CON 12-15
Doc # 8996

Thermogas, West Ch

Williams

ENERGY SERVICES
One Williams Center
P.O. Box 3448
Tulsa, Oklahoma 74101

June 29, 2000

Cal Lundberg, Ph.D.
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, IA 50319

Re: Former Thermogas Company facility in West Chester, Iowa

Dear Mr. Lundberg:

At a meeting held in Departmental offices on April 9, 1996 relative to the sale of former Thermogas Company (Thermogas) facilities to CENEX/Land O'Lakes (CENEX), the Department requested that Thermogas submit specific pieces of phase I/II ESA information for all facilities at which groundwater exceedances had been detected. Per the Department's request, Thermogas submitted the requested information on April 23, 1996. Consequent to this submittal, on July 31, 1996, the Department issued a letter stating that no further action was required at the West Chester facility.

However, due to a prior contractual obligation between Thermogas and CENEX, Thermogas proceeded with a risk assessment of the property. Enclosed please find a copy of this report, entitled "Groundwater Risk Assessment, Thermogas Company, Lewis Access Road, West Chester, Iowa". Since the facility was never in the agrichemical business, no soil samples were taken during the phase I/II fieldwork.

The groundwater risk assessment determined that no risks exceed acceptable limits. Since the facility was never in the agrichemical business, the alachlor detection (not an exceedance) represents a background level.

In explanation of the new letterhead, on December 17, 1999, former owner WILLIAMS sold Thermogas Company to a third party. However, WILLIAMS retained responsibility for ongoing environmental work. I will therefore continue as your contact relative to current environmental concerns at the site.

WILLIAMS' intent in submittal of this letter and report is to obtain the Department's review relative to this information, requesting that a second (to that of July 31, 1996) finding of "no further action" be granted.

If there are any questions regarding this submittal, please call me at 918/573-6582.

Sincerely,

Steve W. Monn
Sr. Environmental Specialist

//
#766062900

c: Ms. Inez Lange
Land O'Lakes, Inc.
P. O. Box 64101
St. Paul, MN 55164

DATE STAMP

GROUNDWATER RISK ASSESSMENT
THERMOGAS COMPANY
LEWIS ACCESS ROAD
WEST CHESTER, IOWA

Submitted to:

Thermogas Company
1717 South Boulder Avenue
Tulsa, Oklahoma 74119

Submitted by:

IT Corporation
1801 Old Highway 8
Suite 124
St. Paul, Minnesota 55112

PROJECT NO. 769765

APRIL 1998

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List of Acronyms

ASTM	American Society for Testing and Materials
CASRN	Chemical Abstract Services Registry Number
COPC	Chemicals of potential concern
EPA	U. S. Environmental Protection Agency
ESA	environmental site assessment
GI	gastrointestinal
HI	Hazard Index
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
IT	International Technology Corporation
NCP	National Contingency Plan
NOAEL	no-adverse-effect-level
RfD	reference dose
RME	reasonable maximum exposure
SF	slope factor
Terracon	Terracon Environmental, Incorporated
Thermogas	Thermogas Company

Executive Summary

A baseline risk assessment was performed for the site located at West Chester, Iowa according to the statement of work described in the International Technology Corporation (IT) proposal to the Thermogas Company (Thermogas) dated July 19, 1996. The risk assessment incorporated information from Environmental Site Assessments (ESAs) conducted by Terracon Environmental, Incorporated (Terracon) and reported to Thermogas on March 13, 1996 (Terracon, 1996).

Based on knowledge of site operations, one groundwater sample was obtained from one soil boring located at the expected point of maximum contamination. Six pesticides were reported in the sample. Chemicals of potential concern (COPC) were identified using data that were assumed to have been validated and were used as such in this risk assessment. Alachlor and atrazine were identified as COPCs for the risk assessment.

The risk assessment was based on an industrial land-use scenario following the approach described by the American Society for Testing and Materials (ASTM) (ASTM, 1995) which is consistent with U. S. Environmental Protection Agency (EPA) guidance (EPA, 1989). Potential exposures of workers to alachlor and atrazine were evaluated for the groundwater ingestion pathway.

The baseline risk assessment indicates that estimated incremental lifetime cancer risks to on-site workers from potential exposures to alachlor and atrazine in groundwater are within target limits described as acceptable by the National Contingency Plan (NCP) (NCP, 1990). The Hazard Index (HI) calculated for exposures to alachlor and atrazine from the groundwater ingestion pathway was below the target value of 1.0 specified by the EPA (1989) and incorporated in ASTM (1995) methodology. Because soil samples from the West Chester, Iowa site were not analyzed, risks associated with potential exposures to chemicals in soil could not be evaluated.

1.0 Introduction

This report presents the findings of a baseline risk assessment performed according to the statement of work described in the IT Corporation (IT) proposal to the Thermogas Company (Thermogas) dated July 19, 1996. The risk assessment addresses the site located at West Chester, Iowa and incorporates information from Phase I and II Environmental Site Assessments (ESAs) conducted by Terracon Environmental, Incorporated (Terracon) and reported to Thermogas on March 13, 1996 (Terracon, 1996).

This risk assessment follows the approach described by the American Society for Testing and Materials (ASTM) (ASTM, 1995) which is also consistent with guidance provided by the U. S. Environmental Protection Agency (EPA) (EPA, 1989).

The purpose and scope of the risk assessment are described in Section 1.1. Background information related to the site is described in Section 1.2. The baseline risk assessment is described in Section 2.0. The conclusion of the risk assessment is described in Section 3.0.

1.1 Purpose and Scope

The purpose of this risk analysis is to support a request to the Iowa Department of Natural Resources for approval to take no further action at the West Chester, Iowa site. Such a request would be supported by results of the assessment which indicate that groundwater concentrations of chemicals reported in March 1996 meet levels of carcinogenic risk described as acceptable by the National Contingency Plan (NCP) (NCP, 1990) and limits of noncarcinogenic hazard specified by the EPA (1989).

The scope of the risk analysis includes a baseline risk assessment based on an assumed industrial land-use scenario for the site. Chemicals of potential concern (COPCs) were identified using groundwater analysis data that were assumed to have been validated and were used as such in this risk assessment. Potential exposures to these chemicals in groundwater were evaluated for workers at the site.

Potential intakes of these COPCs were combined with toxicity information for each chemical to provide a quantitative estimate of carcinogenic risk and noncarcinogenic hazard index (HI). These estimates were compared with target values of risk described as acceptable by the NCP (1990) and values of the HI specified by the EPA (1989) and incorporated in the ASTM (1995)

methodology. Uncertainties associated with the risk analysis were addressed to evaluate their impact on these risk estimates.

1.2 History and Uses of the Site

The site was described in detail in the Phase I and II ESA report (Terracon, 1996). The site was used as a propane distribution center between 1980 and 1984. The site formerly had approximately fifteen 20,000 bushel grain storage bins and a 18,000 gallon propane storage tank (Figure 1-1, Terracon, 1996). The site is currently occupied by an office building and a shop building. The office and shop buildings are currently used for equipment storage. The shop was used for vehicle maintenance. Based on information from interviews (Terracon, 1996), it is believed that no septic tank or water wells are located at the site.

1.2.1 Site Description

The site is located on Hemlock Avenue in the southeast portion of West Chester, Iowa. The site is in a rural area. A hiking trail along U. S. Highway 82 is located to the north. Agricultural crop land is located north of Highway 82 and a trucking firm is located to the northeast. Agricultural land is located on the south and west boundaries of the site. Old Highway 82 is located to the west of the site with a dwelling located across the highway (Figure 1-1, Terracon, 1996).

1.2.2 Summary of Phase I and Phase II Environmental Assessment Findings

One soil boring (Boring #1) was located near the former propane loading area and advanced to a depth of 25 feet (Terracon, 1996). Groundwater was encountered at approximately 20 feet. Soil samples were obtained but were not analyzed. One groundwater sample was obtained and analyzed. Six pesticides and ammonia and nitrate nitrogen were detected in the groundwater sample.

2.0 Baseline Risk Assessment

A baseline risk assessment was conducted to evaluate potential worker exposures to chemicals at the site. The risk assessment was based on conservative assumptions related to the use of analytical data, exposure assumptions, and toxicity information. These conservative assumptions are expected to lead to an overestimation of exposure and risk and, as such, they are designed to be protective of human health.

2.1 Data Evaluation and Selection of Chemicals of Potential Concern

Data reported from analysis of the groundwater sample collected in the Phase II ESA were assumed to have been validated (Terracon, 1996).

2.1.1 Analytical Data

The groundwater sample collected from the soil boring was analyzed for compounds of the Minnesota Department of Agriculture List I and II Pesticide Screens and for ammonia nitrogen and nitrate nitrogen (Terracon, 1996). Results of groundwater analysis (Table 2-1) indicate that alachlor, atrazine, butylate, cyanazine, triflurilin and deethylatrazine pesticides and ammonia and nitrate nitrogen were detected.

2.1.2 Selection of Chemicals of Potential Concern

COPCs were identified according to the following criteria:

- Chemicals not detected in any sample analyzed were excluded from the risk assessment.
- Chemicals reported in groundwater at concentrations below State of Iowa groundwater action levels [Iowa Administrative Code 567 (455B) Chapter 133] were excluded from the COPC list used to assess groundwater exposure.
- The maximum concentration reported for each chemical detected in groundwater was compared to the risk-based concentration derived from values provided by EPA Region 9 (EPA, 1996). A factor of 0.1 was applied to the EPA Region 9 values for noncarcinogens as a measure of conservatism in the COPC selection process.
- If the maximum concentration of a chemical exceeded the risk-based screening concentration, the chemical was retained as a COPC for the risk assessment for all routes of exposure involving that medium.
- If the concentration of a specific chemical did not exceed its risk-based screening concentration for groundwater, the chemical was excluded from the COPC list and was not considered further in the risk assessment.

Alachlor and atrazine were identified as a COPC site according to the selection criteria (Table 2-2).

2.2 Exposure Assessment

A conceptual site model based on an assumed industrial land-use scenario was developed to provide a basis for evaluating potential risks to workers' health at the West Chester site. The conceptual site model (Figure 2-1) shows the elements necessary to describe the complete pathway for exposure to chemicals in groundwater, including:

- sources of the COPCs
- release mechanisms
- transport pathways
- exposure pathways
- receptors.

Potential exposure of the on-site worker through ingestion of groundwater as drinking water is the exposure pathway of concern at this site.

2.2.1 Quantification of Groundwater Intake

Intakes of chemicals were calculated according to standard equations provided by EPA guidance (EPA, 1989 and ASTM, 1995). This guidance includes an evaluation of the "reasonable maximum exposure" (RME) estimate expected to occur. If the RME estimate is determined to be acceptable, then it is likely that all other lesser exposures at the site will be acceptable also. The RME estimates were evaluated using exposure parameters provided in EPA guidance for exposures to the groundwater pathway (EPA, 1989; EPA, 1991; ASTM, 1995). Exposure factors used to estimate the RME intakes are provided in Table 2-3. Calculations were performed using the *Tier 2 RBCA Toolkit* obtained from Groundwater Services, Inc., Houston, Texas.

The intake of contaminants in groundwater by ingestion was estimated using the measured groundwater concentration (Table 2-2) and the following equation (EPA, 1989; ASTM, 1995):

$$I_w = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT} \qquad (1)$$

where:

I_w = intake of a contaminant from water ingestion (mg/kg-day)
C_w = concentration of a contaminant in water (mg/L)
Ir_w = water ingestion rate (L/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)

2.3 Toxicity Assessment

The toxicity assessment weighs available evidence regarding the potential for particular contaminants to cause adverse effects in exposed individuals and provides, when possible, an estimate of the relationship between the extent of an exposure to a contaminant and the increased likelihood and/or severity of effects (EPA, 1989). A detailed discussion of the toxicity assessment, toxicity values, and the toxicological profiles for alachlor and atrazine are given in Appendix A.

2.4 Risk Characterization

The purpose of risk characterization is to integrate the exposure and toxicity assessments to generate quantitative expressions of risk. Quantitative estimates of carcinogenic risk and noncarcinogenic hazards associated with exposures to groundwater were performed in accordance with ASTM and EPA risk assessment guidelines (EPA, 1989; ASTM, 1995).

2.4.1 Calculation of Carcinogenic Risk

Cancer risk from exposures to a chemical carcinogen was estimated using the equation:

$$Cancer\ Risk_{i,p} = I_{i,p} \times SF_{i,p} \qquad (2)$$

where:

$Cancer\ Risk_{i,p}$ = lifetime cancer risk (unitless) from a chemical contaminant *i* for exposure by pathway *p*
$I_{i,p}$ = total daily intake of a contaminant *i* by pathway *p* (mg/kg-day)
$SF_{i,p}$ = slope factor ($[mg/kg\text{-}day]^{-1}$) for a chemical contaminant *i* for exposure by pathway *p*.

Cancer risk from exposure to multiple chemicals in each pathway (e.g., ingestion of soil) was estimated using the equation:

$$Pathway\ Cancer\ Risk_p = \sum_i Cancer\ Risk_{i,p} \quad (3)$$

where:

Pathway Cancer Risk$_p$ = Total lifetime cancer risk from all chemicals (unitless) in pathway *p*.

Lifetime cancer risk from exposures to all chemicals from all pathways was summed:

$$Lifetime\ Cancer\ Risk = \sum_p Pathway\ Cancer\ Risk_p \quad (4)$$

where:

Lifetime Cancer Risk = Total cancer risk from exposures to all chemicals (unitless) from exposures by all pathways.

For purposes of this risk assessment, the estimated lifetime cancer risk represents the cancer risk incurred in a lifetime from chronic exposure that is in excess of the risk to the unexposed general population. As such, it is termed the incremental lifetime cancer risk.

2.4.2 Calculation of Noncarcinogenic Hazard Index

The hazard quotient (HQ) is used to evaluate the noncancer effects of chemical contaminants. The HQ represents the ratio of the dose received by the exposed individual to the dose that is associated with no adverse effects (i.e., the threshold or reference dose).

The HQ for exposures to a chemical contaminant which has noncancer health effects was estimated using the equation below:

$$HQ_{i,p} = \frac{I_{i,p}}{RfD_{i,p}} \quad (5)$$

where:

$HQ_{i,p}$ = hazard quotient for chemical *i* for exposure by pathway *p* (unitless)
$I_{i,p}$ = total daily intake from exposures to chemical *i* by pathway *p* (mg/kg-day)

$RfD_{i,p}$ = reference dose for chemical *i* for exposure by pathway *p* (mg/kg-day).

The HI from exposure to multiple chemicals in each pathway (e.g., ingestion of soil) was estimated using the equation:

$$HI_p = \sum_i HQ_{i,p} \qquad (6)$$

where:

HI_p = hazard index for exposure to all chemicals (unitless) by pathway *p*.

Total HI from all exposures were summed:

$$Total\ HI = \sum_p HI_p \qquad (7)$$

where:

Total HI = total hazard index from exposures to all chemicals by all pathways (unitless).

2.4.3 Characterization of Carcinogenic Risk

Results of calculations of carcinogenic risk associated with exposure to alachlor in groundwater are shown in Table 2-4a. This estimated cancer risk was associated with potential ingestion of alachlor and atrazine in groundwater that was assumed to be used as a source of drinking water at the site (ASTM, 1995). The estimated carcinogenic risk associated (Table 2-4a) was within the target risk range described as acceptable by the NCP (1990).

2.4.4 Characterization of Noncarcinogenic Hazard Index

The HQ calculated for potential ingestion exposures to nitrate in groundwater (Table 2-4b) was below the target value of 1.0 specified by the EPA (1989).

2.4.5 Baseline Risk Assessment Summary

The estimated cancer risk for the groundwater ingestion pathway is within the target risk range of

10^{-6} to 10^{-4} (Table 2-4a). This estimated risk is primarily associated with potential exposure to atrazine. The estimated risk for potential exposure to alachlor is less than 10^{-6}. The ASTM methodology (1995) incorporates a target risk of 10^{-5} for Group C carcinogens such as atrazine (Appendix A). Because atrazine is a Group C carcinogen, the estimated risk from groundwater ingestion of atrazine (Table 2-4a) is below the target risk limit. The HI calculated for the groundwater ingestion pathway (Table 2-4b) is below the target HI of 1.0.

2.5 Uncertainty Analysis

Calculated risk estimates are subject to varying degrees of uncertainty from a variety of sources. These uncertainties can cause risks to be either overestimated or underestimated. Uncertainties associated with exposure and toxicity factors and target risk limits are specified by the risk assessment methodology used and reflect policy decisions to err on the side of conservatism (EPA, 1989; NCP, 1990; ASTM, 1995). As such, these methodological uncertainties tend to overestimate risk. Site-specific uncertainties are those associated with assumptions related to uses and characteristics of the West Chester site that could result in overestimates or underestimates of risk. In this risk assessment, these uncertainties were associated with assumptions related to the number of samples collected and land-use.

2.5.1 Number of Samples

Uncertainties are introduced in this risk assessment by the use of a single groundwater sample to assess risks for the entire site. Because trucks used the driveway to transfer propane at the 12,000 gallon storage tank, the Phase II sampling plan specified collection of a groundwater sample from a single boring located in the driveway near the propane tank (Figure 1-1).

The boring was located to sample the maximum expected concentration based on knowledge of site use. It is expected that any migration of chemicals to other locations would result in lower concentrations. As such, the uncertainties introduced by the use of data from one boring at this location as the basis for the risk assessment for the entire site are expected to result in a conservative overestimate of exposure.

Because soil samples obtained from the soil boring were not analyzed, no evaluation of risks associated with potential exposure to chemicals in soil was possible. Thus, the risk assessment contains uncertainties related to potential risks from the dust and vapor inhalation, soil ingestion and dermal contact pathways.

Information about historic uses of the site is available from interviews (Terracon, 1996). Although, this information indicates that bulk pesticides were not handled or stored at the site, six pesticides were detected in groundwater. Therefore, it is possible that fertilizer or pesticide chemicals might have contaminated soil at this site.

2.5.2 Land Use

In the industrial land-use scenario, it was assumed that an on-site worker will be exposed full time for 25 years at the West Chester site and that the groundwater concentrations of chemicals will remain at the maximum values measured in 1996 without diminishing with time. In addition, it was assumed that groundwater sampled at the site would be used as the source of drinking water for workers at the site during the 25 years of exposure, although it was reported that no drinking water supply is located at the site (Terracon, 1996). These conservative assumptions are expected to lead to an overestimation of exposure to chemicals in groundwater.

3.0 Conclusion

The baseline risk assessment indicates that estimated incremental lifetime cancer risks to on-site workers from potential exposures to alachlor and atrazine in groundwater are within target limits described as acceptable by the NCP (1990). Conservative estimates of noncancer toxicity hazards to workers from potential exposures to alachlor and atrazine in groundwater meet limits specified by the EPA (1989) and incorporated in the ASTM (1995) methodology. Because soil samples from this site were not analyzed, risks associated with potential exposures to chemicals in soil could not be evaluated at the West Chester, Iowa site.

4.0 References

American Society for Testing and Materials (ASTM), 1995. *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, ASTM E 1739-95, West Conshohocken, Pennsylvania.

National Contingency Plan (NCP) 1990. *Federal Register* 55[46]:8666-8865.

Terracon Environmental, Inc. (Terracon), 1996. *Phase I & II Environmental Site Assessment*, Project No. 45965004.E, White Bear Lake, Minnesota, March.

U. S. Environmental Protection Agency (EPA), 1989. *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual, Part A*, U.S. EPA, Office of Environmental and Remedial Response, EPA/540/1-89/002, December.

U. S. Environmental Protection Agency (EPA), 1991. *Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors."* U.S. EPA, Office of Emergency and Remedial Response, OSWER Directive 9285.6-03, March 25.

U.S. Environmental Protection Agency (EPA), 1996. *Region 9 Preliminary Remediation Goals (PRGs), 1996*, Prepared by S. Smucker, EPA Region 9, San Francisco, California, August.

TABLES

Table 2-1 Water Sample Analysis (Terracon, 1996)

Table 1 - Water Sample Analysis						
Thermogas Multi-Site Purchase						
West Chester, IA						
Terracon Project #45965004.E						
			Analysis Summary			
				Sample ID:	B-1-W	
				Lab ID:	285816	
				Date Sampled:	2/6/96	
				Date Reported:	2/19/96	
Analysis	Method	Units	MDL		Level	Action Level
MDA LIST #1	TOTAL				18.8	
Acetochlor	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Alachlor (Lasso)	EPA 507 MODIFIED	ug/L	0.4		1	0.4
Atrazine (Aatrex)	EPA 507 MODIFIED	ug/L	0.2		12.2	3
Butylate (Sutan)	EPA 507 MODIFIED	ug/L	0.2		2	350
Chlropyrifos (Dursban, Lorsban)	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Cyanazine (Bladex)	EPA 507 MODIFIED	ug/L	0.4		0.5	1
EPTC (Eptam, Eradicane)	EPA 507 MODIFIED	ug/L	0.3		<0.3	
Ethalfluralin (Sonalan)	EPA 507 MODIFIED	ug/L	0.4		<0.4	
Fonofos (Dyfonate)	EPA 507 MODIFIED	ug/L	0.2		<0.2	10
Metolachlor (Dual)	EPA 507 MODIFIED	ug/L	0.8		<0.8	70
Metribuzin (Sencor)	EPA 507 MODIFIED	ug/L	0.2		<0.2	100
Pendimethalin (Prowl)	EPA 507 MODIFIED	ug/L	0.4		<0.4	
Phorate (Thimet)	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Prometon (Pramitol)	EPA 507 MODIFIED	ug/L	0.3		<0.3	
Propachlor (Ramrod)	EPA 507 MODIFIED	ug/L	0.4		<0.4	90
Propazine (Milogard)	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Simazine (Princep)	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Terbufos (Counter)	EPA 507 MODIFIED	ug/L	0.5		<0.5	0.9
Triallate (Far-go)	EPA 507 MODIFIED	ug/L	0.4		<0.4	
Trifluralin (Treflan)	EPA 507 MODIFIED	ug/L	0.4		2	5
Deethylatrazine	EPA 507 MODIFIED	ug/L	0.2		1.1	
Deisopropylatrazine	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Ametryn	EPA 507 MODIFIED	ug/L	0.2		<0.2	
Prometryn	EPA 507 MODIFIED	ug/L	0.2		<0.2	

Table 2-1 Water Sample Analysis (Terracon, 1996) - continued

Table 1 - Water Sample Analysis						
Thermogas Multi-Site Purchase						
West Chester, IA						
Terracon Project #45965004.E						
			Analysis Summary			
					Sample ID:	B-1-W
				Lab ID:		285816
			Date Sampled:			2/6/96
			Date Reported:			2/19/96
Analysis	Method	Units	MDL		Level	Action Level
MDA LIST #2						
MCPP	MDA/AEP	ug/L	5		<10.	
Dicamba	MDA/AEP	ug/L	5		<10.	
MCPA	MDA/AEP	ug/L	5		<10.	
2,4-D	MDA/AEP	ug/L	5		<10.	70
Trichlopyr	MDA/AEP	ug/L	5		<10.	
2,4,5-TP	MDA/AEP	ug/L	5		<10.	
MCPB	MDA/AEP	ug/L	5		<10.	
2,4,5-T	MDA/AEP	ug/L	5		<10.	
2,4-DB	MDA/AEP	ug/L	5		<10.	
Chloramben	MDA/AEP	ug/L	5		<10.	
Picloram	MDA/AEP	ug/L	5		<10.	
NUTRIENT						
Ammoniacal nitrogen	EPA 350.2	mg/L	0.1		0.903	30
Nitrate nitrogen	EPA 300.0	mg/L	0.2		6.64	10

Table 2-2

Summary of Chemicals of Potential Concern at the West Chester Site
West Chester, Iowa

Chemical	Frequency of Detection	Maximum Concentration (ppm) [b]	Groundwater Action Level [a] (ppm) [b]	Screening Value (ppm) [b]	Exposure Point Concentration (ppm) [b]
Soil - No Soil Samples Taken at this Site					
Groundwater					
Ammonia	1/1	9.03E-01	3.00E+01	NV	Not a COPC
Nitrate	1/1	6.64E+00	1.00E+01	5.80E+00	Not a COPC
Alachlor (Lasso)	1/1	1.00E-03	4.00E-04	8.40E-05	1.00E-03
Atrazine (Aatrex)	1/1	1.22E-02	3.00E-03	3.00E-05	1.22E-02
Butylate (Sutan)	1/1	2.00E-03	3.50E-01	1.80E-01	Not a COPC
Cyanazine (Bladex)	1/1	5.00E-04	1.00E-03	8.00E-06	Not a COPC
Trifluralin (Treflan)	1/1	2.00E-03	5.00E-03	8.70E-04	Not a COPC
Deethylatrazine	1/1	1.10E-03	NV	NV	Not a COPC

a Iowa Administrative Code 567 (455B) Chapter 133 (not applicable to soil).
b Soil concentrations are in mg/kg. Groundwater concentrations are in mg/L.
NV = no value given

Table 2-3

Exposure Factors Used to Quantify Chemical Intake at the West Chester Site West Chester, Iowa

PATHWAY PARAMETER	EXPOSURE PARAMETER [a]
Ingestion of Potable Water	
Water Ingestion Rate (L/day)	1
Exposure Frequency (days/year)	250
Exposure Duration (years)	25
Body Weight (kg) (Adult)	70
Averaging Time-Noncancer (days)	9,125 [b]
Averaging Time-Cancer (days)	25,550 [c]

a Default parameters (ASTM, 1995) were used unless noted otherwise.
b Calculated as the product of ED (years) x 365 days/year.
c Calculated as the product of 70 years (assumed lifetime) x 365 days/year.

Table 2-4a

Intake and Carcinogenic Risk Associated with Groundwater Ingestion by Workers at the West Chester Site West Chester, Iowa

Chemical	Groundwater Concentration (mg/kg)	Total Carcinogenic Intake Rate (mg/kg/day)	Oral Slope Factor 1/(mg/kg-day)	EPA Weight of Evidence Classification [a]	Chemical Incremental Lifetime Cancer Risk	Pathway Incremental Lifetime Cancer Risk
INORGANIC - No inorganic Chemicals of Potential Concern were identified at this site.						
ORGANIC						
Alachlor	1.00E-03	3.5E-06	8.0E-02	B2	2.8E-07	
Atrazine	1.22E-02	4.3E-05	2.2E-01	C	9.4E-06	
Deethylatrazine	1.10E-03	3.8E-06	2.2E-01	C	8.5E-07	
TOTAL						1.1E-05

a See toxicological profiles for each chemical in Appendix A.

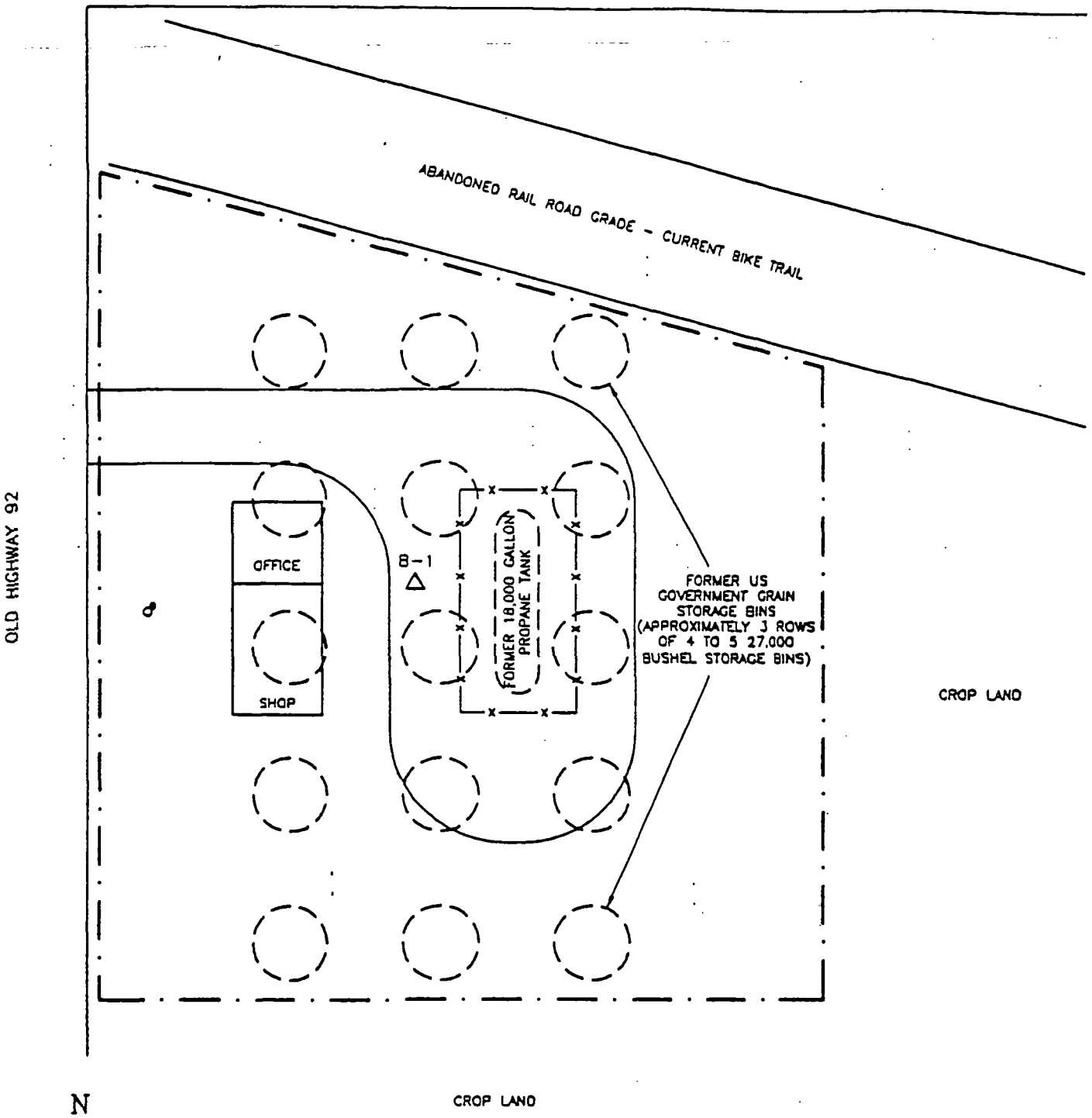
Table 2-4b

Intake and Hazard Quotient Associated with Groundwater Ingestion by Workers at the West Chester Site West Chester, Iowa

Chemical	Groundwater Concentration (mg/kg)	Total Toxicant Intake Rate (mg/kg-day)	Oral Reference Dose (mg/kg-day)	Hazard Quotient	Hazard Index
INORGANIC - No inorganic Constituents of Potential Concern were identified at this site.					
ORGANIC					
Alachlor	1.00E-03	9.8E-06	1.0E-02	9.8E-04	
Atrazine	1.22E-02	1.2E-04	3.5E-02	3.4E-03	
Deethylatrazine	1.10E-03	1.1E-05	5.0E-03	2.2E-03	
TOTAL					6.5E-03

NA = Not Applicable
ND = No Data Available

FIGURES



N

0 NTS

Approximate Scale (Feet)

LEGEND

— · — APPROXIMATE PROPERTY BOUNDARY

—x— FENCE

POLE-MOUNTED ELECTRICAL TRANSFORMER

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

RG MPP 3/5/96 Layers: ALL

SITE DIAGRAM
PHASE II ENVIRONMENTAL SITE ASSESSMENT
THERMOGAS MULTI-SITE PURCHASE
WEST CHESTER, IOWA

Project Mngr: JTH	Terracon ENVIRONMENTAL, INC.	Project No. 45965004.e	
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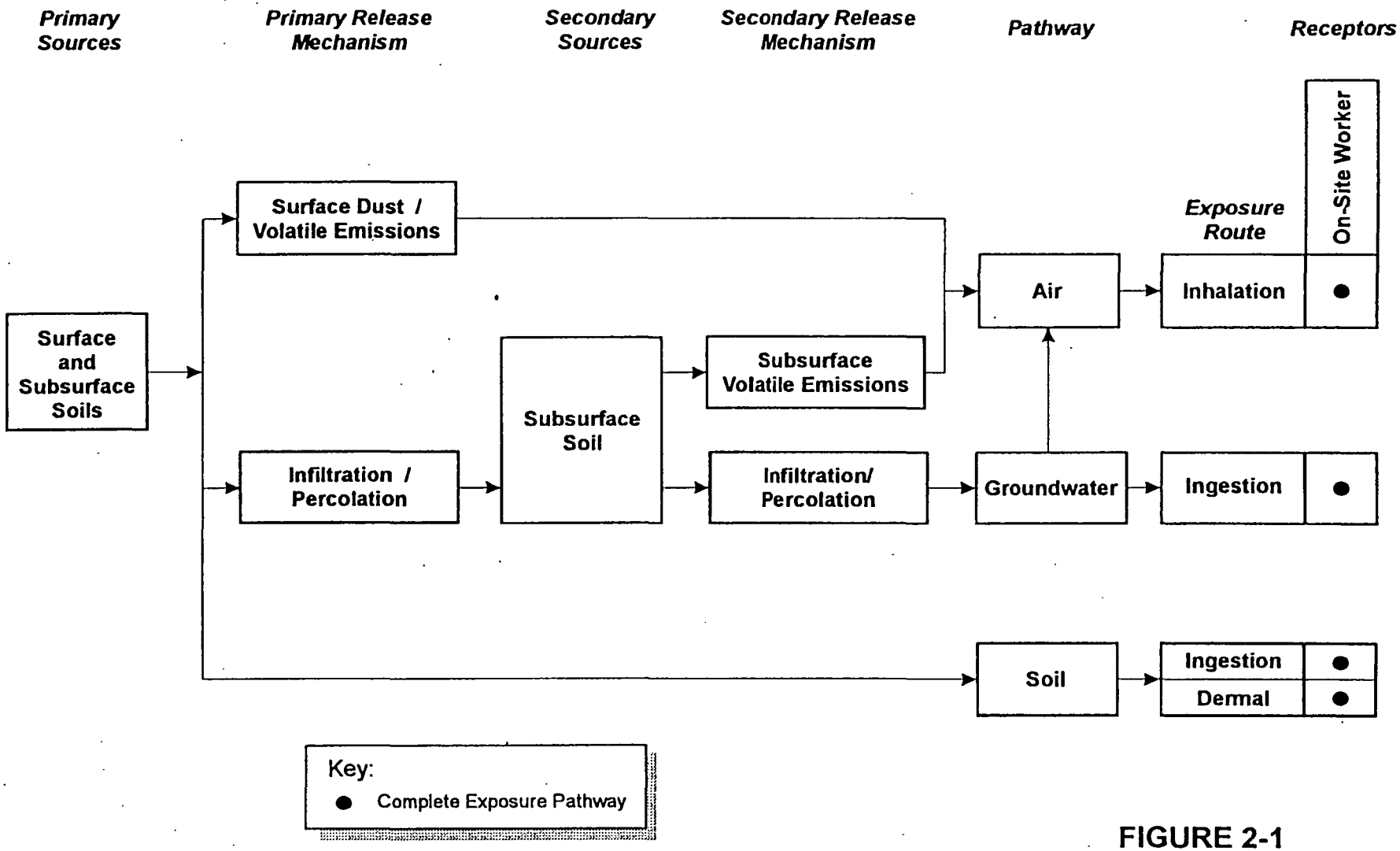

FIGURE 2-1

CONCEPTUAL MODEL FOR THE WEST CHESTER, IOWA SITE

INTERNATIONAL TECHNOLOGY CORPORATION

APPENDIX A

TOXICOLOGICAL PROFILES FOR CHEMICALS OF POTENTIAL CONCERN

Introduction

This section provides toxicological profiles for the chemicals selected as COPCs. Beside each commonly used chemical name is the Chemical Abstract Services Registry Number (CASRN), which is useful to locate information about chemicals such as these that may have multiple unrelated synonyms. Toxicological profiles are brief descriptions of the nature of the adverse effects associated with the COPCs selected for evaluation. It is important to note that a discussion of adverse effects without a discussion of dose is incomplete and potentially misleading, because virtually any chemical may be toxic at some dose, and many chemicals (e.g., nutritionally required minerals, vitamins, amino acids, etc.) enhance human health at some lower dose. An ever growing and compelling body of evidence suggests that many environmental contaminants also enhance health at low doses (Hart and Frame, 1996).

When sufficient data are available, the EPA Integrated Risk Information System (IRIS) (EPA, 1996) presents the EPA's RfD/RfC Work Group-verified chronic toxicity values for threshold, or noncancer, effects, and the Carcinogen Risk Assessment Verification Endeavor Work Group-verified toxicity values for cancer. The toxicity values for noncancer effects include a reference dose (RfD) expressed in mg/kg-day for chronic oral exposure. For cancer effects, IRIS presents an EPA cancer weight-of-evidence group classification that reflects qualitatively the likelihood that the chemical is carcinogenic to humans. IRIS also presents a slope factor (SF) for oral exposure, expressed as the risk per mg/kg-day ingested dose. These quantitative estimates are generally provided for chemicals in EPA weight-of-evidence Groups A and B and, if the data are adequate, Group C. Toxicity values for alachlor and atrazine are tabulated in Table A-1.

References

Hart, R.W. and L.T. Frame, 1996, "Toxicological Defense Mechanisms and How They May Affect the Nature of Dose-Response Relationships," *BELLE (Biological Effects of Low Level Exposure) Newsletter*, 5[1]: 1-16.

U.S. Environmental Protection Agency (EPA), 1996, *Integrated Risk Information System (IRIS)*, On-line, Environmental Criteria and Assessment Office, Cincinnati, OH.

Alachlor (CASRN 15972-60-8)

Alachlor is a preemergence herbicide of the acetanilide family used to control annual grasses and broadleaf weeds in corn, beans and peanuts (EPA, 1988; Sine, 1992).

Absorption data are limited to the statement that alachlor is absorbed from the gastrointestinal (GI) tract of rats treated by gavage, and is dermally absorbed by monkeys (EPA, 1988). Excretion data, however, suggest that at least 53 percent of an oral dose is absorbed by rats.

An acute oral LD_{50} of 930 mg/kg for technical alachlor is presented for rats (EPA, 1988; Montgomery, 1993). The dermal LD_{50} for rabbits is 13.3 g/kg (EPA, 1988). Inhalation LC_{50} values of greater than 5.1 mg/L (5.1 g/m^3) for an unreported exposure duration (EPA, 1988) and greater than 23.4 mg/L (23.4 g/m^3) for 6 hours (RSOC, 1983) were reported for rats, but the form of the test material was not described.

A verified RfD for chronic oral exposure of 1E-2 mg/kg-day is based on a no-adverse-effects-level (NOAEL) of 1 mg/kg-day in a 1-year study in which male and female dogs were dosed with the neat compound in gelatin capsules (EPA, 1996). The next higher dose, 3 mg/kg-day, was a lowest-adverse-effect-level associated with hemosiderosis in the liver and spleen. Hemosiderosis is an early manifestation of hemolytic anemia. Hematological evidence of hemolytic anemia was apparent in dogs dosed at 10 mg/kg-day. An uncertainty factor of 100 was applied to the NOAEL of 1 mg/kg-day to derive the oral RfD of 1E-2 mg/kg-day. The erythrocyte is the most sensitive target organ for oral exposure to alachlor.

Data regarding chronic inhalation and dermal toxicity were not located in the available literature.

Cancer data consist of an 18-month dietary study in mice of both sexes, and two, 2-year feeding studies in rats of both sexes (EPA, 1988). Female mice showed an increased incidence of bronchiolar lung tumors. Rats of both sexes showed increased incidences of nasal turbinate tumors, stomach tumors and thyroid follicular tumors. An additional study (presumably in rats) showed that exposure for as little as one-fourth the expected lifespan would yield tumor incidences similar to those observed in the 2-year studies. EPA (1988) classified alachlor in cancer weight-of-evidence Group B2 (probable human carcinogen) and estimated an oral SF of

8E-2 per mg/kg-day based on combined data from the two, 2-year rat studies. The oral SF 8E-2 per mg/kg-day is accorded provisional status by EPA (1995). Data were not located regarding the carcinogenicity of inhalation exposure to alachlor.

References for Alachlor

Montgomery, J.H., 1993, *Agrochemicals Desk Reference, Environmental Data*, Lewis Publishers, Ann Arbor, MI, pp. 7-9.

Royal Society of Chemistry (RSOC), 1983, *The Agrochemicals Handbook*, RSOC, Nottingham, England, p. A004.

Sine, C., 1992, *Farm Chemicals Handbook*, Meister Publishing Co., Willoughby, OH, p. C-14.

U.S. Environmental Protection Agency (EPA), 1988, *Health Advisory for Alachlor*, Office of Drinking Water, February.

U.S. Environmental Protection Agency (EPA), 1995, *Health Effects Assessment Summary Tables* (HEAST), FY-1995 Annual, Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Publication 9200.6-303 (95-1), EPA/540/R-95/036, NTIS No. PB95-921199.

U.S. Environmental Protection Agency (EPA), 1996, *Integrated Risk Information System (IRIS)*, On-line, Environmental Criteria and Assessment Office, Cincinnati, OH.

Atrazine (CASRN 1912-24-9)

Atrazine is a chlorinated triazine herbicide used for the nonselective control of weeds on industrial or uncropped land, and used for selective season-long weed control in corn, sorghum, sugar cane, and several other crops (EPA, 1988; Sine, 1992).

Urinary excretion and tissue distribution data following gavage administration of radiolabeled compound suggests that atrazine is readily absorbed by the GI tract (EPA, 1988). In rats treated with 0.53 mg atrazine, fecal excretion accounted for 20.3 percent of the administered dose, urinary excretion accounted for 65.5 percent, and radioactivity retained in the tissues accounted for 15.8 percent. These results suggest that at least 80 percent of the administered dose was absorbed. Atrazine is readily metabolized, and it is plausible that a portion of the fecal radioactivity represents metabolites formed systemically, following absorption from the GI tract, and subsequently excreted by the gut.

Acute oral LD_{50} values for technical atrazine range from 672 to greater than 3000 mg/kg in rats and mice (EPA, 1988; Sine, 1992). Cattle and sheep fed high doses of atrazine show anorexia, salivation, depression, muscle spasms and fasciculations, ataxia, increased body temperature and dyspnea, indicating the nervous system is the target organ system for acute oral exposure. Data regarding the acute inhalation toxicity of atrazine were not located. An acute dermal LD_{50} for adult rats is greater than 2500 mg/kg (EPA, 1988). A dermal LD_{50} in rabbits of 7500 mg/kg was reported, but it is unclear if the test material was technical grade or a formulation of atrazine (RSOC, 1983). Short-term dermal exposure of humans and animals induces skin irritation and sensitization, and contact dermatitis.

A chronic oral RfD of 3.5E-2 mg/kg-day was derived from a NOAEL of 3.5 mg/kg-day in a 2-year dietary study in rats (EPA, 1996). Higher dose levels were associated with decreased body weight gain, reduced liver and kidney weights, muscle degeneration, liver necrosis, and altered hematologic and blood chemistry parameters. The liver and erythrocyte appear to be the target organs for the critical effect of chronic oral administration of atrazine to rats. Application of an uncertainty factor of 100 to the NOAEL of 3.5 mg/kg-day yields an RfD of 3.5E-2 mg/kg-day. A 1-year dietary study in dogs clearly identified the heart as the target organ in this species.

Data regarding the chronic inhalation toxicity of atrazine were not located in the available literature.

As noted above, dermal exposure of animals and humans may induce contact dermatitis and sensitization. Data regarding systemic effects subsequent to dermal exposure were not located. The effects observed following oral exposure do not appear to model the critical noncancer effects of dermal exposure; therefore, it is deemed inappropriate to estimate a dermal RfD from the oral RfD.

The carcinogenicity of atrazine was studied in two strains of mice and one strain of rats (EPA, 1988). Dietary administration to mice for 18 or 21 months yielded no evidence of an increased incidence of tumors. A 2-year dietary study in rats, however, showed increased incidence and decreased latency of mammary gland tumors in the females. EPA (1988) classified atrazine in cancer weight-of-evidence Group C (possible human carcinogen), largely on the basis of the increased incidence of mammary gland tumors in female rats. EPA (1988) also noted that propazine, terbutryn and simazine, which are structurally similar to atrazine, are also associated

with mammary gland tumors in rats, and are also classified in Group C. EPA (1988) did not derive a SF for oral exposure to atrazine. EPA (1995), however, derived an oral SF of 2.22E-1 per mg/kg-day based on the incidence of mammary tumors in female rats. The EPA (1995) oral SF is rounded to 2.2E-1 per mg/kg-day to reflect the usual precision about a SF.

References for Atrazine

Royal Society of Chemistry (RSOC), 1983, *The Agrochemicals Handbook*, RSOC, Nottingham, England, p. AO23.

Sine, C., 1992, *Farm Chemicals Handbook*, Meister Publishing Co., Willoughby, OH, p. C-31.

U.S. Environmental Protection Agency (EPA), 1988, *Health Advisory for Atrazine*, Office of Drinking Water, August.

U.S. Environmental Protection Agency (EPA), 1995, *Health Effects Assessment Summary Tables* (HEAST), FY-1995 Annual, Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Publication 9200.6-303 (95-1), EPA/540/R-95/036, NTIS No. PB95-921199.

U.S. Environmental Protection Agency (EPA), 1996, *Integrated Risk Information System (IRIS)*, On-line, Environmental Criteria and Assessment Office, Cincinnati, OH.

Deethylatrazine (CASRN 6190-65-4)

Deethylatrazine is an environmental and mammalian metabolite of atrazine (EPA, 1988a; HSDB, 1996).

Atrazine and deethylatrazine appear to have several characteristics in common. Both are fairly persistent in the environment and may inflict damage on crops that are sensitive to atrazine (HSDB, 1996). In mammalian species, both bind preferentially to erythrocytes, but not to other tissues (EPA, 1988a). Both may induce ocular and skin irritation (HSDB, 1996). When injected into rat mothers during pregnancy only or during pregnancy and lactation, both atrazine and deethylatrazine retard pituitary-gonadal development of male and female offspring.

Data regarding the GI, inhalation and dermal absorption of deethylatrazine were not located in the available literature. The default GAF of 0.9 and ABS of 0.01 for organic chemicals, which were used for atrazine, are also used for deethylatrazine.

Data regarding the toxicity of acute or chronic oral, inhalation or dermal exposure of humans or experimental animals to deethylatrazine were not located in the available literature. Toxicity summaries and oral reference doses, however, are available for four other structurally similar chlorinated triazine herbicides:

- Atrazine: oral RfD of 3.5E-2 mg/kg-day, based on a NOAEL of 3.5 mg/kg-day for effects on the erythrocyte and liver in rats and cardiac toxicity in dogs (EPA, 1997). The LOAEL is 25 mg/kg-day.

- Cyanazine: oral RfD of 2E-3 mg/kg-day, based on a NOAEL of 0.7 mg/kg-day for effects on the erythrocyte and liver in dogs (EPA, 1998b). The LOAEL is 3.1 mg/kg-day.

- Simazine: oral RfD of 5E-3 mg/kg-day based on a NOAEL of 0.52 mg/kg-day for effects on the erythrocyte in rats (EPA, 1987a; 1996). The LOAEL is 5.3 mg/kg-day.

- Propazine: oral RfD of 2E-2 mg/kg-day based on a NOEL of 5 mg/kg-day for reduced body weight gain in rats (EPA, 1987b; 1996). The LEL was 50 mg/kg-day.

The effects of exposure to any of the chlorinated triazines discussed above appear to be similar; except that propazine has no apparent effect on the erythrocyte. Cyanazine and simazine appear to be somewhat more toxic than atrazine or propazine. Of the former, deethylatrazine is morphologically more similar to simazine than cyanazine. In the absence of more appropriate guidance, the oral RfD of 5E-3 mg/kg-day for simazine based on effects on the erythrocyte is adopted as the oral RfD for deethylatrazine for the purposes of this evaluation.

Data regarding the carcinogenicity of exposure of humans or experimental animals to deethylatrazine were not located in the available literature. Cancer data summaries and oral SFs, however, are available for four structurally similar chlorinated triazine herbicides:

- Atrazine: cancer weight-of-evidence Group C (possible human carcinogen); oral SF of 2.2E-1 per mg/kg-day, based on an increased incidence of mammary tumors in female rats fed diets containing the test compound (EPA, 1988a; 1995).

- Cyanazine: cancer weight-of-evidence Group C (possible human carcinogen); oral SF of 8.4E-1 per mg/kg-day, based on an increased incidence of mammary tumors in female rats fed diets containing the test compound (EPA, 1988b; 1995).

- Simazine: cancer weight-of-evidence Group C (possible human carcinogen); oral SF of 1.2E-1 per mg/kg-day, based on an increased incidence of mammary tumors in female rats fed diets containing the test compound (EPA, 1987a; 1995).

- Propazine: cancer weight-of-evidence Group C (possible human carcinogen) based on an increased incidence of mammary tumors in female rats fed diets containing the test compound; an oral SF, however, was not estimated (EPA, 1987b).

The tumor type and cancer potency of exposure to any of the chlorinated triazines discussed above appear to be similar. Of the four, deethylatrazine is morphologically more similar to atropine or simazine or propazine, than to cyanazine. In the absence of more appropriate guidance, the oral SF of 2.2E-1 per mg/kg-day for atrazine is chosen over the oral SF for simazine, only because this is the more conservative approach.

References for Deethylatrazine

Hazardous Substance Data Bank (HSDB), 1996, on-line data base from the National Library of Medicine.

U.S. Environmental Protection Agency (EPA), 1987a, *Health Advisory for Simazine*, Office of Drinking Water, August.

U.S. Environmental Protection Agency (EPA), 1987b, *Health Advisory for Propazine*, Office of Drinking Water, August.

U.S. Environmental Protection Agency (EPA), 1988a, *Health Advisory for Atrazine*, Office of Drinking Water, August.

U.S. Environmental Protection Agency (EPA), 1988b, *Health Advisory for Cyanazine*, Office of Drinking Water, August.

U.S. Environmental Protection Agency (EPA), 1995, *Health Effects Assessment Summary Tables* (HEAST), FY-1995 Annual, Office of Solid Waste and Emergency Response, Washington, D.C., OSWER Publication 9200.6-303 (95-1), EPA/540/R-95/036, NTIS No. PB95-921199.

U.S. Environmental Protection Agency (EPA), 1997, *Integrated Risk Information System (IRIS)*, On-line, Environmental Criteria and Assessment Office, Cincinnati, OH.

Table A-1

Toxicity Values for Chemicals of Potential Concern at the West Chester Site
West Chester, Iowa

Chemical	Cancer Weight-of-Evidence Group	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Oral Reference Dose (mg/kg-day)	Inhalation Reference Dose (mg/kg-day)	Dermal Reference Dose (mg/kg-day)
INORGANIC CHEMICALS - No inorganic Constituents of Potential Concern were identified at this site.							
ORGANIC CHEMICALS							
Alachlor (Lasso)	B2	8.0E-02	ND	NA	1.0E-02	ND	NA
Atrazine (Aatrex)	C	2.2E-01	ND	NA	3.5E-02	ND	NA
Deethylatrazine	C	2.2E-01	ND	2.4E-01	5.0E-03	ND	4.5E-03

NA = Not Applicable
ND = No Data