BDL	1.2	BDL	BDL	BDL	BDL	17.0	0.4	2.3	73	5
BDE 154	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.0	0.0		73	0

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