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Subject: Drinking Water Exposure Assessment for Acetochlor Usage on Sorghum

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Executive Summary

Attached is the EFED drinking water exposure assessment for use of acetochlor on sorghum. This assessment covers only parent compound because the Health Effects Division has previously determined that the toxicological endpoints for the degradates are distinct from parent acetochlor and that the levels in drinking water are not of concern (Acetochlor HED Chapter of the Tolerance Reassessment Document (TRED): DP Barcodes D306535, DP292338; 7/22/05).

Raw drinking water concentrations are provided using EFED's standard evaluation scenarios with the PRZM-EXAMS models. Additionally, this document puts the EFED standard assessment methods using the PRZM-EXAMS models in context with observed monitoring data reflecting a

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previously registered use of acetochlor (on corn). It presents a new exposure assessment method incorporating GIS analysis of spatially and temporally detailed usage data and monitoring results to determine acetochlor-specific watershed "loading factors" for watersheds of various characteristics (crop intensity, weather patterns, and hydrogeology).

The purpose of this exercise is to determine if the watersheds where acetochlor is likely to be used on sorghum are more or less vulnerable than the watersheds where acetochlor is used on corn. This analysis clearly shows that the watersheds where acetochlor is used on sorghum have much lower vulnerability than the watersheds where acetochlor is used on corn. Only as a worst-case scenario could the sorghum use result in an equal level of drinking water exposure. Therefore, while not providing specific exposure estimation, we can safely say that there is a very low probability of exposure from the proposed sorghum use exceeding those previously estimated for corn. These conclusions are based on lower crop intensity for sorghum than corn and would change if the cropping patterns and resultant usage patterns change substantially.

A summary of the PRZM-EXAMS results is presented Table 1. These represent the exposure values for a first tier risk assessment for the proposed use of acetochlor on corn.

Table 1. Summary of EDWCs for usage of Acetochlor on Sorghum

Exposure Assessment Methodology	Acute Conc (ug/L)	1/10 Year Chronic Conc (ug/L)	Cancer/ Chronic Conc (ug/L)
PRZM/EXAMS	42.4	4.11	2.13

These estimates are based upon the results of a single PRZM-EXAMS standard scenario for estimation of exposure from pesticides used on sorghum crops. In the totality of assumptions made for this scenario these exposure numbers are expected by EFED to represent upper bound exposure. Modeling inputs and assumptions are discussed further in the text of the Drinking Water Assessment.

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Drinking Water Exposure to Acetochlor from a proposed use on Sorghum for Grain or Forage

1. <u>PROBLEM FORMULATION</u>

The approach for assessing drinking water exposure accounts for the fact that pesticide concentrations found in drinking water are not random, but are in large part determined by the amount, method, timing and location of pesticide application, the physical characteristics of the watersheds in which the community water supplies (CWS) are located, and other environmental factors, such as rainfall, which can cause the pesticide to move from the location where it was applied. The choice of data and tools to estimate the drinking water exposure component of the exposure depends upon the questions to be answered and the expected exposure in water.

Risk is a function of both hazard and exposure, and estimation of the exposure portion for drinking water requires data on concentrations of the pesticides in the drinking water and consumption of drinking water for different demographic populations on a daily basis. Drinking water is locally derived and concentrations of pesticides in source water fluctuate over time and location for a variety of reasons. Pesticide residues in water fluctuate daily, seasonally, and yearly as a result of the timing of the pesticide application, the vulnerability of the water supply to pesticide loading through runoff, spray drift and/or leaching, and changes in the weather. Concentrations are also affected by the method of application, the location and characteristics of the sites where a pesticide is used, the climate, and the type and degree of pest pressure.

A previous risk assessment work has raised the possibility that predicted exposure levels could end up being at levels presenting some risk to human health. Therefore it was determined that this assessment may benefit by additional characterization of extensive monitoring data on corn and comparing the vulnerability of watersheds where acetochlor is used on sorghum and field corn.

Although there is a significant amount of targeted acetochlor monitoring data which has been collected by the Acetochlor Registration Partnership (ARP) at drinking water intake locations in areas of intensive usage of acetochlor; this reflects only the historical usage on corn. In concert with risk assessors in the Health Effects Division (HED) it was determined that a refined exposure analysis was needed and that it should be based primarily on the unusually detailed and well-characterized monitoring data that were available representing the existing use on corn. EFED is unable to base this exposure assessment directly on the existing monitoring database, extensive as it is, because:

1. The proposed use on sorghum is for a crop with no previous registrations and hence no monitoring data are available that directly represent the proposed use.
2. The lack of raw water sampling at the majority of the ARP monitoring sites makes extrapolation of the results to new use areas more problematic (because of some uncertainty about water treatment efficiency from site to site and because most of the most vulnerable CWS were sampled for finished water only).

For the new uses EFED has PRZM-EXAMS standard modeling scenarios for estimation of drinking water exposure levels. However, EFED has taken advantage of the available monitoring data for acetochlor with unusually detailed (temporally and spatially) usage data (based upon a large body of monitoring data linked to generally available information on weather, hydrogeology, and local usage) to provide some contextual understanding of the modeling results. An extrapolation method was derived to look at expected exposure distributions for any proposed new uses of acetochlor.

Monitoring data provide a picture of the occurrence of acetochlor in drinking water resulting from variable use in selected locations. To be useful in a drinking water exposure characterization, monitoring data must be well-characterized in the context of use and other factors, of sufficient sampling intensity and duration, and matched with watersheds with significant use of the pesticide of interest and with real or plausible future drinking water intake sites. The available acetochlor monitoring data from a Acetochlor Registration Partnership (ARP) study of surface water intakes (7 years of monitoring from approximately 175 drinking water sites at a frequency of about 14 times per year) meets many of these characteristics and therefore the monitoring data, although they represent usage on a different crop than are being proposed are useful for examining the reasonableness of the PRZM-EXAMS results. This is especially true when monitoring is analyzed watershed by watershed, year by year in the context of watershed-specific usage patterns to adjust the monitoring results and extrapolate them to other usage scenarios on new crops.

2. CONCEPTUAL MODEL

Drinking water exposure will vary locally as a result of pesticide use, agricultural practices, nature and vulnerability of drinking water sources, and weather patterns. However, drinking water risk assessment do not necessarily need these factors which vary locally if upper bound exposure levels as estimated with standard Tier I screening level procedures do not reach a level of concern for the relevant toxicological endpoint(s). It is also expected that the analysis of the existing monitoring data (reflecting a use on corn) and the supplemental methods to compare the vulnerabilities of watersheds where acetochlor is used in sorghum and corn are sufficient to provide some indication of the reasonableness of EFED's upper-bound exposure estimates; these analyses further serve as an indicator as to whether Tier II refinements of the exposure estimate might lower the exposure estimates associated with the proposed sorghum use (important should the Tier I estimates of exposure exceed a level of concern). .

3. ANALYSIS PLAN

3.1. Acetochlor Environmental Fate and Transport Characterization

Table 2 summarizes the environmental fate and physical-chemistry properties for acetochlor based on submitted guideline studies. Reviews of individual studies can be found in previous Environmental Fate Assessments (e.g., 1994, DP Barcode D197606), the source MRIDs are also provided in Table 2. Parent acetochlor is moderately soluble in water (233 mg/l), moderately to highly mobile in soil (K_d values of 0.2-23 ml/g), and moderately persistent in soil (aerobic soil pseudo first-order half-lives of 10-20 days: upper 90th percentile half-life = 13.3 days).

For this assessment, the aerobic soil metabolism half-lives were calculated from the raw data (MRIDs 0064805 and 41565147) since the values reported in earlier reviews were inexact and did not discuss deviations from first order kinetics. First-order log-linear regression was used to calculate the half-lives, however, there were typically systematic deviations from first order kinetics (marked slowing of the degradation rate) within 3 to 6 months after application; consequently the last 1 to 3 sampling events were ignored in the half-life calculations (greatly improving the first-order model fit and reducing systematic deviations from the model) that were ultimately used as the basis of input for the PRZM model. A conservative approach was used for selection Freundlich soil partitioning coefficients (K_d and K_{oc}) in that the lowest Koc determined for a non-sand soil was used. Important factors in this decision was the high variability in both K_d and K_{oc} values and uncertainty about the representativeness of the test soils for acetochlor United States use areas.

Some degradates (not included in this exposure assessment) are expected to have even higher mobility and greater persistence based on structural features and laboratory results and can be persistent (refer to the "Acetochlor Drinking Water Assessment" (11/20/05: DP Barcode: D292329) for further details.

Table 2. General fate and physical-chemistry data for acetochlor – as used for model input.

Parameter	Value	Source
Molecular Weight (g/mole)	269.77	Product chemistry
Solubility (25° C) (mg/l)	233	Product chemistry
Vapor Pressure (25° C) (torr)	2.8e-5	Product chemistry
Hydrolysis Half-life (25° C) (days) pH 3 pH 6 pH 9	stable	MRIDs: 00064805, 41565144, 41613301
Aqueous Photolysis Half-life (days)	Stable	MRIDs: 00131388, 41565145
Soil Photolysis Half-life (days)	Stable	MRIDs: 00131388, 00160233, 41565146
Aerobic Soil Metabolism Half-life (days)	13.3[1]	MRIDs: 00064805, 41565147, 41613301, 41963316, 41963317
Aerobic Aquatic Metabolism Half-life (days)	26.6[2]	2 x Aerobic Soil Metabolism Half-life
Anaerobic Aquatic Metabolism Half-life (days)	251[3]	MRIDs: 41338501, 41565148, 41613301, 41963318
Organic Carbon Partitioning Coefficient (K_{oc}, L/kg)	139[4]	MRIDs: 00031329, 00064805, 41338502, 41565149, 41613301, 41963319
Soil Partitioning Coefficient (k_d, L/kg)	Range is 0.19 to 23.2[5]	
Bioconcentration Factors (BCF)	No data	

[1] Based upon upper confidence interval of mean of four studies (Attebury, Ray, Drummer, and Spinks soils). Per EFED Input Parameter Guidance Document. Half-life range was 10 to 20 days.

[2] No aerobic aquatic study available. Guidance Document.
[3] Based upon average half-life of anaerobic soil metabolism studies (multiplied by 2 per Input Parameter
[4] Range is 12.5 to 290 in ten soils.
[5] Spinks (2.4% OM) = 0.30, Sarpy (0.9% OM) = 0.34, Drummer (3.4% OM) = 0.69, Ray (1.2% OM) = 0.29, Lily field (0.77% OM) = 0.19, Frensham (1.9% OM) = 1.48, East Jubiliee (2.6% OM) = 2.16, Old Paddock ((5.4% OM) = 4.37, French A (1.5% OM) = 2.8, and French B (8.0% OM) = 23.2

Table 3. Description of important assumptions underlying acetochlor parent exposure estimates for the requested use on sorghum.

Factor	Assumption	Comment
Application rate	2.5 lb ai / A	This is the maximum rate allowed, lower rates are proposed for use of acetochlor as a part of a herbicide mixture or for certain target weeds.
% Crop Area in Watershed (PCA)	0.80	EFED regional PCA value. If other acetochlor usage sites are considered: Combined sorghum and corn acreage on a county basis can approach but not exceed 60% and most of the highest PCA values occur in counties with high corn acreage and relatively small sorghum acreage (based on the 2002 Census of Agriculture data). However, without reconnaissance surveys of all Community Water System (CWS) watersheds, it cannot be known whether some smaller watersheds have more intense planting to sorghum.
% Crop Treated	100%	Historically, similar herbicides have been applied to significantly less than 100% of sorghum acreage annually; the percentage treated could end up being significantly lower than assumed here. However, to assure exposure is not underestimated for future uses, our standard approach for Tier II PRZM/EXAMS modeling is to assume 100% crop treated due to the uncertainties regarding future usage patterns.
Exposure Distribution (Relative Site Vulnerability)	90th Percentile	Assumes that the combination of weather and land surface conditions on average results in an exposure level observed in less than 10% of CWS. This assumption may result in either an overestimate or underestimate of actual exposure. This is not strictly verified for the PRZM-EXAMS scenario (site), but other assumptions are likely to add sufficient conservatism to the modeling.
Water Treatment	Not treated	Activated carbon treatment systems may lower acetochlor parent concentration in finished drinking water by 60% or more. There is, however significant variability in the efficiency of removal of acetochlor by the treatment systems employed in different CWS and the acetochlor removal efficiency in practice (this appears to be a function of more than just whether a particular type of activated carbon filtration is used, e.g.) for particular CWS with their treatment systems is unknown.

3.2. Conservative Elements and Uncertainties of This Assessment

The basis for this sorghum assessment is different from the basis of the Agency assessment of acetochlor usage on corn. The assessment on corn is based on multiple years of monitoring data and is therefore a direct estimate of the actual exposure at those sites during that time period. The assessment on sorghum is based upon EFED's model for this purpose – PRZM-EXAMS as applied to a single standard scenario for sorghum production in Kansas. Characterization of the probable degree of conservatism of the modeling (i.e., how much lower actual concentrations may be) is provided by analysis of the existing monitoring data for CWS watersheds in acetochlor use areas and extrapolatory methods based upon the range of observed concentrations in drinking water per unit use of acetochlor in the watershed.

The most significant uncertainty with regards to the PRZM-EXAMS model based assessment for sorghum relates to the amount of acetochlor assumed to be applied in the sorghum watersheds. For purposes of this assessment, the Agency has assumed that all planted sorghum will be treated at the maximum 2.5 pounds active ingredient per acre permitted by the label and that the eventual market share could reach 100% in terms of the usage inputs for the PRZM/EXAMS model. EPA has also assumed a crop area factor of 80% in the watershed based upon the maximum percent agricultural crop areas in HUC-8 watersheds in the region modeled.

Actual acetochlor concentrations may be less than those projected in this assessment to the extent that growers use less than the maximum labeled 2.5 pound per acre, the percent sorghum acres treated with acetochlor is less than 100%, and the percent area of crops with acetochlor registrations in the watershed is less than 80%. However, EFED believes that, with the still limited information available on highly local usage patterns for pesticides (e.g., in watersheds of a few hundred to a few thousand acres) it is not possible to determine with confidence what the highest percent crop treated in one of these watersheds will be (and most of the available historical usage data for competitive herbicides that acetochlor might take market share from with sorghum are available only to a state-level resolution). Similarly, it cannot be assumed that the average rate of acetochlor application per treated acre will be less than the maximum label rate in some smaller CWS watersheds. To the extent sorghum production intensity has been spatially resolved (including sorghum production acreage by county and row crop area by CWS watershed) we do know the following

- The highest percent sorghum acreage in any US county is 31.4% (Nueces County, Texas; from the 2002 Census of Agriculture).
- The highest estimated percent sorghum acreage in any of 1604 CWS watersheds we evaluated by GIS procedures was 7.8%
- The highest percent crop area for all existing and proposed registrations of acetochlor in any US county is 56.1% (for Hamilton County, Nebraska; almost all of the crop area here for acetochlor is taken up by field corn, a previously registered use site).

The above statistics suggest there is some potential for reductions in the assumed watershed usage rates for PRZM-EXAMS modeling when and if more spatially explicit crop area data become available.

EFED has also assumed, according to our established regional crop area factors, that 80% of the watershed was composed of sorghum acreage (http://www.epa.gov/oppefed1/models /water/regional_pca.htm). This compares to 7.8% being the highest known % crop area for sorghum in 1604 CWS we evaluated, 31.4% as the highest % sorghum planted in any US county according to the 2002 US Census of Agriculture, and 56.1% being the highest combined acetochlor crop area (corn and sorghum) for any US county according to the 2002 census (there is also a third crop site, sweet corn, with a registration application pending, but crop areas are much lower for this potential use site).

The sorghum assessment may be more conservative than the previously completed corn assessment due to the uncertainty in the sorghum loading estimate (2.5 pounds per acre and 100% eventual market share) which represents maximum possible usage. The corn exposure assessment was based upon CWS monitoring results associated with usage patterns for corn that represented much lower total watershed application amounts than the maximum amount that would be possible with usage assumptions that were necessary for the sorghum assessment.

3.3. Exposure Characterization

Prediction of drinking water exposure to pesticides from new uses is always difficult because of factors such as the many unknowns with regards to how a pesticide will actually be used, variances in pesticide environmental behavior that may occur from what is predicted from existing environmental fate studies and product chemistry data, new variances in weather patterns, and adoption of different agronomic practices that influence the pesticide's fate. In turn, all of these factors may influence the accuracy of exposure predictions with models such as PRZM-EXAMS (as well uncertainties about the model's ability to simulate reality with different pesticides applied under an infinite variety of real-world conditions). The exposure predictions in this document have been put in extensive context by use of the following:

- Comparison to an extensive array of monitoring data from a statistically designed survey of CWS reflecting previously registered uses for acetochlor.

- A GIS-based method to extrapolate from the previous acetochlor monitoring results to predict a range of exposure levels possible from the new sorghum use under various scenarios for watershed-level usage.

4. EXPOSURE ASSESSMENT

4.1. Assessment Methodology

4.1.1. PRZM-EXAMS Standard Scenario Modeling

EFED uses the linked Pesticide Root Zone Model /Exposure Analysis Modeling System (PRZM/EXAMS) environmental fate and transport computer models to calculate EDWCs. PRZM simulates pesticide surface water runoff on daily time steps, incorporating runoff, infiltration, erosion, and evaporation. The model calculates foliar dissipation and runoff, pesticide uptake by plants, soil microbial transformation, volatilization, and soil dispersion and retardation. The EXAMS model simulates pesticide fate and transport in an aquatic environment (one hectare body of water, two meters deep with no outlet). It is assumed that additions to the reservoir from rainfall and runoff are equally balanced by evaporation losses.

The EDWCs used in the assessment have both an average magnitude and a duration over which that average magnitude is calculated. Concentration values chosen for use in the assessment for exposure periods of 1, 4, or 365 days are those that would be expected to be equaled or exceeded only once every ten years based on the 30-year weather history at the site. Lifetime exposure is calculated from the time-weighted exposure over the entire 30-years of the simulation (and hence no probability value is assigned to this endpoint).EFED uses the EDWCs for assessing acute and chronic risks to human health.

The simulation to estimate exposure from the currently proposed use is based on modeling the Kansas sorghum scenario to represent all of US sorghum production. The modeling assumes a single acetochlor application rate of 2.5 lb ai/A (the maximum rate on the proposed label) to 80% of the /watershed. Detailed PRZM/EXAMS results are provided in the Appendix, inputs are provided in Table 2 and in the Appendix.

Where applicable, modeling input parameters were selected according to current guidance (*Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides Version II*, EFED, February 28, 2002).

4.1.2. <u>Characterization of Exposure from Monitoring and Monitoring Extrapolation Methods</u>

4.1.2.1.Source Data for Estimation of Acetochlor Runoff Loading Factors

Actual acetochlor concentrations in CWS water from the ARP study for previously registered uses (field corn) provide some indication of realistic exposure levels albeit for a crop with significantly different production areas than for the proposed sorghum use. These data are particularly useful for exposure characterization because the ARP study was not only a multi-year monitoring program with relatively frequent sampling targeted to CWS surface water sources and accompanied by detailed usage information and site hydrogeologic and weather data over the monitoring period.

EFED attempted to evaluate levels of acetochlor that might be observed from the proposed use on sorghum by looking at the ARP CWS study results on a watershed by watershed basis to determine the relative acetochlor contamination potential at all sites. Important to the accuracy of this method is the ability to quantitate the effect of extrinsic factors on observed concentrations, the most important of these factors for CWS water is water treatment effects on acetochlor levels. In other words, monitoring data on raw water sampled at a point just before the treatment system of the CWS takes effect are the ideal data to calculate acetochlor "loading factors", the amount of acetochlor expected in a watershed per unit level of usage of acetochlor in the watershed for that year.

A significant constraint on the precision of the "Monitoring Extrapolation" (ME) methodology was that the ARP did not monitor raw water at the majority of sites (generally, each year only about 35 to 45 of the ~175 sites were sampled for both raw and finished water). The majority of the highly vulnerable sites turned out to be sites for which the ARP did not choose to sample raw water. Although raw and finished water sample concentration ratios can be calculated from the sites that did have paired sampling, EFED did not feel confident in extrapolating from these data to estimate pretreatment concentrations at other sites (the primary reason for this being that treatment efficiency varies significantly from one CWS to another and these differences cannot be fully attributed to readily available details on the treatment methods such as the presence or absence of granulated or activated carbon filtration). A secondary issue is that the same "batch" of water cannot be precisely matched pre- and post-treatment (although the large number of samples taken from each CWS at least provides a means to calculate the variability that may be induced by this practical limitation on sampling). For these reasons, EFED does not present here correction factors for treatment efficiency.

4.1.2.2. Procedure for the Monitoring Extrapolation Calculations

The acetochlor Monitoring Extrapolation (ME) methodology permits examination of the distribution of exposures to acetochlor across sorghum production areas using various assumptions of usage levels. The ME method has been employed to compare a realistic range of concentrations in drinking water from the existing corn and the proposed sorghum use and thereby provide further characterization to the PRZM-EXAMS modeling results by combining vulnerabilities of sorghum and corn watersheds. The ME has not been employed at this stage to look at intrinsic vulnerabilities (i.e., related to site specific hydrogeology and weather) of specific CWS but does provide a range of potential exposure levels given different levels of runoff vulnerability. ME results should not therefore be directly used for quantitative exposure assessment.

The monitoring extrapolation method was based upon incorporation of the following inputs:

- Analysis of usage by year by watershed (using data smoothing techniques and adjusting for outliers to improve the county-level usage estimates based upon the submitted sales data).
- Calculation of watershed usage intensities for each year of monitoring at each ARP site (converting county-based usage data to watershed-based usage).
- Calculation of watershed loading factors for determination of acute and chronic acetochlor "loading factors" based on the unit concentration of acetochlor per unit usage in the CWS watershed.
- Reproduction of acetochlor watershed usage rates assumed according to accepted EFED practice (as with PRZM-EXAMS modeling inputs).

Please see the Appendix for details including example calculations.

4.2. Exposure Assessment Results

Results are provided here for both chronic and acute exposure. However, the endpoint of concern for human exposure identified by OPP-Health Effects Division relates to a chronic, lifetime exposure risk (Acetochlor HED Chapter of the Tolerance Reassessment Document (TRED): DP

Barcodes D306535, DP292338; 7/22/05). Based upon PRZM-EXAMS modeling for a single site over a 30-year period in Kansas long-term chronic exposure is not expected to exceed 2.13 ug/L. We used these results as a measure of lifetime exposure – the duration most appropriate for the primary toxicological endpoint of concern for acetochlor. EFED believes that, relevant to risk assessment for a cancer endpoint, this is a reasonable upper-bound lifetime exposure estimate for acetochlor from the sorghum use. More details on the PRZM/EXAMS modeling results are presented in Table 4 (including both chronic and acute exposure estimates for both sorghum and the existing corn use – for easier comparison of the potential impacts of the sorghum use and the existing corn use). EFED policy is to estimate exposure at a vulnerable site using the 90^{th} percentile acute and chronic exposure for modeling scenarios for the crop use site in question; in this case the only established EFED scenario for sorghum is from Kansas. Estimated chronic and acute exposure levels range from 2.13 ug/L for a multi-year weighted mean exposure to 42.4 ug/L for a peak daily exposure (90^{th} percentile of all yearly maximum daily exposure values) – see Table 4 (second line of data).

Table 4. Concentration Summary of EDWCs for Use of Acetochlor on Sorghum (ug/L) and comparative values for corn: Underlined values are the values Recommended by EFED for Exposure Assessment.

Model / Data Source	**Exposure Assessment Scenario / Percentile**	**Peak Day**	**Peak 96 Hour Avg.**	**365 Day Avg.**	**Lifetime (from P-E 30-yr. average)**
PRZM/EXAMS	KS Sorghum – Max (2.5 lb ai/ A rate)	49.90	47.39	4.84	
PRZM/EXAMS	KS **Sorghum** – 90^{th} %ile (these are the values used for exposure estimation)	42.43	39.48	4.11	**2.13**
PRZM/EXAMS	KS Sorghum – 50^{th} %ile	16.78	15.64	1.87	
Field Corn Results (for comparison)					
PRZM/EXAMS,	Corn – 90^{th} %ile. Range for five scenarios – from IL, MS, NC, OH, and PA (3 lb ai/A rate)	21.32 to 64.52	20.20 to 60.67	2.31 to 7.72 (IL)	0.98 to 4.51
Targeted CWS Monitoring Results (Corn Use – reflects actual usage levels over 7 year period)					
Data Source	Exposure Period Measured / Selected Value Type		**Peak (ca. 14-day)**	**TWAM (365 Day Avg.)**	**7-Year TWM[2]**
CWS Monitoring Study by ARP	Highest values from ~175 sites monitored for 7 years[1]		18.2	1.428	0.282

[1] Since raw, pretreated water was not sampled at the majority of CWS, the highest values may be from finished water and the measured levels of parent acetochlor would sometimes tend to be significantly lower than the level in the source water before treatment (generally in cases where an effective activated carbon treatment system was in place at the CWS). However, the maximum measured exposure levels at such a large number of sites is still expected to be protective (higher in magnitude) than what is likely to occur at the vast majority of sites where acetochlor is used on corn in the CWS watershed).

Note that these values naturally tend to be lower than modeled estimates because watershed-wide usage intensity tends to be lower than the maximum possible intensity

[2] Used as a conservative estimate of lifetime exposure.

For comparative purposes to the previously registered use on field corn, Table 4 also includes a range of select EEC values for five EFED standard corn scenarios as well as the observed (maximum) acetochlor acute and chronic exposure levels.

4.2.1. Chronic Exposure Estimation and Characterization

The PRZM/EXAMS multi-year (30-year simulation) chronic exposure level estimate for acetochlor on sorghum is 2.13 ug/L. and serves as the endpoint for use in cancer risk estimation (there is no range for this estimate based upon the way the model is currently configured). This falls within in the range of multi-year chronic exposure levels from the field corn use estimated by PRZM/EXAMS (i.e., 0.98 to 3.41 at five different sites using the available standard modeling scenarios for corn ; long-term EDWCs for corn were higher than for the sorghum scenario at two of the five sites modeled - see Appendix). Monitored data showed lower chronic exposure (up to 0.282 ug/L) over 7 years of usage of acetochlor on field corn

The PRZM/EXAMS estimate of year-long chronic exposure levels to acetochlor from the proposed sorghum use in terms of a time-weighted annual mean in a 90th percentile year is 4.11 ug/L (the value to be used in a yearly exposure assessment). The model results ranged from 2.43 to 8.92 ug/L for 50th to 100th percentile annual exposure levels (calculated from model simulations of 30 consecutive years of application of acetochlor to sorghum).

Applying the ME method with GIS analysis of sorghum cropping patterns in 1679 CWS watersheds yields estimated lifetime exposure levels that are consistently about two to three times lower than estimates with corn in high use, high vulnerability watersheds. Estimated levels with the ME method are very similar to the PRZM/EXAMS modeling results (i.e., in a 95th percentile vulnerability watershed with all sorghum or corn acres treated – see Appendix for details on these calculations). This provides some perspective to the PRZM/EXAMS predicted exposure levels for the sorghum use implying, as explained in more detail in the Appendix that actual exposure levels arising from the sorghum use will probably only rarely approach the level observed from the corn use.

A close look at some of the CWS watershed sorghum cropping data shows that relatively few watersheds are likely to have sorghum production and hence acetochlor usage at high intensity levels. In the highest sorghum production state of Kansas, the median CWS sorghum crop area factor is only 0.07% percent sorghum crop area) and the 90th percentile CWS sorghum crop area factor is 4.1%. Application of these lower crop area factors to modeling with PRZM/EXAMS or estimation with the ME procedure results in proportionally lower exposure estimates.

Some perspective on the existing monitoring data (again representing the corn, not sorghum use) is provided by analysis of the available acetochlor usage data. Measured concentrations of acetochlor in CWS from the ARP study for the corn use were generally lower than predicted by PRZM/EXAMS for corn. For example, the highest time-weighted multi-year mean concentration measured at approximately 175 CWS sites was 0.282 ug/L which is several times lower than the PRZM/EXAMS long-term concentration predictions. However, an analysis of the usage data submitted by the ARP when analyzed by application year by watershed shows that a significantly lower level of usage (compared to what must be assumed when modeled with PRZM/EXAMS) is associated with most CWS watersheds (up to 0.77 lb ai/A per year average rate in the ARP CWS compared with rates of about 1 to 2 lb ai/A assumed with the modeling).

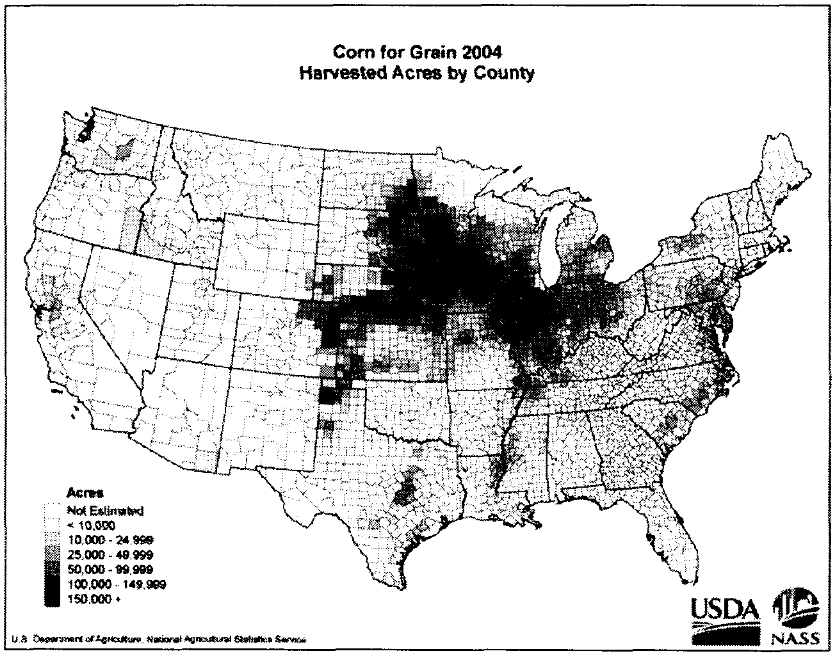

Figure 1. Corn for grain production map, 2004.

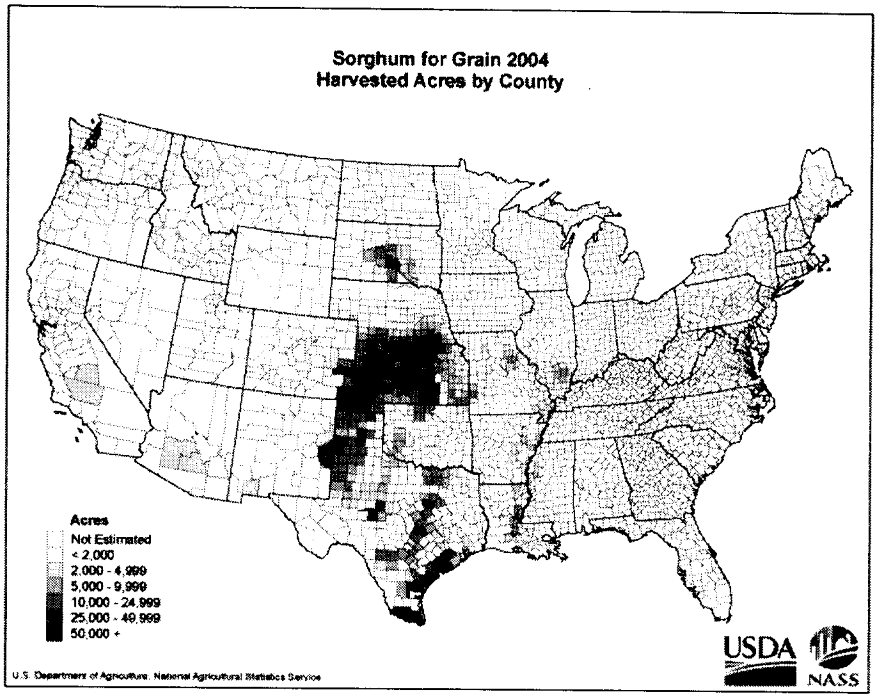

Figure 2. Sorghum for grain production map, 2004.

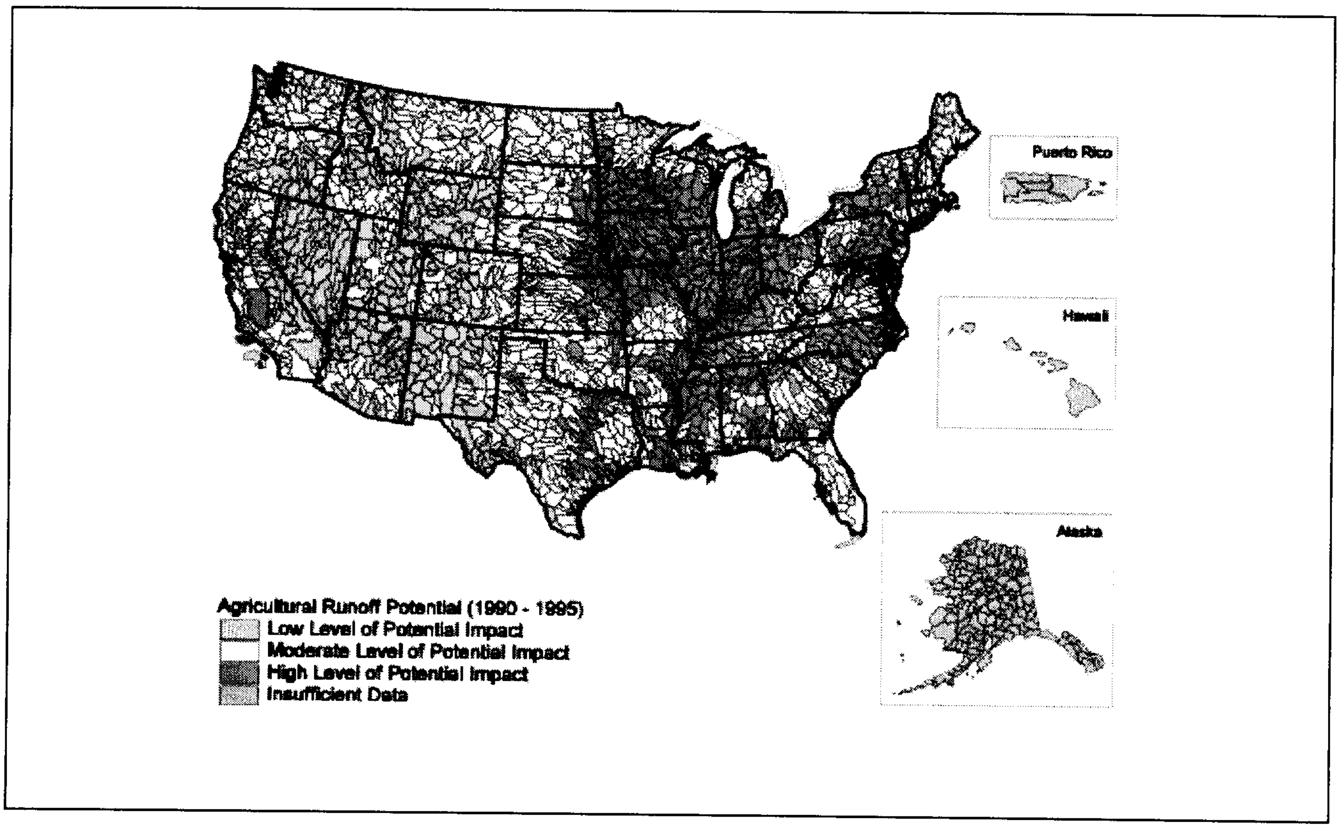

Figure 3. Agricultural Runoff Potential (Source: US Department of Agriculture, Natural Resource Conservation Service; from 1990 to 1995 data).

4.2.2. Acute Exposure Estimation

The PRZM/EXAMS acetochlor acute exposure levels from the proposed use on sorghum are estimated to be about 41.8 (96-hour) to 43.8 (24-hour) ug/L. The 1- and 4-day EDWCs for sorghum were in the middle range of the estimates for the existing corn use (24 to 65 ug/L). The PRZM/EXAMS modeling for sorghum predicted an acute exposure range of 19 to 94 ug/L for 50^{th} to 100^{th} percentile acute exposure levels (again, as calculated from taking 24-hour or 96-hour peaks from each year modeled).

The following discussion is intended to characterize the range of vulnerabilities of sorghum production sites associated with the watersheds CWS intakes and provide some context in terms of levels of drinking water exposure levels arising from the historical uses of acetochlor.

Monitoring results from the corn use (maximum value of 18.2 ug/L) are similar in magnitude to the PRZM/EXAMS predictions for acute exposure from the corn use (24 to 65 ug/L for 96 hours) EFED's analysis of the existing data demonstrates a potential for higher exposure from the corn use than the sorghum use in watersheds of similar vulnerability (and this is even before accounting for the fact that a smaller percentage of sorghum production regions (versus corn production regions) are located in watersheds with high intrinsic runoff potential – compare Figures 1 and 2 with Figure 3). Furthermore, there are many more CWS watersheds drawing from in regions with high corn crop area (the maximum estimated is 44%, with hundreds of CWS utilizing surface water from watersheds with at least a few percent of the acreage planted to corn) than there are in regions with a high sorghum crop area (the maximum estimated is 8% with less than 40 CWS utilizing surface waters from watersheds with >1% of the area planted to sorghum).

Detailed results of the acute exposure ME results are provided in the Appendix.

4.2.3. Conclusions

The PRZM/EXAMS estimates provide conservative estimates of exposure to acetochlor from sorghum use. The estimated lifetime exposure level of 2.14 ug/L (for the cancer endpoint of concern) is within the range of PRZM/EXAMS predicted drinking water concentrations from the corn use but higher than observed concentrations in acetochlor-use site targeted drinking water surveys. However, characterization work involving detailed analysis of the monitoring results in the context of usage patterns indicates that the watersheds where acetochlor is used on sorghum have lower vulnerability than the watersheds where acetochlor is used on corn. This leads EFED to conclude that exposure from the sorghum use is not likely to exceed the levels previously observed from the field corn use and as a worst case scenario may be equal to the field corn use. Our analysis of monitoring data for acetochlor show residues from the existing uses that are somewhat lower than PRZM/EXAMS predictions for corn or the proposed sorghum use. The available spatially and temporally detailed usage data associated with the ARP monitoring program provides direct evidence that the crop intensity and actual usage levels in the watershed are very important factors affecting the drinking water concentration observed in surface waters from a watershed.

PRZM/EXAMS exposure estimates for corn and sorghum are similar but cropping intensity data indicate that there are far fewer regions of intense sorghum production than of intense corn production in the US and this is likely to result in most cases smaller exposure levels arising from the sorghum use than from the corn use.

5. APPENDIX

5.1. PRZM/EXAMS Output file and Input Summaries

5.1.1. Kansas Sorghum Scenario Modeling

```
Includes Regional PCA Arkansas-White-Red Region 11: 80%)
stored as acetochlor.out                          Run by Michael R. Barrett on 8/16/2006

Chemical: Acetochlor                ran this with 6/1 acetochlor application
each year (also runs done with 5/1 and 5/15 app. Dates, not presented here)

PRZM environment: KSsorghumC.txt    modified Satday, 12 October 2002 at 14:57:56
                        Note comments above
EXAMS environment: ir298.exv  modified Thuday, 29 August 2002 at 15:34:12

Metfile: w13996.dvf     modified Wedday, 3 July 2002 at 09:04:44

Water segment concentrations (ppb)
```

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	14.45	13.73	11.14	7.447	5.671	1.569
1962	14.08	13.34	11.96	9.169	6.865	1.932
1963	10.69	10.08	7.935	5.724	4.502	1.407
1964	29.55	28.44	23.12	14.43	10.51	2.851
1965	35.3	33.01	26.74	15.66	11.68	3.251
1966	30.04	27.52	21.06	12.82	9.585	2.889
1967	43.07	36.77	22.45	11.8	8.746	2.591
1968	29.14	27.35	22.86	12.81	9.124	2.515
1969	51.77	47.61	39.04	23.97	18.05	5.387
1970	53.18	49.54	43.45	27.51	20.65	6.056
1971	15.7	14.79	11.63	7.875	6.211	2.096
1972	9.754	9.263	7.51	5.876	4.781	1.47
1973	62.38	59.24	45.81	25.67	18.05	4.659
1974	45.14	42.54	33.46	20.62	15.3	4.374
1975	36.61	34.82	28.11	18.39	14.08	4.221
1976	5.443	5.184	4.174	3.832	3.114	1.161
1977	37.44	34.88	26.41	15.45	11.17	3.009
1978	33.84	32.18	24.48	18.11	14.15	3.981
1979	22.07	20.5	15.48	10.52	7.951	2.402
1980	5.201	4.922	3.944	2.444	2.015	0.6875
1981	29.68	27.04	19.86	11.7	8.383	2.268
1982	15.4	14.61	12.89	8.417	6.201	1.805
1983	9.666	9.037	7.875	5.649	4.381	1.308
1984	15.73	13.89	9.481	6.384	5.117	1.553
1985	56.65	53.27	42.79	26.72	19.51	5.196
1986	9.375	8.844	7.952	5.611	4.428	1.415

1987	19.89	18.61	15.61	10.24	7.844	2.279
1988	18.44	17.5	14.32	9.21	7.244	2.44
1989	9.735	9.202	7.601	5.212	3.996	1.295
1990	16.43	15.33	12	7.635	5.791	1.639
Mean	26.2	24.4	19.4	12.2	9.2	2.6569

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	62.38	59.24	45.81	27.51	20.65	6.056
0.064516129	56.65	53.27	43.45	26.72	19.51	5.387
0.096774194	53.18	49.54	42.79	25.67	18.05	5.196
0.129032258	51.77	47.61	39.04	23.97	18.05	4.659
0.161290323	45.14	42.54	33.46	20.62	15.3	4.374
0.193548387	43.07	36.77	28.11	18.39	14.15	4.221
0.225806452	37.44	34.88	26.74	18.11	14.08	3.981
0.258064516	36.61	34.82	26.41	15.66	11.68	3.251
0.290322581	35.3	33.01	24.48	15.45	11.17	3.009
0.322580645	33.84	32.18	23.12	14.43	10.51	2.889
0.35483871	30.04	28.44	22.86	12.82	9.585	2.851
0.387096774	29.68	27.52	22.45	12.81	9.124	2.591
0.419354839	29.55	27.35	21.06	11.8	8.746	2.515
0.451612903	29.14	27.04	19.86	11.7	8.383	2.44
0.483870968	22.07	20.5	15.61	10.52	7.951	2.402
0.516129032	19.89	18.61	15.48	10.24	7.844	2.279
0.548387097	18.44	17.5	14.32	9.21	7.244	2.268
0.580645161	16.43	15.33	12.89	9.169	6.865	2.096
0.612903226	15.73	14.79	12	8.417	6.211	1.932
0.64516129	15.7	14.61	11.96	7.875	6.201	1.805
0.677419355	15.4	13.89	11.63	7.635	5.791	1.639
0.709677419	14.45	13.73	11.14	7.447	5.671	1.569
0.741935484	14.08	13.34	9.481	6.384	5.117	1.553
0.774193548	10.69	10.08	7.952	5.876	4.781	1.47
0.806451613	9.754	9.263	7.935	5.724	4.502	1.415
0.838709677	9.735	9.202	7.875	5.649	4.428	1.407
0.870967742	9.666	9.037	7.601	5.611	4.381	1.308
0.903225806	9.375	8.844	7.51	5.212	3.996	1.295
0.935483871	5.443	5.184	4.174	3.832	3.114	1.161
0.967741935	5.201	4.922	3.944	2.444	2.015	0.6875
p=0.1	53.039	49.347	42.415	25.5	18.05	5.1423
p=0.5	20.98	19.555	15.545	10.38	7.8975	2.3405

Average of yearly averages: 2.656883333

Inputs generated by pe4.pl - 8-August-2003

.

Data used for this run:
Output File: acetochlor
Metfile: w13996.dvf
PRZM scenario: KSsorghumC.txt
EXAMS environment file: ir298.exv
Chemical Name: acetochlor

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	269.77	g/mol	

```
Henry's Law Const.      henry       atm-m^3/mol
Vapor Pressure    vapr  2.80E-05    torr
Solubility  sol   233   mg/L
Kd    Kd          mg/L
Koc   Koc   139   mg/L
Photolysis half-life    kdp   0     days  Half-life
Aerobic Aquatic Metabolism    kbacw 26.6  days  Halfife
Anaerobic Aquatic Metabolism  kbacs 251   days  Halfife
Aerobic Soil Metabolism asm   13.3  days  Halfife
Hydrolysis: pH 7  0     days  Half-life
Method:     CAM   1     integer     See PRZM manual
Incorporation Depth:    DEPI  0     cm
Application Rate: TAPP  2.802 kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.05  fraction of application rate applied to pond
Application Date  Date  01-06 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:  FILTRA
      IPSCND
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    IR
Flag for runoff calc.   RUNOFF      monthly     none, monthly or total(average
of entire run)

Inputs generated by pe4.pl - 8-August-2003
```

5.1.2. Texas Sorghum Scenario Modeling

(Not currently approved for exposure assessment other than for organophospate insecticides and therefore was not used in this exposure assessment)

```
Stored as TXSorgIR67.out
Chemical: Acetochlor
PRZM environment: TXsorghumOP.txt   modified Satday, 12 October 2002 at 17:29:44
EXAMS environment: ir298.exv  modified Thuday, 29 August 2002 at 15:34:12
Metfile: w13958.dvf     modified Wedday, 3 July 2002 at 09:06:24
Water segment concentrations (ppb)
```

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	11.6	11.01	8.917	6.101	4.756	1.321
1962	8.036	7.629	6.302	4.373	3.674	1.057
1963	4.153	3.939	3.251	2.345	1.768	0.4922
1964	12.25	11.63	9.431	6.234	4.691	1.262
1965	74.61	71.39	62.22	40.83	30.44	8.292
1966	46.49	44.9	38.23	26.07	19.65	5.477
1967	8.68	8.264	6.791	5.221	4.013	1.194
1968	68.28	66.02	57.45	40.32	30.66	8.398
1969	39.98	38.12	31.66	20.61	15.4	4.333
1970	54.61	52.26	43.82	28.36	21.16	5.902
1971	4.292	4.077	3.31	2.31	1.768	0.5955
1972	284	272	230	152	114	30.91
1973	8.616	8.221	7.014	5.001	3.844	1.685
1974	90.35	85.64	71.36	50.08	37.81	10.36

```
1975   16.61 16.09 13.98 9.527 7.362 2.253
1976   66.45 63.66 54.76 37.06 28.24 7.845
1977   4.872 4.639 3.755 3.132 2.409 0.8554
1978   128   121   100   64.87 48.07 12.83
1979   111   107   90.26 69.45 53.27 14.87
1980   36.53 34.76 29.59 19.18 14.33 4.092
1981   30.92 29.5  25.31 18.07 13.66 3.732
1982   51    48.49 39.55 27.15 20.29 5.504
1983   76.61 73.13 61.26 40.55 30.47 8.422
1984   4.359 4.129 3.541 2.806 2.136 0.7511
1985   4.14  3.929 3.23  2.224 1.697 0.4696
1986   245   234   214   146   109   29.29
1987   20.56 19.55 16.3  11.13 8.486 2.803
1988   8.314 7.917 6.58  4.98  3.891 1.105
1989   68.92 66.23 59.92 39.35 29.28 7.888
1990   127   120   95.99 59.8  43.94 11.82

Sorted results
Prob. Peak  96 hr 21 Day      60 Day      90 Day      Yearly
0.032258064516129 284   272   230   152   114   30.91
0.0645161290322581      245   234   214   146   109   29.29
0.0967741935483871      128   121   100   69.45 53.27 14.87
0.129032258064516 127   120   95.99 64.87 48.07 12.83
0.161290322580645 111   107   90.26 59.8  43.94 11.82
0.193548387096774 90.35 85.64 71.36 50.08 37.81 10.36
0.225806451612903 76.61 73.13 62.22 40.83 30.66 8.422
0.258064516129032 74.61 71.39 61.26 40.55 30.47 8.398
0.290322580645161 68.92 66.23 59.92 40.32 30.44 8.292
0.32258064516129  68.28 66.02 57.45 39.35 29.28 7.888
0.354838709677419 66.45 63.66 54.76 37.06 28.24 7.845
0.387096774193548 54.61 52.26 43.82 28.36 21.16 5.902
0.419354838709677 51    48.49 39.55 27.15 20.29 5.504
0.451612903225806 46.49 44.9  38.23 26.07 19.65 5.477
0.483870967741936 39.98 38.12 31.66 20.61 15.4  4.333
0.516129032258065 36.53 34.76 29.59 19.18 14.33 4.092
0.548387096774194 30.92 29.5  25.31 18.07 13.66 3.732
0.580645161290323 20.56 19.55 16.3  11.13 8.486 2.803
0.612903225806452 16.61 16.09 13.98 9.527 7.362 2.253
0.645161290322581 12.25 11.63 9.431 6.234 4.756 1.685
0.67741935483871  11.6  11.01 8.917 6.101 4.691 1.321
0.709677419354839 8.68  8.264 7.014 5.221 4.013 1.262
0.741935483870968 8.616 8.221 6.791 5.001 3.891 1.194
0.774193548387097 8.314 7.917 6.58  4.98  3.844 1.105
0.806451612903226 8.036 7.629 6.302 4.373 3.674 1.057
0.838709677419355 4.872 4.639 3.755 3.132 2.409 0.8554
0.870967741935484 4.359 4.129 3.541 2.806 2.136 0.7511
0.903225806451613 4.292 4.077 3.31  2.345 1.768 0.5955
0.935483870967742 4.153 3.939 3.251 2.31  1.768 0.4922
0.967741935483871 4.14  3.929 3.23  2.224 1.697 0.4696

0.1   127.9 120.9 99.599      68.992      52.75 14.666
                              Average of yearly averages:   6.52696

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: TXSorgIR67
```

```
Metfile:    w13958.dvf
PRZM scenario:    TXsorghumOP.txt
EXAMS environment file: ir298.exv
Chemical Name:    Acetochlor
Description Variable Name     Value Units Comments
Molecular weight  mwt   269.77      g/mol
Henry's Law Const.      henry       atm-m^3/mol
Vapor Pressure    vapr  2.8e-5      torr
Solubility  sol   233   mg/L
Kd    Kd          mg/L
Koc   Koc   139   mg/L
Photolysis half-life    kdp         days  Half-life
Aerobic Aquatic Metabolism    kbacw 26.6  days  Halfife
Anaerobic Aquatic Metabolism  kbacs 251   days  Halfife
Aerobic Soil Metabolism asm   13.3  days  Halfife
Hydrolysis: pH 5        days  Half-life
Hydrolysis: pH 7        days  Half-life
Hydrolysis: pH 9        days  Half-life
Method:     CAM   2     integer     See PRZM manual
Incorporation Depth:    DEPI  0.0   cm
Application Rate: TAPP  2.26  kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.05  fraction of application rate applied to pond
Application Date  Date  01-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:  FILTRA
      IPSCND
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    IR
Flag for runoff calc.   RUNOFF      total none, monthly or total(average of
entire run)
```

5.1.3. Illinois Corn Scenario Modeling – Early Applications

```
stored as ILcorn2.out                 Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: ILCornC.txt modified Satday, 12 October 2002 at 16:01:38
                        April 15 application date
EXAMS environment: ir298.exv  modified Thuday, 29 August 2002 at 15:34:12

Metfile: w14923.dvf     modified Wedday, 3 July 2002 at 09:04:40

Water segment concentrations (ppb)
```

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	9.639	9.455	8.552	7.003	5.563	1.497
1962	21.31	20.03	15.75	11.04	9.052	2.61
1963	30.75	29.66	27.62	22.17	17.58	4.806
1964	76.16	71.39	59.13	41.66	32.07	9.119
1965	69.37	65.62	53.37	37.48	29.26	8.258
1966	27.85	27.15	24.36	17.58	13.39	3.722
1967	10.84	10.46	9.723	7.83	6.046	1.742
1968	14.76	14.48	13.44	10.62	8.611	2.517

1969	21.61	20.92	18.28	13.91	10.72	2.887
1970	14.84	13.36	10.78	8.563	6.602	1.834
1971	28.34	27.52	23.95	17.99	13.94	3.758
1972	113	108	96.06	66.83	48.71	13.04
1973	160	141	95.63	56.06	40.82	11.29
1974	17.94	16.29	13.85	10.51	7.753	2.322
1975	17.34	16.97	15.71	11.71	9.458	2.829
1976	47.75	46.13	40.36	30.09	23.98	7.162
1977	7.598	7.262	6.602	5.81	4.606	1.565
1978	9.895	9.446	7.878	6.322	5.326	1.633
1979	20.03	19.47	18.12	14.2	11.34	3.274
1980	12.47	11.85	10.39	7.419	6.62	2.048
1981	6.277	6.013	5.068	3.886	3.112	0.9439
1982	73.57	71.25	61.95	42.27	32.48	8.787
1983	6.504	6.188	5.088	3.98	3.145	1.06
1984	29.45	28.01	24.42	17.82	13.82	3.949
1985	14.43	13.78	11.79	10.12	8.477	2.638
1986	24.85	23.65	19.62	13.98	10.9	3.025
1987	12.02	11.4	9.216	6.697	5.924	1.738
1988	6.218	6.081	5.521	5.231	4.387	1.309
1989	38.96	37.82	33.45	24.84	19.35	5.499
1990	32.44	30.3	23.88	16.08	12.04	3.396
Mean	32.5	30.7	25.7	18.3	14.2	4.0

Sorted results

Prob. Peak	96 hr	21 Day		60 Day		90 Day	Yearly
0.032258065	160	141	96.06	66.83	48.71	13.04	
0.064516129	113	108	95.63	56.06	40.82	11.29	
0.096774194	76.16	71.39	61.95	42.27	32.48	9.119	
0.129032258	73.57	71.25	59.13	41.66	32.07	8.787	
0.161290323	69.37	65.62	53.37	37.48	29.26	8.258	
0.193548387	47.75	46.13	40.36	30.09	23.98	7.162	
0.225806452	38.96	37.82	33.45	24.84	19.35	5.499	
0.258064516	32.44	30.3	27.62	22.17	17.58	4.806	
0.290322581	30.75	29.66	24.42	17.99	13.94	3.949	
0.322580645	29.45	28.01	24.36	17.82	13.82	3.758	
0.35483871	28.34	27.52	23.95	17.58	13.39	3.722	
0.387096774	27.85	27.15	23.88	16.08	12.04	3.396	
0.419354839	24.85	23.65	19.62	14.2	11.34	3.274	
0.451612903	21.61	20.92	18.28	13.98	10.9	3.025	
0.483870968	21.31	20.03	18.12	13.91	10.72	2.887	
0.516129032	20.03	19.47	15.75	11.71	9.458	2.829	
0.548387097	17.94	16.97	15.71	11.04	9.052	2.638	
0.580645161	17.34	16.29	13.85	10.62	8.611	2.61	
0.612903226	14.84	14.48	13.44	10.51	8.477	2.517	
0.64516129	14.76	13.78	11.79	10.12	7.753	2.322	
0.677419355	14.43	13.36	10.78	8.563	6.62	2.048	
0.709677419	12.47	11.85	10.39	7.83	6.602	1.834	
0.741935484	12.02	11.4	9.723	7.419	6.046	1.742	
0.774193548	10.84	10.46	9.216	7.003	5.924	1.738	
0.806451613	9.895	9.455	8.552	6.697	5.563	1.633	
0.838709677	9.639	9.446	7.878	6.322	5.326	1.565	
0.870967742	7.598	7.262	6.602	5.81	4.606	1.497	
0.903225806	6.504	6.188	5.521	5.231	4.387	1.309	
0.935483871	6.277	6.081	5.088	3.98	3.145	1.06	
0.967741935	6.218	6.013	5.068	3.886	3.112	0.9439	

```
0.1   75.901      71.376      61.668      42.209      32.439      9.0858
                              Average of yearly averages:   4.008596667

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: ILcorn2
Metfile:    w14923.dvf
PRZM scenario:    ILCornC.txt
EXAMS environment file: ir298.exv
Chemical Name:    acetochlor
Description Variable Name     Value Units Comments
Molecular weight  mwt   269.77       g/mol
Henry's Law Const.      henry        atm-m^3/mol
Vapor Pressure    vapr  2.80E-05     torr
Solubility  sol   233   mg/L
Kd    Kd          mg/L
Koc   Koc   139   mg/L
Photolysis half-life    kdp   0      days  Half-life
Aerobic Aquatic Metabolism    kbacw 26.6   days  Halfife
Anaerobic Aquatic Metabolism  kbacs 251    days  Halfife
Aerobic Soil Metabolism asm   13.3  days  Halfife
Hydrolysis: pH 7  0     days  Half-life
Method:     CAM   1     integer      See PRZM manual
Incorporation Depth:    DEPI  0      cm
Application Rate: TAPP  3.363 kg/ha
Application Efficiency: APPEFF       0.95  fraction
Spray Drift DRFT  0.05  fraction of application rate applied to pond
Application Date  Date  15-04 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:  FILTRA
      IPSCND
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    IR
Flag for runoff calc.   RUNOFF          none, monthly or total(average of
entire run)
```

5.1.4. Illinois Corn Scenario Modeling – Late Applications

```
stored as ILcorn1.out                 Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: ILCornC.txt modified Satday, 12 October 2002 at 16:01:38
                        May 1 application date
EXAMS environment: ir298.exv  modified Thuday, 29 August 2002 at 15:34:12

Metfile: w14923.dvf     modified Wedday, 3 July 2002 at 09:04:40

Water segment concentrations (ppb)

Year  Peak  96 hr 21 Day      60 Day      90 Day      Yearly
1961  8.541 8.287 7.297 5.511 4.366 1.178
1962  52.72 49.57 39.11 26.5  20.14 5.648
```

1963	13.38	12.95	11.26	8.159	6.362	1.973
1964	14.62	14.04	11.9	8.827	6.953	2.046
1965	11.58	11.11	9.528	7.722	6.219	1.754
1966	65.46	61.37	51.79	33.26	24.11	6.573
1967	21.02	18.82	12.3	7.657	6.355	2.083
1968	6.284	6.107	5.497	4.593	3.67	1.128
1969	8.348	8.073	7.376	5.943	4.421	1.205
1970	68.25	61.92	42.09	25.51	18.98	5.136
1971	11.75	11.35	9.49	6.955	5.38	1.58
1972	50.24	47.74	40.24	24.25	17.75	4.75
1973	136	127	99.62	59.94	43.85	12.21
1974	53.29	50.18	42.91	24.45	17.87	5.431
1975	8.041	7.757	7.067	6.057	4.879	1.722
1976	28.35	27.36	23.83	17.81	13.97	4.202
1977	14.43	13.79	11.37	7.803	6.13	1.936
1978	27.72	26.45	21.88	15.06	11.98	3.568
1979	15.78	15.26	14.33	11.05	8.739	2.61
1980	27.01	25.66	22.77	16.21	12.64	3.692
1981	6.373	6.196	5.698	4.534	3.691	1.192
1982	14.13	13.37	11.2	7.887	6.342	1.795
1983	6.694	6.508	5.949	4.45	3.766	1.134
1984	34.55	32.89	26.94	21.59	16.71	4.823
1985	27.3	26.06	21.57	15.51	12.32	3.812
1986	37.83	35.56	28.63	17.51	13.07	3.668
1987	31.47	29.85	24.15	15.95	12.38	3.455
1988	12.01	11.55	9.714	8.026	6.498	1.961
1989	7.798	7.553	6.909	5.978	4.795	1.435
1990	103	96.27	76.97	45.21	32.79	8.913
Mean	30.8	29.0	23.6	15.7	11.9	3.4

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	136	127	99.62	59.94	43.85	12.21
0.064516129	103	96.27	76.97	45.21	32.79	8.913
0.096774194	68.25	61.92	51.79	33.26	24.11	6.573
0.129032258	65.46	61.37	42.91	26.5	20.14	5.648
0.161290323	53.29	50.18	42.09	25.51	18.98	5.431
0.193548387	52.72	49.57	40.24	24.45	17.87	5.136
0.225806452	50.24	47.74	39.11	24.25	17.75	4.823
0.258064516	37.83	35.56	28.63	21.59	16.71	4.75
0.290322581	34.55	32.89	26.94	17.81	13.97	4.202
0.322580645	31.47	29.85	24.15	17.51	13.07	3.812
0.35483871	28.35	27.36	23.83	16.21	12.64	3.692
0.387096774	27.72	26.45	22.77	15.95	12.38	3.668
0.419354839	27.3	26.06	21.88	15.51	12.32	3.568
0.451612903	27.01	25.66	21.57	15.06	11.98	3.455
0.483870968	21.02	18.82	14.33	11.05	8.739	2.61
0.516129032	15.78	15.26	12.3	8.827	6.953	2.083
0.548387097	14.62	14.04	11.9	8.159	6.498	2.046
0.580645161	14.43	13.79	11.37	8.026	6.362	1.973
0.612903226	14.13	13.37	11.26	7.887	6.355	1.961
0.64516129	13.38	12.95	11.2	7.803	6.342	1.936
0.677419355	12.01	11.55	9.714	7.722	6.219	1.795
0.709677419	11.75	11.35	9.528	7.657	6.13	1.754
0.741935484	11.58	11.11	9.49	6.955	5.38	1.722
0.774193548	8.541	8.287	7.376	6.057	4.879	1.58

```
0.806451613 8.348 8.073 7.297 5.978 4.795 1.435
0.838709677 8.041 7.757 7.067 5.943 4.421 1.205
0.870967742 7.798 7.553 6.909 5.511 4.366 1.192
0.903225806 6.694 6.508 5.949 4.593 3.766 1.178
0.935483871 6.373 6.196 5.698 4.534 3.691 1.134
0.967741935 6.284 6.107 5.497 4.45  3.67  1.128

0.1   67.971      61.865      50.902      32.584      23.713      6.4805
                              Average of yearly averages:   3.420433333

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: ILcorn1
Metfile:    w14923.dvf
PRZM scenario:    ILCornC.txt
EXAMS environment file: ir298.exv
Chemical Name:    acetochlor
Description Variable Name     Value Units Comments
Molecular weight  mwt   269.77      g/mol
Henry's Law Const.      henry       atm-m^3/mol
Vapor Pressure    vapr  2.80E-05    torr
Solubility  sol   233   mg/L
Kd    Kd          mg/L
Koc   Koc   139   mg/L
Photolysis half-life    kdp   0     days  Half-life
Aerobic Aquatic Metabolism    kbacw 26.6  days  Halfife
Anaerobic Aquatic Metabolism  kbacs 251   days  Halfife
Aerobic Soil Metabolism asm   13.3  days  Halfife
Hydrolysis: pH 7  0     days  Half-life
Method:     CAM   1     integer     See PRZM manual
Incorporation Depth:    DEPI  0     cm
Application Rate: TAPP  3.363 kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.05  fraction of application rate applied to pond
Application Date  Date  01-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:  FILTRA
      IPSCND
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    IR
Flag for runoff calc.   RUNOFF            none, monthly or total(average of
entire run)
```

5.1.5. <u>North Carolina Corn Scenario Modeling</u>

```
stored as NCcorn1.out               Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: ILCornC.txt modified Satday, 12 October 2002 at 16:01:38

EXAMS environment: ir298.exv  modified Thuday, 29 August 2002 at 15:34:12
```

Metfile: w13722.dvf   modified Wedday, 3 July 2002 at 09:05:50

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	21.06	20.36	17.52	12	9.498	2.666
1962	6.214	5.938	4.936	4.352	3.408	0.9827
1963	21.44	20.37	17.91	12.37	9.851	2.958
1964	6.23	5.99	5.102	3.763	2.989	0.8768
1965	7.84	7.478	6.078	5.064	3.891	1.09
1966	21.38	20.38	17.04	12.27	9.348	2.574
1967	11.24	10.81	9.635	6.693	5.103	1.458
1968	6.395	6.141	5.209	4.697	3.74	1.074
1969	11.55	11.09	10.02	7.263	5.845	1.641
1970	20.94	20.12	17.36	12.41	9.648	2.704
1971	20.9	20.19	16.98	11.53	9.137	2.578
1972	70.94	67.38	56.59	37.59	27.91	7.493
1973	6.271	6.024	5.124	3.818	2.755	0.8329
1974	27.66	26.43	24.42	16.63	12.89	3.62
1975	6.256	5.978	5.258	4.643	3.635	1.07
1976	15.3	14.94	12.68	9.565	7.61	2.17
1977	8.111	7.747	6.488	5.604	4.529	1.318
1978	34.16	32.84	28.46	19.55	14.74	4.068
1979	17.37	16.67	15.43	11.3	8.748	2.469
1980	17.66	16.84	14.14	8.859	6.952	1.995
1981	12.29	11.79	9.908	7.409	5.791	1.629
1982	6.18	5.884	4.824	3.85	2.858	0.8076
1983	9.597	9.402	7.974	6.209	5.002	1.445
1984	11.08	10.38	8.256	7.129	5.581	1.553
1985	42.84	40.88	34.19	23.47	17.78	4.884
1986	25.03	23.9	19.86	12.76	10.02	2.77
1987	6.415	6.157	5.313	4.463	3.593	1.024
1988	9.96	9.569	8.104	6.161	4.943	1.397
1989	88.99	86.36	75.74	49.85	37.03	9.903
1990	57.58	54.51	44.66	28.83	21.94	6.226
Mean	21.0	20.1	17.2	12.0	9.2	2.6

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	88.99	86.36	75.74	49.85	37.03	9.903
0.064516129	70.94	67.38	56.59	37.59	27.91	7.493
0.096774194	57.58	54.51	44.66	28.83	21.94	6.226
0.129032258	42.84	40.88	34.19	23.47	17.78	4.884
0.161290323	34.16	32.84	28.46	19.55	14.74	4.068
0.193548387	27.66	26.43	24.42	16.63	12.89	3.62
0.225806452	25.03	23.9	19.86	12.76	10.02	2.958
0.258064516	21.44	20.38	17.91	12.41	9.851	2.77
0.290322581	21.38	20.37	17.52	12.37	9.648	2.704
0.322580645	21.06	20.36	17.36	12.27	9.498	2.666
0.35483871	20.94	20.19	17.04	12	9.348	2.578
0.387096774	20.9	20.12	16.98	11.53	9.137	2.574
0.419354839	17.66	16.84	15.43	11.3	8.748	2.469
0.451612903	17.37	16.67	14.14	9.565	7.61	2.17
0.483870968	15.3	14.94	12.68	8.859	6.952	1.995
0.516129032	12.29	11.79	10.02	7.409	5.845	1.641
0.548387097	11.55	11.09	9.908	7.263	5.791	1.629

0.580645161	11.24	10.81	9.635	7.129	5.581	1.553
0.612903226	11.08	10.38	8.256	6.693	5.103	1.458
0.64516129	9.96	9.569	8.104	6.209	5.002	1.445
0.677419355	9.597	9.402	7.974	6.161	4.943	1.397
0.709677419	8.111	7.747	6.488	5.604	4.529	1.318
0.741935484	7.84	7.478	6.078	5.064	3.891	1.09
0.774193548	6.415	6.157	5.313	4.697	3.74	1.074
0.806451613	6.395	6.141	5.258	4.643	3.635	1.07
0.838709677	6.271	6.024	5.209	4.463	3.593	1.024
0.870967742	6.256	5.99	5.124	4.352	3.408	0.9827
0.903225806	6.23	5.978	5.102	3.85	2.989	0.8768
0.935483871	6.214	5.938	4.936	3.818	2.858	0.8329
0.967741935	6.18	5.884	4.824	3.763	2.755	0.8076

0.1 56.106 53.147 43.613 28.294 21.524 6.0918
Average of yearly averages: 2.5759

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: NCcorn1
Metfile: w13722.dvf
PRZM scenario: NCcornEC.txt
EXAMS environment file: ir298.exv
Chemical Name: acetochlor

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	269.77	g/mol	
Henry's Law Const.	henry		atm-m^3/mol	
Vapor Pressure	vapr	2.80E-05	torr	
Solubility	sol	233	mg/L	
Kd	Kd		mg/L	
Koc	Koc	139	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	26.6	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	251	days	Halfife
Aerobic Soil Metabolism	asm	13.3	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	1	integer	See PRZM manual
Incorporation Depth:	DEPI	0	cm	
Application Rate:	TAPP	3.363	kg/ha	
Application Efficiency:	APPEFF	0.95	fraction	
Spray Drift	DRFT	0.05	fraction of application rate applied to pond	
Application Date	Date	01-05	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND			
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR	IR		
Flag for runoff calc.	RUNOFF			none, monthly or total(average of entire run)

5.1.6. Pennsylvania Corn Scenario Modeling

stored as PAcorn1.out Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: PAcornC.txt modified Satday, 12 October 2002 at 16:25:26

EXAMS environment: ir298.exv modified Thuday, 29 August 2002 at 15:34:12

Metfile: w14737.dvf modified Wedday, 3 July 2002 at 09:06:12

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	6.135	5.938	5.293	4.017	3.213	0.9615
1962	6.192	5.993	5.238	3.861	3.077	0.9716
1963	6.226	6.05	5.375	4.064	3.247	1.029
1964	6.194	5.991	5.226	3.865	3.084	0.9688
1965	6.217	6.004	5.205	3.825	3.056	0.9687
1966	6.214	6.05	5.417	4.108	3.253	1.01
1967	7.879	7.695	6.999	5.686	4.612	1.488
1968	6.837	6.639	5.71	5.192	4.394	1.447
1969	6.294	6.09	5.317	3.925	3.131	1.05
1970	6.2	6.011	5.295	3.979	3.191	0.9937
1971	6.188	6.023	5.39	4.097	3.276	1.003
1972	6.203	6.01	5.28	4.061	3.433	1.098
1973	6.186	6.025	5.405	4.104	3.257	0.9868
1974	6.187	6.009	5.329	4.054	3.266	1.019
1975	6.194	5.984	5.197	3.818	3.04	0.9362
1976	6.181	6.004	5.329	3.977	3.157	0.9716
1977	6.181	5.967	5.168	3.786	3.006	0.9216
1978	6.172	5.984	5.284	3.939	3.132	0.9672
1979	6.189	5.992	5.249	3.913	3.137	0.9776
1980	6.216	6.009	5.228	3.858	3.06	0.9318
1981	7.127	6.906	6.056	5.01	4.027	1.275
1982	6.862	6.56	5.46	4.733	4.356	1.558
1983	6.257	6.081	5.406	4.074	3.232	1.04
1984	14.69	14.16	12.16	10.9	8.981	2.77
1985	32.79	31.52	26.84	19.43	15.59	4.868
1986	6.398	6.177	5.347	3.91	3.111	1.116
1987	6.205	6.01	5.269	3.883	3.063	0.9519
1988	34.88	33.26	27.56	19.35	15.02	4.722
1989	36.09	34.65	32.81	24.37	19.48	6.276
1990	6.746	6.556	5.833	4.41	3.525	1.367
Mean	9.5	9.1	8.0	6.1	4.9	1.6

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	36.09	34.65	32.81	24.37	19.48	6.276
0.064516129	34.88	33.26	27.56	19.43	15.59	4.868
0.096774194	32.79	31.52	26.84	19.35	15.02	4.722
0.129032258	14.69	14.16	12.16	10.9	8.981	2.77
0.161290323	7.879	7.695	6.999	5.686	4.612	1.558
0.193548387	7.127	6.906	6.056	5.192	4.394	1.488
0.225806452	6.862	6.639	5.833	5.01	4.356	1.447

```
0.258064516 6.837 6.56  5.71  4.733 4.027 1.367
0.290322581 6.746 6.556 5.46  4.41  3.525 1.275
0.322580645 6.398 6.177 5.417 4.108 3.433 1.116
0.35483871  6.294 6.09  5.406 4.104 3.276 1.098
0.387096774 6.257 6.081 5.405 4.097 3.266 1.05
0.419354839 6.226 6.05  5.39  4.074 3.257 1.04
0.451612903 6.217 6.05  5.375 4.064 3.253 1.029
0.483870968 6.216 6.025 5.347 4.061 3.247 1.019
0.516129032 6.214 6.023 5.329 4.054 3.232 1.01
0.548387097 6.205 6.011 5.329 4.017 3.213 1.003
0.580645161 6.203 6.01  5.317 3.979 3.191 0.9937
0.612903226 6.2   6.01  5.295 3.977 3.157 0.9868
0.64516129  6.194 6.009 5.293 3.939 3.137 0.9776
0.677419355 6.194 6.009 5.284 3.925 3.132 0.9716
0.709677419 6.192 6.004 5.28  3.913 3.131 0.9716
0.741935484 6.189 6.004 5.269 3.91  3.111 0.9688
0.774193548 6.188 5.993 5.249 3.883 3.084 0.9687
0.806451613 6.187 5.992 5.238 3.865 3.077 0.9672
0.838709677 6.186 5.991 5.228 3.861 3.063 0.9615
0.870967742 6.181 5.984 5.226 3.858 3.06  0.9519
0.903225806 6.181 5.984 5.205 3.825 3.056 0.9362
0.935483871 6.172 5.967 5.197 3.818 3.04  0.9318
0.967741935 6.135 5.938 5.168 3.786 3.006 0.9216

0.1   30.98 29.784      25.372      18.505      14.4161     4.5268
                              Average of yearly averages:   1.554833333

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: PAcorn1
Metfile:     w14737.dvf
PRZM scenario:     PAcornC.txt
EXAMS environment file: ir298.exv
Chemical Name:     acetochlor
Description Variable Name     Value Units Comments
Molecular weight  mwt    269.77       g/mol
Henry's Law Const.       henry        atm-m^3/mol
Vapor Pressure    vapr   2.80E-05     torr
Solubility  sol    233    mg/L
Kd     Kd          mg/L
Koc    Koc    139    mg/L
Photolysis half-life    kdp    0      days  Half-life
Aerobic Aquatic Metabolism    kbacw 26.6   days  Halfife
Anaerobic Aquatic Metabolism  kbacs 251    days  Halfife
Aerobic Soil Metabolism asm    13.3   days  Halfife
Hydrolysis: pH 7  0      days  Half-life
Method:      CAM   1      integer      See PRZM manual
Incorporation Depth:     DEPI  0      cm
Application Rate: TAPP  3.363 kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.05  fraction of application rate applied to pond
Application Date  Date  01-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:   FILTRA
      IPSCND
      UPTKF
Record 18:   PLVKRT
```

PLDKRT
FEXTRC 0.5
Flag for Index Res. Run IR IR
Flag for runoff calc. RUNOFF none, monthly or total(average of entire run)

5.1.7. Ohio Corn Scenario Modeling

stored as OHcorn1.out Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: OHCornC.txt modified Satday, 12 October 2002 at 16:15:50

EXAMS environment: ir298.exv modified Thuday, 29 August 2002 at 15:34:12

Metfile: w93815.dvf modified Wedday, 3 July 2002 at 09:06:06

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	27.41	26.51	23.13	16.55	12.91	3.683
1962	7.711	7.334	6.079	5.101	4.165	1.345
1963	9.978	9.638	8.414	6.349	5.397	1.776
1964	6.217	6.03	5.678	4.417	3.533	1.159
1965	9.847	9.408	7.843	5.973	5.043	1.584
1966	6.272	6.09	5.72	4.618	3.637	1.12
1967	38.34	36.45	32.04	20.64	15.62	4.56
1968	31.85	29.65	27.25	18.67	14.46	4.405
1969	25.69	24.46	21.48	15.08	11.59	3.406
1970	9.118	8.781	7.689	6.083	4.917	1.615
1971	38.86	37.39	33.54	23.14	17.82	5.17
1972	23.72	23.07	20.78	15.19	12.12	3.82
1973	17	16.48	14.67	10.56	8.222	2.468
1974	21.06	20.1	16.56	11.44	9.079	2.65
1975	13.24	12.76	10.97	8.066	6.311	1.878
1976	7.19	6.787	5.812	5.222	4.255	1.389
1977	54.05	51.85	42.89	29.42	22.86	6.659
1978	10.58	10.28	9.349	7.036	5.567	1.74
1979	7.525	7.281	6.425	5.249	4.148	1.193
1980	29.5	28.17	23.82	14.46	10.8	3.004
1981	10.34	9.999	9.177	6.677	4.914	1.442
1982	8.701	8.272	7.229	5.784	4.858	1.433
1983	51.97	50.23	45.2	31.37	23.46	6.534
1984	14.23	13.75	11.83	9.085	7.523	2.5
1985	106	101	84.58	58.29	46	13.63
1986	6.71	6.49	5.806	4.634	3.605	1.379
1987	6.193	5.96	5.222	4.658	3.675	1.086
1988	6.698	6.466	5.507	4.829	3.848	1.114
1989	25.97	23.67	18.99	13.1	10.32	2.97
1990	86.33	80.85	66.82	43.93	32.41	8.738
Mean	23.9	22.8	19.7	13.9	10.8	3.2

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	106	101	84.58	58.29	46	13.63

0.064516129	86.33	80.85	66.82	43.93	32.41	8.738
0.096774194	54.05	51.85	45.2	31.37	23.46	6.659
0.129032258	51.97	50.23	42.89	29.42	22.86	6.534
0.161290323	38.86	37.39	33.54	23.14	17.82	5.17
0.193548387	38.34	36.45	32.04	20.64	15.62	4.56
0.225806452	31.85	29.65	27.25	18.67	14.46	4.405
0.258064516	29.5	28.17	23.82	16.55	12.91	3.82
0.290322581	27.41	26.51	23.13	15.19	12.12	3.683
0.322580645	25.97	24.46	21.48	15.08	11.59	3.406
0.35483871	25.69	23.67	20.78	14.46	10.8	3.004
0.387096774	23.72	23.07	18.99	13.1	10.32	2.97
0.419354839	21.06	20.1	16.56	11.44	9.079	2.65
0.451612903	17	16.48	14.67	10.56	8.222	2.5
0.483870968	14.23	13.75	11.83	9.085	7.523	2.468
0.516129032	13.24	12.76	10.97	8.066	6.311	1.878
0.548387097	10.58	10.28	9.349	7.036	5.567	1.776
0.580645161	10.34	9.999	9.177	6.677	5.397	1.74
0.612903226	9.978	9.638	8.414	6.349	5.043	1.615
0.64516129	9.847	9.408	7.843	6.083	4.917	1.584
0.677419355	9.118	8.781	7.689	5.973	4.914	1.442
0.709677419	8.701	8.272	7.229	5.784	4.858	1.433
0.741935484	7.711	7.334	6.425	5.249	4.255	1.389
0.774193548	7.525	7.281	6.079	5.222	4.165	1.379
0.806451613	7.19	6.787	5.812	5.101	4.148	1.345
0.838709677	6.71	6.49	5.806	4.829	3.848	1.193
0.870967742	6.698	6.466	5.72	4.658	3.675	1.159
0.903225806	6.272	6.09	5.678	4.634	3.637	1.12
0.935483871	6.217	6.03	5.507	4.618	3.605	1.114
0.967741935	6.193	5.96	5.222	4.417	3.533	1.086

0.1	53.842	51.688	44.969	31.175	23.4	6.6465
			Average of yearly averages:			3.181666667

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: OHcorn1
Metfile: w93815.dvf
PRZM scenario: OHCornC.txt
EXAMS environment file: ir298.exv
Chemical Name: acetochlor

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	269.77	g/mol	
Henry's Law Const.	henry		atm-m^3/mol	
Vapor Pressure	vapr	2.80E-05	torr	
Solubility	sol	233	mg/L	
Kd	Kd		mg/L	
Koc	Koc	139	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	26.6	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	251	days	Halfife
Aerobic Soil Metabolism	asm	13.3	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	1	integer	See PRZM manual
Incorporation Depth:	DEPI	0	cm	
Application Rate:	TAPP	3.363	kg/ha	
Application Efficiency:	APPEFF	0.95	fraction	

Spray Drift DRFT 0.05 fraction of application rate applied to pond
Application Date Date 01-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17: FILTRA
IPSCND
UPTKF
Record 18: PLVKRT
PLDKRT
FEXTRC 0.5
Flag for Index Res. Run IR IR
Flag for runoff calc. RUNOFF none, monthly or total(average of entire run)

5.1.8. Mississippi Corn Scenario Modeling

stored as MScorn1.out Run by Michael R. Barrett on 7/17/2006

Chemical: acetochlor
PRZM environment: MScornC.txt modified Satday, 12 October 2002 at 16:06:02

EXAMS environment: ir298.exv modified Thuday, 29 August 2002 at 15:34:12

Metfile: w13893.dvf modified Wedday, 3 July 2002 at 09:06:20

Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	7.729	7.435	6.406	4.808	3.741	1.044
1962	6.152	5.824	4.669	3.025	2.287	0.6305
1963	6.147	5.879	4.905	3.309	2.512	0.7121
1964	6.141	5.865	4.865	3.246	2.449	0.6794
1965	10.86	10.29	8.349	5.954	4.906	1.387
1966	35.81	34.33	28.89	19.84	15.06	4.158
1967	24.52	23.46	19.6	13.15	10.19	2.947
1968	6.179	5.924	5.361	4.13	3.171	0.8932
1969	6.144	5.866	4.861	3.249	2.443	0.6719
1970	15.12	14.43	11.93	8.02	6.11	1.672
1971	6.166	5.931	5.06	3.485	2.64	0.7449
1972	41.04	39.19	32.49	21.82	16.61	4.484
1973	13.56	13.01	11.95	8.271	6.238	1.704
1974	13.34	12.69	9.585	6.223	5.388	1.602
1975	21.63	20.58	17.22	12.35	9.496	2.627
1976	6.169	5.944	5.108	3.609	2.767	0.7948
1977	6.149	5.831	4.706	3.012	2.236	0.6118
1978	114	108	82.98	50.81	37.64	10.16
1979	40.32	38.41	31.97	21.23	16.05	4.389
1980	6.163	5.883	4.869	3.218	2.384	0.6641
1981	6.144	5.89	4.962	3.377	2.53	0.6862
1982	6.143	5.845	4.782	3.155	2.37	0.6405
1983	46.04	42.71	35.78	23.42	17.6	4.84
1984	171	162	131	77.3	57.07	15.32
1985	6.305	6.031	5.034	3.404	2.58	0.8565
1986	6.15	5.873	4.871	3.236	2.411	0.654
1987	6.14	5.827	4.717	3.054	2.286	0.619
1988	6.142	5.863	4.856	3.214	2.41	0.6464
1989	6.14	5.886	4.955	3.399	2.601	0.7099

1990	7.5	7.204	6.164	4.226	3.18	0.8625
Mean	22.0	20.9	17.1	11.0	8.3	2.3

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258065	171	162	131	77.3	57.07	15.32
0.064516129	114	108	82.98	50.81	37.64	10.16
0.096774194	46.04	42.71	35.78	23.42	17.6	4.84
0.129032258	41.04	39.19	32.49	21.82	16.61	4.484
0.161290323	40.32	38.41	31.97	21.23	16.05	4.389
0.193548387	35.81	34.33	28.89	19.84	15.06	4.158
0.225806452	24.52	23.46	19.6	13.15	10.19	2.947
0.258064516	21.63	20.58	17.22	12.35	9.496	2.627
0.290322581	15.12	14.43	11.95	8.271	6.238	1.704
0.322580645	13.56	13.01	11.93	8.02	6.11	1.672
0.35483871	13.34	12.69	9.585	6.223	5.388	1.602
0.387096774	10.86	10.29	8.349	5.954	4.906	1.387
0.419354839	7.729	7.435	6.406	4.808	3.741	1.044
0.451612903	7.5	7.204	6.164	4.226	3.18	0.8932
0.483870968	6.305	6.031	5.361	4.13	3.171	0.8625
0.516129032	6.179	5.944	5.108	3.609	2.767	0.8565
0.548387097	6.169	5.931	5.06	3.485	2.64	0.7948
0.580645161	6.166	5.924	5.034	3.404	2.601	0.7449
0.612903226	6.163	5.89	4.962	3.399	2.58	0.7121
0.64516129	6.152	5.886	4.955	3.377	2.53	0.7099
0.677419355	6.15	5.883	4.905	3.309	2.512	0.6862
0.709677419	6.149	5.879	4.871	3.249	2.449	0.6794
0.741935484	6.147	5.873	4.869	3.246	2.443	0.6719
0.774193548	6.144	5.866	4.865	3.236	2.411	0.6641
0.806451613	6.144	5.865	4.861	3.218	2.41	0.654
0.838709677	6.143	5.863	4.856	3.214	2.384	0.6464
0.870967742	6.142	5.845	4.782	3.155	2.37	0.6405
0.903225806	6.141	5.831	4.717	3.054	2.287	0.6305
0.935483871	6.14	5.827	4.706	3.025	2.286	0.619
0.967741935	6.14	5.824	4.669	3.012	2.236	0.6118
0.1	45.54	42.358	35.451	23.26	17.501	4.8044

Average of yearly averages: 2.28039

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:

Output File: MScorn1

Metfile: w13893.dvf

PRZM scenario: MScornC.txt

EXAMS environment file: ir298.exv

Chemical Name: acetochlor

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	269.77	g/mol	
Henry's Law Const.	henry		atm-m^3/mol	
Vapor Pressure	vapr	2.80E-05	torr	
Solubility	sol	233	mg/L	
Kd	Kd		mg/L	
Koc	Koc	139	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	26.6	days	Halfife

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Anaerbic Aquatic Metabolism    kbacs 251    days  Halfife
Aerobic Soil Metabolism asm    13.3  days  Halfife
Hydrolysis: pH 7   0      days  Half-life
Method:      CAM   1      integer      See PRZM manual
Incorporation Depth:      DEPI  0      cm
Application Rate: TAPP  3.363 kg/ha
Application Efficiency: APPEFF      0.95  fraction
Spray Drift DRFT  0.05   fraction of application rate applied to pond
Application Date  Date   01-05 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:  FILTRA
      IPSCND
      UPTKF
Record 18:  PLVKRT
      PLDKRT
      FEXTRC      0.5
Flag for Index Res. Run IR    IR
Flag for runoff calc.   RUNOFF          none, monthly or total(average of
entire run)
```

5.2. Details of Monitoring Data Analysis and Monitoring Extrapolation Method Estimates for Exposure for Sorghum and Corn

5.2.1. Chronic Exposure - Uncertainties in the Predicted Values for Sorghum – Comparisons with Existing Monitoring Data

A closer look at some of the CWS watershed sorghum cropping data shows that relatively few watersheds are likely to have sorghum production and hence acetochlor usage at high intensity levels. In the highest sorghum production state of Kansas, the range of lifetime exposures for 118 CWS with watershed areas of less than 10 million acres is 0 to 0.358, with a median CWS site exposure of 0.002 ug/L (only 0.07% percent sorghum crop area) and a 90th percentile CWS site exposure in Kansas of 0.093 ug/L (watershed with 4.1% sorghum crop area).

Some perspective on the existing monitoring data (again representing the corn, not sorghum use) is provided by analysis of the available acetochlor usage data. Measured concentrations of acetochlor in CWS from the ARP study for the corn use were generally lower than predicted by PRZM/EXAMS for corn. For example, the highest time-weighted multi-year mean concentration measured at approximately 175 CWS sites was 0.282 ug/L which is several times lower than the PRZM/EXAMS long-term concentration predictions (Table 5). However, an analysis of the usage data submitted by the ARP when analyzed by application year by watershed shows that a significantly lower level of usage (compared to what must be assumed when modeled with PRZM/EXAMS) is associated with most CWS watersheds (up to 0.77 lb ai/A per year average rate in the ARP CWS compared with rates of about 1 to 2 lb ai/A assumed with the modeling).

For additional perspective, back-calculation with the ME method to the ARP sites results in an estimate of a maximum long-term or lifetime chronic exposure level of 1.186 to 2.448 ug/L when acetochlor is applied at the maximum label rate to corn in a watershed with the maximum calculated percent corn crop area (i.e., 44%); this assumes 95th percentile vulnerability. This is very comparable to predicted concentrations for similar levels of use made with PRZM/EXAMS. When the ME method assumes application to the ARP sites at the maximum actual watershed application rate (0.77 lb ai/A) for all 189 sites the lifetime exposure estimate drops to 0.685 to 1.414 ug/L (again, assuming 95th percentile vulnerability). The difference between the measured and predicted concentrations reflects the fact that the "ideal" combination of high usage, high intrinsic site vulnerability, and weather patterns which promote maximum acetochlor runoff occurs rarely and so the predicted levels will also rarely be measured in monitoring surveys.

Table 5. Comparison of long-term (lifetime) drinking water exposure estimated and measured data for proposed (sorghum, underlined data) and existing uses (field corn).

<u>Monitoring Results</u>			
			Measured Value[1]
Corn, ARP CWS Monitoring, highest site			0.282
Corn, ARP CWS Monitoring, 95th Percentile site			0.125
Corn, ARP CWS Monitoring, 90th Percentile site			0.108
<u>PRZM-EXAMS Modeling Results – Corn and Sorghum Uses</u>			
		Theoretical Maximum[2]	Predicted Value
Corn, PRZM-EXAMS modeling range for five sites (scenarios)		1.55 to 4.01	0.98 to 3.41
Corn, PRZM-EXAMS (IL scenario, early season planting & applications)		4.01	3.41
Corn, PRZM-EXAMS (IL scenario, late season)		3.42	2.91
Corn, PRZM-EXAMS (MS)		2.28	1.94
Corn, PRZM-EXAMS (NC)		2.58	0.98
Corn, PRZM-EXAMS (OH)		3.18	2.61
Corn, PRZM-EXAMS (PA)		1.55	1.27
<u>Sorghum, PRZM-EXAMS (KS)</u>		<u>2.66</u>	<u>2.13</u>

Monitoring Extrapolation Method Estimates – Corn and Sorghum Uses			
Crop Site and Source of Watershed Usage Intensity Estimate	Estimated Concentrations for Specified Watershed Vulnerability Level		
------------------------------------	Maximum Vulnerability	Median Vulnerability	95^{h} Percentile Vulnerability
Corn, monitoring extrapolation, use based on highest measured ARP CWS PCT	6.790	0.351	1.94
Corn, monitoring extrapolation, use based on highest ARP CWS PCA	11.75	0.608	3.36
Corn , monitoring extrapolation, theoretical CWS watershed in highest crop intensity county	14.65	0.758	4.19
Sorghum, monitoring extrapolation, use based on highest CWS PCA	1.72	0.089	0.491
Sorghum, monitoring extrapolation, theoretical CWS watershed in highest crop intensity county	6.92	0.358	1.44

[1] The actual acetochlor concentration in CWS intake water before treatment could be higher because at most facilities only finished water was analyzed in the ARP monitoring program (at facilities with both raw and finished water sampling and inclusion of granular or activated carbon in the treatment program finished water concentrations usually averaged less than half the raw water concentrations. Represents the time-weighted mean value for the entire monitoring period at a site (seven years at most sites).

Percentiles were calculated from a distribution of CWS long-term time-weighted mean concentrations for those CWS that had an average acetochlor usage rate > 0.05 lb ai / A in the watershed(s) for the source water (or 1987 corn cropping intensity > 10% for a few sites with watershed-wide acetochlor usage rates not yet calculated). One hundred ten of the CWS in the ARP monitoring program met these criteria.

[2] I.e., PRZM-EXAMS MODEL predicted concentrations for application of acetochlor to the entire watershed; the estimated concentrations are lower because of the use of regional crop area factors (the estimated maximum concentration for the region in which the scenario is located.

Another significant source of monitoring data comes from the USGS National Water Quality Assessment (NAWQA) program: the average acetochlor concentration was 0.004 ug/L for 31 stream sampling sites in watersheds with predominantly agricultural land use with a minimum of 20 samples collected. The maximum long-term average (not time-weighted) concentration from these 31 sites was 1.724 ug/L. (from Maple Creek near Nickerson, NE; the watershed size at the sampling point was reported to be 368 square miles). The 95th percentile site mean (not time-weighted) concentration was 0.190 ug/L.

highest estimated single sample concentration from 2000+ stream samples analyzed for acetochlor between 1995 and 2001 was 25.1 ug/L; one in 20 samples taken from streams in watersheds with predominantly agricultural land use (however, not necessarily including substantial corn production, the only registered use for acetochlor during this monitoring period) bore acetochlor concentrations of 0.165 ug/L (i.e., the 95th percentile sample concentration; see http://ca.water.usgs.gov/pnsp/pestsw/Pest-SW_2001_table1_ag.html . These results are comparable to the ARP CWS data, with the important caveat that many of the streams / rivers sampled in the NAWQA program may be in watersheds with little acetochlor usage (after all, the program, even when examined for the subset of streams in watersheds with predominantly agricultural land use, does not specifically target areas where corn production / acetochlor use is likely to occur).

5.2.2. Projected Vulnerability of CWS in Sorghum Production Regions (Chronic Exposure Characterization)

Applying the ME method with GIS analysis of sorghum cropping patterns in 1679 CWS watersheds yields estimated lifetime exposure levels that are consistently lower than estimates with corn (Table 5). This provides some perspective to the PRZM/EXAMS predicted exposure levels for the sorghum use implying, as explained in more detail below, that actual exposure levels arising from the sorghum use will probably only rarely approach the level observed from the corn use.

While this review has not specifically examined the vulnerability of each CWS watershed where acetochlor could be used on sorghum, even a casual comparison of the cropping areas for the two crops (Figure 1 and Figure 2) and runoff potential maps (Figure 3, based on overall statistics for combined solute and sediment transport) implies that overall, the likelihood of substantial runoff of acetochlor is probably equal or less from the sorghum use. The only apparent reason why more runoff might occur from the sorghum use is if the market share or percent crop treated turned out to be much higher for sorghum than for corn. On the other hand, cropping densities for sorghum (as well as the number of production acres nationally) are generally much lower than for corn (note the differences in the usage level brackets in Figure 1 and Figure 2).

The lower drinking water concentration estimates for sorghum than corn from the ME method are due to the large difference in estimated cropping density (that is, the highest calculated sorghum cropping density in a CWS watershed was 7.8% compared to 44.4% for field corn). However, as noted earlier, it is not known whether some uncharacterized current or potential CWS watersheds may have higher crop densities – by comparison the highest county cropping densities (from 2002 Census of Agriculture data) were 55.4% for corn and 31.4% for sorghum.

For additional perspective, back-calculation with the ME method to the ARP CWS monitoring sites results in estimates of maximum long-term or lifetime chronic exposure level of acetochlor that are very comparable to predicted concentrations for similar levels of use made with PRZM/EXAMS. When the ME method assumes application to the ARP sites at the maximum actual watershed application rate (0.77 lb ai/A) for all 189 sites the lifetime exposure estimate drops to about 1/3 to 2/3 of the PRZM/EXAMS estimates (assuming 95th percentile site vulnerability). The difference between the measured and predicted concentrations reflects the fact that the "ideal" combination of high usage, high intrinsic site vulnerability, and weather patterns which promote maximum acetochlor runoff occurs rarely and so the predicted levels will also rarely be measured in monitoring surveys.

Of the three sets of vulnerability levels tested with the ME method (maximum, 95th percentile, and median – Table 5) probably the 95th percentile provides the most realistic estimates for a screening level concentration.[1] This is probably in actuality roughly equivalent to a 90th percentile overall vulnerability site since at many of the more vulnerable sites monitored no raw water was sampled and a precise site-specific treatment efficiency factor could not be calculated (and results from other sites show that the various treatment systems utilizing activated carbon filtration often removed the majority of the acetochlor parent compound in raw, pre-treated water).

5.2.3. Acute Exposure Characterization Results and Disscussion

The PRZM/EXAMS acetochlor acute exposure levels from the proposed use on sorghum are estimated to be about 41.8 (96-hour) to 43.8 (24-hour) ug/L. The 1- and 4-day EDWCs for sorghum were in the middle range of the estimates for the existing corn use (24 to 65 ug/L). The PRZM/EXAMS modeling for sorghum predicted an acute exposure range of 19 to 94 ug/L for 50th to 100th percentile acute exposure levels (again, as calculated from taking 24-hour or 96-hour peaks from each year modeled).

The following discussion is intended to characterize the range of vulnerabilities of sorghum production sites associated with the watersheds CWS intakes and provide some context in terms of levels of drinking water exposure levels arising from the historical uses of acetochlor.

Monitoring results, when the highest observed concentrations are compared, are similar in magnitude to the PRZM/EXAMS predictions for acute exposure from the corn use (Table 6). The PRZM/EXAMS predictions for the sorghum use are likewise comparable with the corn use.

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[1] Note that EFED does not recommend using the results of the ME method along with PRZM/EXAMS for risk calculations chiefly because the most realistic estimate of a high vulnerability scenario that actually has a significant probability of occurrence cannot be made without specific analysis of the vulnerability levels of all sorghum production regions / watersheds (where the current predictions apply) compared with corn production watersheds. Also relevant to this decision is the inability to separate out water treatment effects on acetochlor concentration at a majority of sites.

EFED's analysis of the existing data demonstrates a potential for higher exposure from the corn use than the sorghum use in watersheds of similar vulnerability (and this is even before accounting for the fact that there are fewer CWS in sorghum production regions than in corn production regions that are located in watersheds with high intrinsic runoff potential). There are many more CWS watersheds in regions with high corn crop area (the maximum estimated is 44%) than there are in regions with a high sorghum crop area (the maximum estimated is 8%).

Table 6. Comparison of acute drinking water exposure estimated and measured data for proposed (sorghum, underlined data) and existing uses (field corn).

Estimation or Measurement Source	Sorghum	Corn
PRZM-EXAMS (p=0.1); 96-hour	41.8	24 to 65
ME, highest CWS	53.9	130.9
ME, 90th %ile CWS	7.3	ND
Monitoring, highest ARP CWS	ND	18.2
Monitoring, 95th %ile ARP CWS	ND	4.2
Monitoring, 90th %ile ARP CWS	ND	2.5
Monitoring, highest NAWQA stream	ND	62.3

For perspective, back-calculation with the ME method to the ARP sites results in an estimate of a maximum acute exposure level of up to 76.5 to 130.9 ug/L when acetochlor is applied at the maximum label rate to corn in a watershed with the maximum calculated percent corn crop area (i.e., 44%); this assumes 95^{th} percentile vulnerability. When the ME method is applied to the ARP sites with the maximum actual watershed application rate (0.77 lb ai/A) for all 189 sites the acute exposure estimate drops to 44.2 to 75.6 ug/L (again, assuming 95^{th} percentile vulnerability). The difference between the measured and predicted concentrations reflects the fact that the "ideal" combination of high usage, high intrinsic site vulnerability, and weather patterns which promote maximum acetochlor runoff occurs rarely and so the predicted levels will also rarely be measured in monitoring surveys.

5.3. Monitoring Data Extrapolation Method Description

5.3.1. Watershed Usage Estimation

The underlying data for this procedure was derived from sales data by county and by year provided by the Acetochlor Registration Partnership (ARP) member companies. The usage (sales) data constitute Confidential Business Information (CBI) and therefore are not included in this document. Some modifications of these data were made in order to reduce the impacts of anomalies / artefacts in the sales data as a represent of actual use within the county in the year the sales were made. These included negative sales in a few cases (i.e., more acetochlor product was returned by farmers than was sold in a county in a given year) and the sudden lack of any sales data for a county or unusually large drops in sales in one county in a given year followed by a return to "normal" sales levels the following year even though the monitoring data did not seem to indicate a large drop in usage in the same counties over the year in question. Consequently, the following procedure was utilized to smooth the sales data to provide the best possible estimates of usage by county and by year over the 1995 to 2001 ARP surface drinking water supply monitoring period:

- Use running 3-year county averages around the year of interest, except 1995 estimates based on 1995 to 1997 sales data.
- Adjust usage estimates by a year weighting factor (so 1995 estimates, e.g., would end up reflecting lower overall usage of acetochlor in 95 than in 96 or 97.)
- Ignore negative or non reporting data.

Sample results of the pre- and post-transformed sales data are provided in Table A1.

Table A1. Example transformation of ARP sales data for estimation of acetochlor usage by year by county.

Pretransformed Data – Sales by County by Year									
County	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
A	66,868	134,551	144,507	120,902	185,703	130,451	102,930	136,126	177,553
B	4,094	43,882	31,429	53,542	47,148	44,621	24,283	29,219	84,917
C	2,016	17,140	29,066	29,980	15,578	19,319	37,387	23,794	17,058
D	9,034	32,805	92,774	81,246	70,822	39,853	41,175	28,163	53,754
E	23,897	96,142	79,520	72,981	89,026	72,788	94,528	114,989	97,621
F	205			31		825			
G	20,081	60,982	60,411	62,382	66,318	47,751	88,346	33,125	11,189
H	13,780	31,801	72,372	36,238	31,288	46,988	25,936	27,121	28,516
I	54,128	243,880	182,309	103,421	229,506	199,615	161,174	207,686	209,919
J	2,380	5,971	15,987	17,598	5,215	18,919	6,924	8,785	27,208
K	20,750	167,022	130,804	128,473	146,634	95,123	150,113	76,901	154,143
L			1,664			139			
M	9,153	71,718	63,441	142,833	108,113	69,810	46,016	67,699	38,453
N	2,719	36,581	33,172	45,305	26,152	11,182	32,017	183,821	160,201
O	8,656	68,482	63,889	78,191	83,292	33,650	25,241	8,558	90,385
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Transformed Data – Estimated Usage by County, 1995 to 2001									
County		**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	
A		122,369	129,134	156,091	153,217	126,865	133,967	118,658	
B		39,423	41,602	45,715	50,941	35,131	35,575	39,424	
C		23,309	24,598	25,821	22,744	21,882	29,186	22,284	
D		63,279	66,777	84,719	67,281	45,968	39,588	35,059	

E		76,073	80,279	83,571	82,311	77,600	102,352	87,479	
F		30	32	34	451	751	900	1	
G		56,227	59,335	65,435	61,858	61,275	61,353	37,784	
H		42,959	45,334	48,407	40,145	31,547	36,272	23,233	
I		162,036	170,994	178,278	186,691	178,694	206,105	164,847	
J		12,102	12,771	13,425	14,630	9,402	12,555	12,224	
K		130,428	137,638	140,450	129,790	118,627	116,793	108,560	
L		1,529	1,614	1,729	148	128	153	1	
M		85,053	89,755	108,782	112,446	67,791	66,538	43,340	
N		35,202	37,148	36,203	28,970	20,994	82,308	107,103	
O		64,422	67,984	77,982	68,407	43,042	24,454	35,370	

5.3.2. Calculation of Watershed Specific Usage associated with Community Water Systems included in the ARP Monitoring Program

Watershed delineations were generated in the course of site characterization work for this 1995 to 2001 monitoring program and provided by the ARP to EPA. Many of the ARP CWS utilized multiple water sources and were associated with multiple watersheds. The watersheds for a CWS in the ARP monitoring program varied in size from 83 acres to 444 million acres (the latter representing a source from the lower Mississippi River). Utilizing ARC-INFO software, EFED apportioned county-level usage estimates (see section 5.3.1) to the ARP watersheds; this apportionment was proportional to the ratio of cropland in the portion of the county within the watershed to the county as a whole, assuming all acetochlor use within a county was distributed evenly among the acres planted to corn in the county and the corn acreage was likewise evenly distributed geographically over the cropland acres for the county in question. These calculations were repeated for each year of the ARP monitoring program (1995 to 2001) using the year-specific usage estimates by county but crop area calculations were not varied by year. The source for the spatial distribution of cropland was the circa 1992, 30-meter resolution, National Land Cover Data set (NLCD; Vogelmann and others, 2001[2]). "Cropland" in the calculation of watershed use consists of the NLCD classifications pasture/hay and orchards/vineyards/other, and a combined category consisting of three individual NLCD classifications: row crops, small grains, and fallow.

The calculated watershed application rates are summarized in Table A2

Table A2. Distribution of watershed application rates for the sites monitored in the ARP surface-water based drinking water supply study.

Pretransformed Data – Sales by County by Year								
Percentile or bin	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Multi-Year**
Maximum lb ai / watershed acre	0.564	0.595	0.657	0.685	0.839	1.121	0.931	0.770
95%ile rate	0.228	0.275	0.308	0.336	0.301	0.435	0.343	0.306
# of sites with usage data	156	157	156	156	155	154	154	150

[2] Vogelmann, J.E., Howard, S.M., Yang, L., Larson, C.R., Wylie, B.K., and Van Driel, N., 2001, Completion of the 1990s national land cover data set for the conterminous United States from landsat thematic mapper data and ancillary data sources: Photogrammetric Engineering and Remote Sensing, v. 67, p. 650–652.

# > 0.01 lb/A	125	144	143	141	141	140	144	143
# > 0.02 lb/A	103	127	131	134	129	135	134	131
# > 0.05 lb/A	61	90	94	101	96	102	101	99
# > 0.10 llb/A	35	60	71	74	66	74	68	69
# > 0.20 lb/A	14	27	38	41	29	42	38	30
# > 0.40 lb/A	1	2	2	2	2	9	5	1

[1] In the interest of time for this assessment the watershed usage was not calculated for all sites with monitoring data (approximately175 for 1995 to 1999, but declining to 165 in 200 and 153 in 2001) ; however, these sites were pre-screened and determined to have very low watershed usage rates or other characteristics that made them unsuitable for calculation of acetochlor loading factors.

5.3.3. Calculation of Watershed Loading Factors Associated with each ARP Monitoring Site

Once usage was apportioned by year to each ARP CWS, acute and chronic exposures "Acetochlor Loading Factors" (ALF) were calculated. The ALF is the amount of acetochlor in the CWS water over a specified exposure period per unit application of acetochlor to the watershed for the relevant year. ALFs were calculated for acute and chronic exposure periods for each site / site-year which had both a sufficient acetochlor watershed usage rate and concentration to accurately calculate the ALF. ALF calculations were made for both the raw water data (only available for an average of 35 of the approximately 175 CWS included in the monitoring program each year of the study) and finished water data (available for all sites monitored). The lack of data on acetochlor concentrations prior to the intake water being subject to treatment systems decreased the accuracy and precision of the estimates of ALF. This is because it is known that some commonly employed treatment systems (e.g., those including powdered or granular activated carbon treatment) can remove a substantial percentage of parent acetochlor from the water but the efficiency of the treatment is also highly variable depending on the specifics / mechanics of the treatment system employed by a specific CWS. Therefore, without raw water samples at a specific CWS monitored at a site by the ARP, it is not possible to precisely determine the ALF. Paired raw / finished water sampling at the remaining sites does give some insight into the treatment effects on acetochlor, but the accuracy of estimates by adding a treatment factor is likely to be highly variable from site to site (and therefore, if employed, may provide inaccurate ALF estimates at some sites).

The calculated ALF factors for the ARP CWS sites should be viewed as providing as providing a detailed picture of the amount of acetochlor detected in surface waters (with both temporal and spatial specificity) under different weather / hydrogeologic conditions in a set of sites representative of areas where corn is grown, but technically the distribution of ALF factors only is accurate for future projections only if the different water treatment systems for each CWS do not change substantially in their degree of efficacy in removing parent acetochlor from source water. Overall, if the ALFs are applied to the estimation of acetochlor in source drinking water, there is expected to be some degree of negative bias introduced since the ARP data are predominantly from finished water sample analyses (exclusively so at the majority of CWS in the study). Recall that, at least for those systems employing the use of activated carbon, the treatment process can remove a large percentage of parent acetochlor from the raw water.

Table A3 provides example data for calculation of loading factors (in this case for an annual exposure estimate, but analogous calculations were made for multi-year, 96-hour, and other exposure periods of interest). Loading factors are calculated as follows:

$$LF = X_{twc} / WS_{rate}$$

$$WS_{rate} = WS_{lbs} / WSA$$

X*twc* = Time-weighted concentration over the exposure period of interest.
WS*rate* = Amount of acetochlor applied per acre per year over the watershed(s) for the CWS.
WS*lbs* = the total pounds of acetochlor applied to the entire watershed in the year of interest (calculated by GIS analysis of the transformed county usage data (see Table A1) along with row cropland distribution mapping layers.)
WSA = Total area of the watershed(s) associated with the CWS intake of interest in acres.

Table A3. Example calculation sequence for acetochlor loading factors at an ARP CWS monitoring site.

Pounds of acetochlor applied to the watershed, 1995 to 2001 (WS*lbs*)						
Ac-Use-95	**Ac-Use-96**	**Ac-Use-97**	**Ac-Use-98**	**Ac-Use-99**	**Ac-Use-00**	**Ac-Use-01**
2682	2831	2962	2926	2727	3549	3094
Pounds of acetochlor applied per acre, 1995 to 2001 (WS*rate*)						
lbs Ac/A, 1995	**lbs Ac/A, 1996**	**lbs Ac/A, 1997**	**lbs Ac/A, 1998**	**lbs Ac/A, 1999**	**lbs Ac/A, 2000**	**lbs Ac/A, 2001**
0.225	0.238	0.249	0.246	0.229	0.298	0.260
Acetochlor Concentration Over the Exposure Period of Interest (ug/L), 1995 to 2001 (X*twc*, in this case, the time-weighted annual means)						
95TWAM	96TWAM	97TWAM	98TWAM	99TWAM	00TWAM	01TWAM
0.119	0.458	0.019	0.261	0.126	0.013	0.055
Acetochlor Annual Loading Factors (ug/L), 1995 to 2001						
L.F. , 1995	**L.F. , 1996**	**L.F. , 1997**	**L.F. , 1998**	**L.F. , 1999**	**L.F. , 2000**	**L.F. , 2001**
0.529	1.928	NC	1.063	0.551	NC	0.212
NC = Not calculated because the acetochlor concentration was too low (<0.02 ug/L annual mean concentration) to achieve sufficient accuracy. Loading factors were also not calculated if the watershed usage rate was too low for accurate calculations (<0.01 lb ai/A of the watershed).						

The resulting loading factors are presented in Table A4.

Table A4. TWAM Loading factors for acetochlor (ug/L of acetochlor per lb ai/A applied in the watershed) from the ARP CWS study.

	1995	1996	1997	1998	1999	2000	2001	Multi-Year
Max	11.988	25.574	9.727	5.486	7.079	6.895	17.953	8.815
Mean	1.720	2.536	1.035	0.973	0.872	0.669	1.381	0.821
StdDev	2.503	5.068	1.493	1.125	1.361	1.324	3.160	1.192
99%ile	10.485	24.995	6.759	5.119	6.395	5.469	13.455	5.071
95%ile	6.637	10.030	2.495	3.043	3.089	0.933	4.229	2.520
90%ile	3.846	4.152	2.186	2.144	1.836	0.832	3.390	1.820
75%ile	1.997	2.285	1.396	1.262	0.841	0.606	0.856	0.949
50%ile	0.599	1.114	0.442	0.517	0.416	0.417	0.338	0.456
25%ile	0.363	0.344	0.190	0.227	0.191	0.228	0.231	0.274
Coun	34	54	53	58	44	25	34	72

[1] In the interest of time for this assessment the watershed usage was not calculated for all sites with monitoring data (approximately175 for 1995 to 1999, but declining to 165 in 200 and 153 in 2001) ; however, these sites were pre-screened and determined to have very low watershed usage rates or other characteristics that made them unsuitable for calculation of acetochlor loading factors.