

US EPA ARCHIVE DOCUMENT

**MEMORANDUM:** November 17, 1999

**SUBJECT:** Review of Norvatis document entitled "Human Exposure to Atrazine and Simazine via Ground and Surface Water: Update - IV." MRID #44597601 (No barcode but should satisfy outstanding barcodes D218661, D223959, D231741, and D239245)

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**INTRODUCTION**

These reports contain (for 21 major atrazine and/or simazine use states) 1993-1997 data on atrazine and simazine in Community Water Supplies (CWSs) that are regulated under the Safe Drinking Water Act (SDWA). The triazine data along with population data are in the Norvatis developed CWS Population-linked Exposure (PLEX) database. This report covers surface water, ground water and "other" source CWSs. "Other source" CWSs are CWSs which use a blend of surface and ground water or for which the source of water is unknown.

To date, Norvatis has submitted the following reports on data in the PLEX database:

- (1) MRID #43598634 - the initial report covering 1993 through the second quarter 1994 (D215586-GW and D218661-SW)
- (2) MRID #43934413 - update I report covering 1993-second quarter 1995 (D223959-GW and D233890-SW)
- (3) MRID #44152122 - update II report covering 1993-second quarter 1996 (D231741-GW and D223889-SW)
- (4) MRID #44315414 - update III report covering 1993-second quarter 1997 (D239245)
- (5) MRID #44597601 - update IV report covering 1993-1997 (No Barcode)

(6) Supplement to update IV report containing EFED/OPP requested cumulative frequency data and graphs (No MRID # or Barcode)

Before the OPP reorganization in the Spring 1997, the EFED included separate ground and surface water sections. Consequently, separate ground and surface water pesticide program action (PPA) sheets were issued for the original report (D215586-GW and D218661-SW), update I (D223959-GW and D233890-SW), and update II (D231741-GW and D223889-SW)

The surface water and "other" source portions of the initial report (MRID #43598634), update I report (MRID #43934413), and update II report (MRID #44152122) were included in a review dated March 30, 1997 from H. Nelson of EFED/OPP to J. McQueen of SRRD/OPP. That 3/30/97 review was meant to satisfy all of the surface water PPA sheets (original - D218661; update I-D233890; and update II-D223889), but mistakenly refers to and includes one of the ground water PPA sheets (D215586 for the original report) instead of the surface water PPA sheet for the original report (D218661). However, that review was meant to satisfy the D218661 surface water PPA sheet instead of the D215586 ground water PPA sheet..

The ground water source portions of the initial, update I and update II reports were never formally reviewed by the Ground Water Section. Consequently, the ground water PPA sheets for update I (D223959) and update II (D231741-GW) have not been satisfied. As discussed in the previous paragraph, the ground water PPA sheet for the original report (D215586) was accidentally satisfied by the 3/30/97 review of surface water data.

This review evaluates the surface water, ground water, and "other" source portions of the update IV report (MRID 44315414) which includes all available data in the 21 major use states from January 1993 through July 1998. Consequently, this review is meant to satisfy all remaining PPA sheets issued for Plex database reports:

D218661-for SW portion of original report (should have been satisfied by the 3/30/97 review)  
D223959-for GW portion of update I  
D231741-for GW portion of update II  
D239245-for update III  
No barcode for update IV

This update IV report (MRID #44315414) does provide some distribution information for period means with the use of bins/bar graphs. However, it does not provide percentiles nor cumulative frequency curves for maximums, annual mean, or period mean concentrations. However, at the request of EFED, Norvatis has supplied a 12/2/98 supplemental report (no MRID #) which does provide maximum and period mean cumulative frequency curves for some of the data. The review of that report is contained in another memo dated November 18, 1999 from H. Nelson of EFED/OPP to Pam Noyes of SRRD/OPP .

## SUMMARY OF DATA SCOPE AND LIMITATIONS

- 1) Norvatis has obtained for 21 "major use states", a substantial amount of data on atrazine and simazine in the drinking water of Community Water Supplies (CWSs) regulated by the Safe Drinking Water Act. The data are for samples collected between January 1993 and December 1997. Norvatis has developed the CWS Population /Linked Exposure (PLEX) database to house the concentration data as well as associated data on populations exposed. The 21 states reportedly account for approximately 92% and 91% of atrazine and simazine use in the U.S., respectively.
- 2) Most of the Norvatis data analysis focuses on state wide and 21 state wide population weighted "1993-1997 period means". Period means are means over the longest time period for which data are available during 1993-1997. Individual state wide and 21 state wide population weighted means (of any kind) are of limited value in characterizing exposure because individual CWSs can be exposed to much higher concentrations than indicated by the population weighted mean. Also, while period means are of value in assessing chronic risks, annual means (of value in assessing compliance with the Safe Drinking Water Act ) and maximums (of value in assessing acute risks) are also of value and should have received equal focus. Annual means exceeding the MCL were listed in tables in the main body of the text, but the focus of the analysis was on period means. Maximums were listed for each state, but no further data analysis of maximums was provided.
- 4) The data submitted by CWSs under the SDWA and placed into the PLEX database do not include data on major degradates of atrazine such as the desethyl, desisopropyl, diamino, and hydroxy atrazine degradates. It is possible that such degradates could exert cumulative effects along with atrazine and together pose a substantially greater risk than atrazine by itself.
- 5) Plotting the period means, annual means, and maximums as cumulative distribution curves would have done a better job of showing the distribution of data than the bar graph/bin distributions of population weighted period means provided in the Update IV report and in previous PLEX database reports.. Norvatis has supplied EFED requested cumulative frequency curves in a 12/2/98 supplement (reviewed separately) and has agreed to supply additional EFED requested cumulative frequency curves in another forth coming supplement.
- 6) Despite the large volume of data in the PLEX database, there are no atrazine or simazine data available for numerous CWSs due primarily to waivers granted by the states. For example for the January 1993 through December 1997 time frame in 21 major use states, 1363 of 5068 surface water source CWSs (26.9%); 12,844 of 26,794 of ground water source CWSs (47.9%); and 420 of 789 "other" source CWSs (53.2%) have no atrazine data in the PLEX database. Furthermore, many of the CWSs which have data only have it for one or two quarters of the 20 quarters between January 1993 and December 1997. Norvatis cites waivers granted to many CWSs by the states as the major cause of the data gaps. Therefore, the data in the PLEX database do not represent a randomly sampled subset for the population across the 21 states. However, assuming

that the granting of a waiver was generally justified by existing monitoring data or use patterns that showed low contamination potential, the data in the PLEX database should generally be conservatively biased.

7) It should be noted that while some of the annual means reported by Norvatis are based on the average of 4 quarterly means or values (as specified in the SDWA), many of the annual means were based on only two or three quarterly means or values and some were set equal to a single available quarterly mean or value. Likewise, the "period means" (longest available mean) were based on available data. Consequently, many "period" means are less than 5 years and some are only annual or even quarterly means or values.

Computing annual means from less than 4 quarters of data represents a greater source of error in the exposure assessment for surface water than ground water because changes in surface water concentrations over one year are typically substantially greater than changes in ground water concentrations over one year.

8) Because of the data gaps discussed in data scope and limitations item #6 above, caution should be followed in attempting to extrapolate from the existing database. However, as previously indicated, although the data do not represent a random sample of the entire population in the 21 states, they should be conservatively biased.

9) Because of annual and period means often being based on data for a small number of quarters as discussed in item #7 above, caution should also be observed in using the reported annual means and period means. Norvatis is correct in indicating that overestimates of annual means are common when they are based on one or two quarters encompassing pesticide use. Since such estimates are generally conservative, they should continue. However, underestimates of annual means generally occur when they are based on one or two quarters outside of the pesticide use season. Such estimates should probably be discontinued for surface water because they often are less than actual annual means.

#### **SUMMARY OF ATRAZINE DATA**

1) Of the 18,024 CWSs in the PLEX database with atrazine data, 182 had one or more annual atrazine means (1993, 1994, 1995, 1996, 1997) > than the MCL for atrazine of 3 ug/L. Of the 182 CWSs, 81 are suppliers and 101 are purchasers from the 81 suppliers. Of the 81 suppliers, 74, 5, and 2 have surface water, "other", and ground water sources, respectively. Of the 81 suppliers, 33 are in Illinois, 16 are in Missouri, 12 are in Kansas, 12 are in Ohio, 4 are in Kentucky, 2 are in Indiana, and one each are in North Carolina and Texas.

Of the 182 CWSs with one or more annual means > 3 ug/L, 13 CWSs had period means (the longest mean available) > 3 ug/L (10 are suppliers and 3 are purchasers).

2) The total population in the 21 "major use states" was listed as approximately 175 million people of which 164 million (93.7%) derive their drinking water from 32,651 CWSs and 125 million (71.4%) derive their drinking water from the 18,024 CWSs having atrazine data in the PLEX database. Of the 125 million "assessed population", 29.5 million (23.6% of the assessed population) are served by the 2104 CWSs with one or more atrazine detections, 7.39 million (5.9% of the assessed population) are served by the 466 CWSs with at least one atrazine detection > 3 ug/L, 1.24 million (1.0% of the assessed population) are served by the 182 CWSs with at least one atrazine annual mean > the MCL of 3 ug/L, and 42,597 (0.034% of the assessed population) are served by the 13 CWSs with an atrazine period mean > 3 ug/L

3) The top 10 of the 21 states with respect to the highest maximum reported atrazine concentration in are in descending order: IL (42 ug/L), OH (39 ug/L), MO (27 ug/L), KY (23 ug/L), KS (16 ug/L), IN (14 ug/L), LA (12.9 ug/L), TX (10.5 ug/L), MI (7.3 ug/L), and NE (5.9 ug/L). Percentiles such as the 95<sup>th</sup> were not provided.

4) The top 10 of the 21 states with respect to the percent atrazine detections in surface water source CWSs are in descending order: IA (571/795 = 71.8%), OH (561/814 = 68.9%), IL (1510/2314 = 65.2%), KS (321/498 = 64.5%), MO (1030/2019 = 51%), LA (61/154 = 39.6%), IN (246/664 = 37.0%), NE (8/23 = 34.8%), TX (328/1196 = 27.4%), and MD (58/412 = 14.1%).

5) The top 10 of the 21 states with respect to percent atrazine detections in ground water source CWSs are in descending order: WI (227/1471 = 15.4%), NE (507/3388 = 15.0%), IA (533/3679 = 14.5%), KS (166/1177 = 14.1%), HI (154/2051 = 7.5%), MD (31/779 = 4.0%), IL (182/5909 = 3.1%), IN (42/1571 = 2.7%), TX (6/294 = 2.0%), and KY (15/808 = 1.9%).

For most states, the percent atrazine detection in ground water source CWSs was much less than in surface water source CWSs. However, two notable exceptions were WI (15.4% in GW versus 3.6% in SW) and HI (7.5% in GW versus 1.4% in SW)

## **SUMMARY OF SIMAZINE DATA**

1) Only 4 of 17,863 CWSs with simazine data in the PLEX database had one or more annual simazine means (1993, 1994, 1995, 1996, 1997) > than the MCL for simazine of 4 ug/L. The Hillsboro IL surface water sourced CWS which serves 4,400 people had a 1994 annual average (based on 5 samples) of 4.82 ug/L. The other 3 CWSs are ones which purchase their water from the Hillsboro IL CWS and serve a combined total of 2078 people.

In general, the frequency and levels of exposure to simazine are substantially less than those for atrazine. Such differences in exposure may be due more to differences in use volume than to other differences such as in environmental fate properties.

2) The top 10 of the 21 states with respect to the highest maximum reported simazine concentration are in descending order: IL (18 ug/L), MO (6.7 ug/L), OH (5.2 ug/L), TX (4.2

ug/L), IN (3.9 ug/L), KY (3.3 ug/L), PA (3.0 ug/L), NC (2.4 ug/L), MD (2.0 ug/L), and CA (1.3 ug/L).

3) The top 10 of the 21 states with respect to the percent simazine detections in surface water source CWSs are in descending order: OH (296/792 = 37.4%), IL (341/2020 = 16.9%), LA (21/127 = 16.5%), IA (31/235 = 13.2%), IN (52/552 = 9.4%), KY (42/789 = 5.3%), MD (19/395 = 4.8%), NC (63/1494 = 4.2%), MI (11/267 = 4.1%), and TX (23/1195 = 1.9%).

4) The top 10 of the 21 states with respect to the percent simazine detections in ground water source CWSs are in descending order: KY (6/421 = 1.4%), MO (23/3006 = 0.77%), IL (38/5902 = 0.64%), IN (8/1485 = 0.54%), KS (3/688 = 0.44%), TX (1/295 = 0.34%), MI (5/1987 = 0.25%), HI (5/2050 = 0.24%), FL (1/457 = 0.22%), and WI (2/1209 = 0.17%), NC (12/9875 = 0.12%), IA (3/2672 = 0.11%),

For most states, the percent simazine detection in ground water source CWSs was much less than in surface water source CWSs.

## RECOMMENDATIONS

1) Under its voluntary stewardship program, Norvatis is participating in monitoring and in watershed management activities with a number of the surface water source CWSs with one or more annual atrazine means > the atrazine MCL of 3 ug/L. Periodic meetings (at least once a year) should be held with Norvatis to determine the extent and effectiveness of such activities in helping CWSs remain or get back into compliance with the SDWA for atrazine.

2) When a CWS requires additional treatment and monitoring to maintain compliance with the SDWA with respect to atrazine, Norvatis should cover the additional treatment and monitoring costs or agree to cancel or adequately restrict atrazine use within the immediate watershed areas supplying water to the CWS.

3) The EFED remains concerned about exposure to the major degradates of atrazine as well as atrazine. Norvatis has included as analytes, a number of triazine ring degradates of atrazine in their Rural Well Survey. In discussions with the EFED, Norvatis has also agreed to include at least some of those degradates as analytes in their Voluntary Monitoring Program of mostly surface water source CWSs. The EFED/OPP recommends that Norvatis be requested to submit more recent data from the Voluntary Monitoring Program including any data on degradates.

4) The EFED is also concerned with exposure in drinking water to other triazines and herbicides as well as any of their degradates that may have the same mammalian toxicity mode of action as atrazine and/or its degradates. To support adequate exposure and risk assessments and to comply with the multiresidue exposure and risk analyses requirements of the Food Quality Protection Act (FQPA), the EFED will continue to work with the USGS and the American Crop Protection Association (ACPA) to develop multiresidue drinking water monitoring programs for select

CWSs nationwide. The American Water Works Association (AWWA) should be included in such discussions. Also, the OPP should help to adequately fund such programs.

## **METHODOLOGY**

### Data Collection

Federally regulated Community Water Supplies serve 94.5% (243 million people) of the U.S. population. Although surface water source CWSs represent only approximately 19% of the total number of CWSs, they supply 61% of the population served by CWSs.

Norvatis sent questionnaires to 21 major atrazine and simazine use states requesting information on the CWSs within the state, the water source(s) for each CWS, the population served by each CWS, and any data on atrazine or simazine collected in compliance with the SDWA. The state selections were based on information provided in Table 1 (Table 1.1-1 of the report). The selection criteria for both atrazine and simazine were lbs ai applied per state and percent of state land treated. The 21 states selected for data collection are shown in Figure 1 (Figure 1.1-1 of the study report). The selected states reportedly represent 92% of total atrazine use, 91% of total simazine use and 68% (175 million people) of the population in the United States. However, atrazine and simazine exposure estimates could only be made for the 125 or 128 million people in those states who get their drinking water from CWSs having atrazine or simazine data, respectively in the PLEX database.

### Scope of Data

There are substantial amounts of data in the CWS PLEX database. Nevertheless, there are also substantial numbers of CWSs with no data in the PLEX database.. Table 2 (Table 4.2-1 of the report) lists the total number of surface water, ground water, and "other" source CWSs and the populations they serve in each of the "21 major use states". Tables 3 and 4 (Tables 4.2-2 and 4.2-4 of the report) list the number of surface water, ground water and "other" source CWSs and the populations they serve that have atrazine or simazine data, respectively in the PLEX data. As can be seen from a comparison of Tables 3 and 4 to Table 2, the number of CWSs in the database are substantially lower than the number of CWSs in the 21 major use states.

For the January 1993 through December 1997 time frame in 21 major use states, 1363 of 5068 surface water source CWSs (26.9%); 12,844 of 26,794 of ground water source CWSs (47.9%); and 420 of 789 "other source CWSs (53.2%) have no atrazine data in the PLEX database. For the same time frame and states, 1262 of 5068 surface water source CWSs (24.9%); 13,137 of 26,794 ground water source CWSs (49.0%); and 389 of 789 "other" source CWSs (49.3%) have no simazine data in the PLEX database.

Many of the CWSs that do have data in the PLEX database have only limited data. One value for atrazine or simazine in one quarter of one year was generally sufficient to be included in the



database. As can be seen from the Appendices, many of the CWSs listed in the database have data limited to one or two quarterly samples in one year.

Norvatis indicates that limited or no SDWA data for many CWSs arises from data waivers from the states. Therefore, the data in the PLEX database do not represent a randomly sampled subset for the population across the 21 states. However, assuming that the granting of a waiver was generally justified by existing monitoring data or use patterns, the data in the PLEX database should generally be conservatively biased.

Despite substantial numbers of CWSs with no data in the PLEX database, the number of CWSs and population served for which SDWA data are available has greatly increased from the initial report to the current update IV as more CWSs have begun to comply with the monitoring requirements of the SDWA and to submit their data to the states. In addition for update IV, several thousand CWSs (whose complete water supply is purchased from a single monitored supplier CWS) have been added to the database. In estimating exposure, the population served by a CWS which purchases its entire water supply from a single supplier CWS are reasonably assumed to be exposed to the concentrations monitored in the supplier CWS.

The data submitted by CWSs under the SDWA do not include data on major degradates of atrazine such as the desethyl, desisopropyl, diamino, and hydroxy atrazine degradates. It is possible that such degradates could exert cumulative effects along with atrazine and together pose a substantially greater risk than atrazine by itself.

#### Method Detection Limits and Handling of Non-Detects

Method Detection Limits (MDLs) for atrazine and simazine as reported by the states are listed in Tables 5 and 6 (Tables 4.2-6 and 4.2-7 from the report), respectively. The tables refer to them (apparently erroneously so) as limits of quantification (LOQs), but LOQs are generally higher than MDLs.

All MDLs are now  $\leq 0.5$  ug/L. However, high MDL values for Louisiana and Texas during 1993-1995 precluded the use of such data in the exposure assessment. The only LA and TX data used in the exposure assessment were data collected during 1996-1997.

Norvatis computed means and performed exposure assessments using two different methods for handling non-detects (Substitution Method and Robust Method). In the Substitution Method, all non-detects were assumed to be equal to half the detection limit. The Substitution Method of handling non-detects is more conservative than the Robust Method. All of the computed means and exposure assessments listed in the exposure tables in the report were computed using the Substitution Method of estimating non-detects.

For states having sufficient detections in surface water, ground water, and "other" source water, the Robust Method was used to determine maximum likelihood estimates of distribution

parameters by fitting assumed lognormal distributions to observed data. The resulting lognormal distributions were then also used to estimate concentrations below the detection limit.

For comparative purposes when possible, means were also computed and exposure assessments also performed using the Robust Method for estimating non-detects. However, they were not listed in the tables in the report because they are generally less conservative than when based on the Substitution Method for estimating non-detects.

### Computations

For each CWS for which there were SWDA data available, an arithmetic mean of the atrazine or simazine values for each quarter (Jan.-Mar., Apr.-June, July-Sept., Oct.-Dec.) was calculated to give a quarterly mean. If only a single value was available for a quarter, it represented the quarterly mean. Annual means were calculated for 1993 and/or 1994 and/or 1995 and/or 1996 and/or 1997. The annual mean for a given year and CWS was computed from the average of  $\leq 4$  quarterly means or values. The period mean for a CWS based on  $\leq 5$  years of data were computed by averaging over the longest time period during 1993-1997 for which the CWS has data.

It should be noted that while some of the annual means are based on the average of 4 quarterly means or values (as specified in the SDWA), many of the annual means were based on only two or three quarterly means or values and some were set equal to a single available quarterly mean or value. Likewise, the period means were based on available data. Consequently, many period means cover less than the 5 years within the 1993-1997 interval and some are only annual means or quarterly means or values.

Computing annual means from less than 4 quarters of data represents a greater source of error in the exposure assessment for surface water than ground water because changes in surface water concentrations over one year are typically substantially greater than changes in ground water concentrations over one year.

CWSs with one or more annual means  $\geq$  the MCL for atrazine (3 ug/L) or the MCL for simazine (4 ug/L) were identified along with their annual means and population served.

Summary statistics for each state and across all of the 21 states included number of CWSs with a period mean  $>$  MCL and the associated populations exposed. Summary statistics for each state and across all 21 states also included population weighted period means

$$\text{State or 21 State Population Weighted Period Mean} = \frac{\sum_i P_i C_i}{\sum_i P_i}$$

where

$P_i$  = population served by CWS  $i$

$C_i$  = period mean concentration in CWS  $i$

$\sum$  = summation over all CWSs (in the state or across all 21 states) having data in the PLEX database

Individual state wide and 21 state wide population weighted means are of limited value in characterizing exposure because individual CWSs can be exposed to much higher concentrations than indicated by the population weighted mean. Also, from the standpoint of determining compliance with the SDWA, period means are of less importance than annual means because it is the latter rather than the former which is compared to the MCL

This update IV report (MRID #44315414) does provide some distribution information for period means with the use of bins/bar graphs. However, it does not provide percentiles nor cumulative frequency for maximums, annual mean concentrations, or period means.

## RESULTS

### CWSs with Atrazine Annual and/or Period Means > MCL of 3 ug/L

Table 7 (Table 5.2-4 of the report) lists the 182 out of 18,024 CWSs in the PLEX database with atrazine data which had one or more annual atrazine means (1993, 1994, 1995, 1996, 1997) > than the MCL for atrazine of 3 ug/L. Table 8 (Table 5.2-5 of the report) lists the 13 CWSs with period means > than the atrazine MCL of 3 ug/L. Tables 7 and 8 also list for each CWS the populations served, the annual means for each year, the period mean, the maximum detected for each year and the number of detects out of the number of samples for each year.

Table 9 (Table 5.2-3 of the report) lists the numbers of CWSs with atrazine detections and the numbers of supplier and purchaser CWSs in each state with annual atrazine means  $\geq$  the MCL of 3 ug/L and/or with period means  $\geq$  3 ug/L. Of the 182 CWSs listed in Table 7, 81 are suppliers and 101 are purchasers. Of the 81 suppliers, 74, 5, and 2 have surface water, blend, and ground water sources, respectively. Of the 81 suppliers, 33 are in Illinois, 16 are in Missouri, 12 are in Kansas, 12 are in Ohio, 4 are in Kentucky, 2 are in Indiana, and one each are in North Carolina and Texas. Of the 18,024 CWSs with atrazine data in the PLEX database, 2104 CWSs (6.4%) had atrazine detections

The 81 supplier CWSs with at least one annual mean > MCL of 3 ug/L accounted for 96 annual means > MCL. Of the 81 supplier CWSs, 68 had only one annual mean > MCL, 11 had two annual means > MCL, and 2 had three annual means > MCL. The 96 annual means > MCL of 3 ug/L were distributed as follows: 3 ug/L  $\leq$  ann. mean < 4 ug/L (50 means), 4 ug/L  $\leq$  ann. mean <

6 ug/L (30 means),  $6 \text{ ug/L} \leq \text{ann. mean} < 9 \text{ ug/L}$  (11 means), and  $9 \leq \text{ann. mean} \leq 12 \text{ ug/L}$  (5 means)

Of the 13 CWSs listed in Table 8 (Table 5.2-5 of the report) having period means (the longest mean available)  $> 3 \text{ ug/L}$ , 10 are suppliers and 3 are purchasers. Of the 10 suppliers, 9 have surface water sources and one has a blend source.

### National Summaries for Atrazine

Table 10 (Table 4.2-3 of the report) summarizes atrazine detection data in the PLEX database. It lists for each of the 21 major use states and source type (surface water, groundwater, other) the number of samples and the number of detections. It also lists for each state the maximum detected, but does not specify the source associated with the maximum.

The percent atrazine detections in surface water source CWSs in each of the 21 "major use states" are in descending order: IA (571/795 = 71.8%), OH (561/814 = 68.9%), IL (1510/2314 = 65.2%), KS (321/498 = 64.5%), MO (1030/2019 = 51%), LA (61/154 = 39.6%), IN (246/664 = 37.0%), NE (8/23 = 34.8%), TX (328/1196 = 27.4%), MD (58/412 = 14.1%), MI (38/271 = 14.0%), KY (102/1277 = 8.0%), WI (2/55 = 3.6%), HI (1/70 = 1.4%), PA (4/320 = 1.3%), NC (18/1494 = 1.2%), MN (1/143 = 0.70%), CA (1/592 = 0.17%), DE (0/35 = 0.0%), FL (0/9 = 0.0%), and NY (0/374 = 0.0%)

The percent atrazine detections in ground water source CWSs in each of the 21 "major use states" are in descending order: WI (227/1471 = 15.4%), NE (507/3388 = 15.0%), IA (533/3679 = 14.5%), KS (166/1177 = 14.1%), HI (154/2051 = 7.5%), MD (31/779 = 4.0%), IL (182/5909 = 3.1%), IN (42/1571 = 2.7%), TX (6/294 = 2.0%), KY (15/808 = 1.9%), PA (30/4042 = 0.74%), DE (3/481 = 0.62%), FL (2/457 = 0.43%), OH (6/2151 = 0.28%), NC (12/9875 = 0.12%), CA (4/7737 = 0.05%), MI (1/1999 = 0.05%), LA (0/1197 = 0.0%), and NY (0/1741 = 0.0%).

For most states, the percent atrazine detection in ground water source CWSs was much less than in surface water source CWSs. However, two notable exceptions were WI (15.4% in GW versus 3.6% in SW) and HI (7.5% in GW versus 1.4% in SW)

Maximum reported atrazine concentrations (ug/L) in CWSs in each of the 21 "major use states" in descending order are: IL (42), OH (39), MO (27), KY (23), KS (16), IN (14), LA (12.9), TX (10.5), MI (7.3), NE (5.9), NC (4.5), IA (4.0), MD (3.5), PA (3.4), WI (3.1), DE (1.9), MN (1.6), HI (1.3), CA (0.6), FL (0.5), NY (no detections). Percentiles such as the 95<sup>th</sup> were not provided.

Table 11 (Table 5.2-1 of the report) lists for the 21 major use states combined and each source type category (Ground Water, Surface Water, Other) various summary statistics for atrazine data in the PLEX Database for January 1993-December 1997.

The total population in the 21 "major use states" was listed in Table 11 as approximately 175 million people of which 164 million (93.7%) derive their drinking water from 32,651 CWSs and 125 million (71.4%) derive their drinking water from the 18,024 CWSs having atrazine data in the PLEX database. Of the 125 million "assessed population", 29.5 million (23.6% of the assessed population) are served by the 2104 CWSs with one or more atrazine detections, 7.39 million (5.9% of the assessed population) are served by the 466 CWSs with at least one atrazine detection  $> 3$  ug/L, 1.24 million (1.0% of the assessed population) are served by the 182 CWSs with at least one atrazine annual mean  $>$  the MCL of 3 ug/L, and 42,597 (0.034% of the assessed population) are served by the 13 CWSs with an atrazine period mean  $> 3$  ug/L

Table 12 (Table 5.2-2 of the report) lists for the 21 major use states combined and each source type category (Ground Water, Surface Water, Other) the numbers of CWSs and population exposed to atrazine period means within 6 different concentration range bins.

Of the 3705 surface water source CWSs with atrazine data in the PLEX database, 12 CWSs (serving 32,159 people) have atrazine period means  $\geq 3$  ug/L and 450 CWSs (serving approximately 3.26 million people) have atrazine period means between 1 and 3 ug/L. The remaining 3243 surface water source CWSs with atrazine data in the PLEX data base (serving  $64.3 \times 10^6$  people) have atrazine period means  $\leq 1$  ug/L.

There are no ground water source CWSs with atrazine period means  $\geq 3$  ug/L and 217 ground water source CWSs (serving 555,362 people) with atrazine period means between 1 and 3 ug/L. The remaining 13,733 ground water source CWSs with atrazine data in the PLEX data base (serving approximately 48.7 million people) have atrazine period means  $\leq 1$  ug/L.

There is one "other" source CWS (serving 10,438 people) with an atrazine period mean  $\geq 3$  ug/L and 14 "other" water source CWSs (serving 98,403 people) with atrazine period means between 1 and 3 ug/L. The remaining 354 "other" water source CWSs with atrazine data in the PLEX data base (serving approximately 7.97 million people) have atrazine period means  $\leq 1$  ug/L.

Figure 2 (Figure 5.2-1 of the report) is a bar graph plot of atrazine population weighted period means for various concentration bins and water source types versus the percent of the total population served by CWSs with atrazine in the PLEX database represented by each bin and water source type.

#### CWSs with Simazine Annual Means $>$ MCL of 4 ug/L

Table 13 (Table 5.3-4 of the report) lists the 4 out of 17,863 CWSs in the PLEX database with simazine data which had one or more annual simazine means (1993, 1994, 1995, 1996, 1997)  $\geq$  than the MCL for simazine of 4 ug/L. The Hillsboro IL CWS which serves 4,400 people had a 1994 annual average (based on 5 samples) of 4.82 ug/L. The other 3 CWSs listed in Table 14 are ones which purchase their water from the Hillsboro IL CWS and serve a combined total of 2078 people

None of the CWSs had 1993-1997 simazine period means  $\geq 4$  ug/L

Of 17,863 CWSs in the PLEX database with simazine data, 725 CWSs (2.2%) had simazine detections (Table 14 which is Table 5.3-3 of the study report)

### National Summaries for Simazine

Table 15 (Table 4.2-5 of the report) summarizes simazine detection data in the PLEX database. It lists for each of the 21 major use states and source type (surface water, groundwater, other) the number of samples and the number of detections. It also lists for each state the maximum detected, but does not specify the source associated with the maximum.

The percent simazine detections in surface water source CWSs in each of the 21 "major use states" are in descending order: OH (296/792 = 37.4%), IL (341/2020 = 16.9%), LA (21/127 = 16.5%), IA (31/235 = 13.2%), IN (52/552 = 9.4%), KY (42/789 = 5.3%), MD (19/395 = 4.8%), NC (63/1494 = 4.2%), MI (11/267 = 4.1%), TX (23/1195 = 1.9%), CA (8/594 = 1.3%), PA (9/785 = 1.2%), MO (8/1115 = 0.72%), KS (1/342 = 0.29%), DE (0/35 = 0.0%), FL (0/9 = 0.0%), HI (0/70 = 0.0%), MN (0/147 = 0.0%), NE (0/22 = 0.0%), NY (0/362 = 0.0%), and WI (0/53 = 0.0%).

The percent simazine detections in ground water source CWSs in each of the 21 "major use states" are in descending order: KY (6/421 = 1.4%), MO (23/3006 = 0.77%), IL (38/5902 = 0.64%), IN (8/1485 = 0.54%), KS (3/688 = 0.44%), TX (1/295 = 0.34%), MI (5/1987 = 0.25%), HI (5/2050 = 0.24%), FL (1/457 = 0.22%), WI (2/1209 = 0.17%), NC (12/9875 = 0.12%), IA (3/2672 = 0.11%),

For most states, the percent simazine detection in ground water source CWSs was much less than in surface water source CWSs.

Maximum reported simazine concentrations (ug/L) in each of the 21 "major use states" in descending order are: IL (18), MO (6.7), OH (5.2), TX (4.2), IN (3.9), KY (3.3), PA (3.0), NC (2.4), MD (2.0), CA (1.3), FL (1.0), MI (0.8), NY (0.7), KS (0.66), HI (0.52), NE (0.51), WI (0.38), DE (no detections), and MN (no detections).

Table 16 (Table 5.3-1 of the report) lists for the 21 major use states combined and each source type category (Ground Water, Surface Water, Other) various summary statistics for simazine data in the PLEX Database for January 1993-December 1997:

The total population in the 21 "major use states" was listed in Table 16 as approximately 175 million people of which 164 million (93.7%) derive their drinking water from 32,651 CWSs and 128 million (73.1%) derive their drinking water from 17,863 CWSs having simazine data in the PLEX database. Of the 128 million "assessed population", 15.1 million (11.8% of the assessed population) are served by 725 CWSs with one or more simazine detections, 85460 people

(0.07% of the assessed population) are served by 23 CWSs with at least one simazine detection > 4 ug/L, 6478 people (0.005% of the assessed population) are served by 4 CWSs with at least one atrazine annual mean > the MCL of 4 ug/L, and none (0.0% of the assessed population) are served by CWSs with an simazine period mean > 4 ug/L

Table 17 (Table 5.3-2 of the report) lists for the 21 major use states combined and each source type category (Ground Water, Surface Water, Other) the numbers of CWSs and population exposed to simazine period means within 6 different concentration range bins.

Of the 3806 surface water source CWSs with simazine data in the PLEX database, none have simazine period means  $\geq 4$  ug/L but 7 CWSs (serving 11,851 people) have simazine period means between 1 and 4 ug/L. The remaining 3799 surface water source CWSs with simazine data in the PLEX data base (serving approximately 70.4 million people) have simazine period means  $\leq 1$  ug/L.

Of the 13657 ground water source CWSs with simazine data in the PLEX database, none have simazine period means  $\geq 4$  ug/L but 5 CWSs (serving 19,899 people) have period means between 1 and 4 ug/L. The remaining 13,652 ground water source CWSs with simazine data in the PLEX data base (serving approximately 49.0 million people) have simazine period means  $\leq 1$  ug/L.

There are no "other" source CWSs with a simazine period mean  $\geq 4$  ug/L and no "other" water source CWSs (serving  $0.098 \times 10^6$  people) with a simazine period mean between 1 and 4 ug/L. The 400 "other" water source CWSs with simazine data in the PLEX data base (serving  $8.63 \times 10^6$  people) all have simazine period means  $\leq 1$  ug/L.

Figure 3 (Figure 5.3-1 of the report) is a bar graph plot of population weighted period mean simazine concentrations for various concentration bins and water source types versus the percent of the total population served by CWSs with simazine in the PLEX database represented by each bin and water source type.

### **COMPARISON OF DATA FROM PRIVATE WELL SURVEYS TO PLEX DATA ON GROUND WATER SOURCE CWSs**

The data in the PLEX database cover CWSs, but not private wells. The authors compared the atrazine and simazine data in the PLEX database for ground water source CWSs to data for wells obtained from the Norvatis Rural Well Survey, the USGS Mid-Continent Study, the USGS NAWQA Study, the Heidelberg College/American Farm Bureau Cooperative Private Well Study, the California Department of Pesticide Regulation Domestic Well Study, the Iowa Geological Survey Study, the Minnesota Department of Agriculture Study, and the USGS/Missouri Department of Health Cooperative Study.

Comparison of detection frequencies between data for ground water source CWSs in the PLEX database and the aggregate rural/private well studies are provided for atrazine and simazine in Tables 18 and 19 (Tables 3.1-2 and 3.1-3 of the study report), respectively. Despite generally lower LOQs in the rural/private well surveys, atrazine was detected more frequently in the CWS PLEX database than in the aggregate private/rural well surveys. Atrazine was detected in 13950 of 57258 samples (24.4%) of ground water source CWSs in the PLEX database compared to 1408 of 16382 samples (8.59%) of rural/private wells. However, simazine (which also generally had lower LOQs in the private/rural well surveys), was detected more frequently in the aggregate private/rural well surveys than in the CWS PLEX database. Simazine was detected in 595 of 3754 samples (15.8%) in the aggregate private/rural well surveys compared to 119 of 53578 samples (0.222%) of ground water source CWSs in the PLEX database.

Tables 18 and 19 also contain a comparison of the number of ground water CWSs with 1993-1997 period means > MCL to the number of rural wells with a concentration > MCL. However, whereas multiple samples were often taken from CWSs over different years, there was generally only one sample collected from each well in the private/rural well surveys. Therefore, a comparison of the percentage of individual CWS concentrations > MCL to the percentage of private/rural well samples > the MCL is more valid. In Table 11 (Table 5.2-1 of the study report) it can be seen that only 21 of 57258 samples (0.037%) of ground water source CWSs had atrazine concentrations > 3 ug/L compared to 25 of 16382 (0.153%) private/rural samples as shown in Table 18. In Table 16 (Table 5.3-1 of the study report) it can be seen that only 4 of 53578 samples (0.007%) of ground water source CWSs had simazine concentrations > 4 ug/L compared to 1 of 3754 (0.027%) private/rural samples as shown in Table 19.

The authors compared 4 arithmetic means of atrazine concentrations in ground water samples in the CWS PLEX database to arithmetic means for the 4 major private/rural well surveys. The 4 PLEX ground water means differed because each one was calculated from data only from states included in the corresponding private/rural well survey. The 4 PLEX atrazine ground water means (0.154, 0.136, 0.124, and 0.148 ug/L) were all greater than the atrazine means for the 4 major private/rural well surveys (0.152 ug/L for the Norvatis Rural Well Survey; 0.058 ug/L for the USGS NAWQA study, 0.037 ug/L for the USGS Midcontinent study; and 0.057 ug/L for the Farm Bureau/Heidelberg College Cooperative study). However, the Norvatis Rural Well Survey atrazine mean (0.152 ug/L) was only slightly smaller than the corresponding PLEX atrazine ground water mean of 0.154 ug/L.

The authors compared 2 arithmetic means of simazine concentrations in ground water samples in the CWS PLEX database to arithmetic means for the 2 major private/rural well surveys having simazine data. The 2 PLEX ground water means differed because each one was calculated from data only from states included in the corresponding private/rural well survey. The 2 PLEX simazine ground water means (0.147 and 0.151 ug/L) were all greater than the simazine means for the 2 major private/rural well surveys having simazine data (0.113 ug/L for the Norvatis Rural Well Survey; and 0.007 ug/L for the USGS NAWQA study).



## GREAT LAKES

Presumably because of the large number of people served by CWSs which withdraw their water from the Great Lakes, the report includes a separate section on the Great Lakes. Table 20 (Table 2.22-1 of the study report) indicates that 767 CWSs serving approximately 18.4 million people obtain their water from the Great Lakes. Of those, 616 CWSs serving approximately 17.1 million people have atrazine and/or simazine data in the PLEX database.

Table 21 (Table 2.22-2 of the study report) provides detection limit ranges and indicates that of the 616 CWSs drawing water from the Great Lakes and having atrazine and/or simazine data in the Plex database, 58 (9.4%) have atrazine detections and 11 (1.8%) have simazine detections.

Unfortunately, despite the availability of PLEX data, the analysis in the report is based on a 1990-1993 raw water monitoring study of the Great Lakes by Schottler and Eisenreich (1994) from which "population weighted" atrazine means of  $< 0.1$  ug/L are derived for each lake. It is unclear how such population weighted means were derived. Furthermore, as previously indicated, population weighted means are of limited value in assessing exposure and risk.

Tables 7 and 14 indicate that none of the CWSs with annual atrazine means  $\geq$  atrazine MCL of 3 ug/L or annual simazine means  $\geq$  simazine MCL of 4 ug/L derive their water from the Great Lakes.

## STATE SUMMARIES FOR ATRAZINE AND SIMAZINE

The type of information provided for atrazine and simazine in Tables 11,12, 16 and 17, and Figures 2 and 3 over all 21 states combined is provided individually for each state in the report. The atrazine tables and figures for the states with the highest number of CWSs with annual and/or period mean atrazine concentrations  $>$  than the atrazine MCL of 3 ug/L (Illinois, Kansas, Missouri, and Ohio) are attached:

Illinois: Tables 22 and 23 (Tables 2.5-1 and 2.5-2 of the study report) and Figure 4 (Figure 2.5-1 of the study report).

Kansas: Tables 24 and 25 (Tables 2.8-1 and 2.8-2 of the study report) and Figure 5 (Figure 2.8-1 of the study report).

Missouri: Tables 26 and 27 (Tables 2.14-1 and 2.14-2 of the study report) and Figure 6 (Figure 2.14-1 of the study report).

Ohio: Tables 28 and 29 (Tables 2.18-1 and 2.18-2 of the study report) and Figure 7 (Figure 2.14-1 of the study report).

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