UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

CERTIFIED MAIL

Dear Registrants:

This is to inform you that the Environmental Protection Agency (hereafter referred to as EPA or the Agency) has completed its review of the available data and public comments received related to the preliminary and revised risk assessments for the pesticide atrazine. The public comment period on the revised risk assessment phase of the reregistration process is closed. Based on comments received during the public comment period and additional data received from the registrants, the Agency revised the human health and environmental effects risk assessments and made them available to the public on May 6, 2002. Additionally, the Agency held a Technical Briefing on April 16, 2002, where the results of the revised human health and environmental effects risk assessments were presented to the general public. This Technical Briefing concluded Phase 4 of the Public Participation Pilot Process developed by the Tolerance Reassessment Advisory Committee (TRAC), and initiated Phase 5 of that process. During Phase 5, all interested parties were invited to participate and provide comments and suggestions on ways the Agency might mitigate the estimated risks presented in the revised risk assessments. This public participation and comment period commenced on May 6, 2002, and closed on July 5, 2002.

Based on its review, EPA has identified risk mitigation measures that the Agency believes are necessary to address the human health and environmental risks associated with the current use of atrazine. The EPA is now publishing its interim decision on the reregistration eligibility of and risk management decision for the current uses of atrazine and associated human health and environmental risks. The reregistration eligibility and tolerance reassessment decisions for atrazine will be finalized once the cumulative assessment for all of the triazine herbicides is complete. The enclosed "Interim Reregistration Eligibility Decision for Atrazine" was approved on January 31, 2003, and contains the Agency's decision on the individual chemical atrazine.

The Agency is aware that several pertinent studies are being performed at this time by researchers that may reduce some of the uncertainties in understanding potential atrazine effects on amphibian endocrinology and reproductive and developmental responses. The Agency has committed to provide these studies along with other available studies, a summary of the available data and methodologies and various data analyses for an external scientific review by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Science Advisory Panel (SAP) at a public meeting which is scheduled for June, 2003. The Agency anticipates that the results from this SAP meeting will provide significant input to enable it publish an amendment to this IRED in October 2003 which will address the issue of the potential effects of atrazine on amphibian endocrinology and development.

A Notice of Availability for this Interim Reregistration Eligibility Decision (interim RED) is being published in the *Federal Register*. To obtain a copy of the interim RED document, please contact the OPP Public Regulatory Docket (7502C), US EPA, Ariel Rios Building, 1200 Pennsylvania Avenue NW, Washington, DC 20460, telephone (703) 305-5805. Electronic copies of the interim RED and all supporting documents are available on the Internet. See http:www.epa.gov/pesticides.

The interim RED is based on the updated technical information found in the atrazine public docket. The docket includes background information and comments on the Agency's preliminary risk assessments, the Agency's April 2002 revised risk assessments for atrazine, and a document summarizing the Agency's Response to Comments. The Response to Comments document addresses corrections to the preliminary risk assessments submitted by chemical registrants and responds to comments submitted by the general public and stakeholders during the comment period on the risk assessment. The docket also includes comments on the revised risk assessment, and any risk mitigation proposals submitted during Phase 5. For atrazine, a proposal was submitted by Syngenta Crop Protection, Inc. (Syngenta), a technical registrant. Comments on mitigation or mitigation suggestions were submitted by growers, agricultural extension agents, environmental organizations, university scientists, and various other organizations.

This document and the process used to develop it are the result of a pilot process to facilitate greater public involvement and participation in the reregistration and/or tolerance reassessment decisions for pesticides. As part of the Agency's effort to involve the public in the implementation of the Food Quality Protection Act of 1996 (FQPA), the Agency is undertaking a special effort to maintain open public dockets on pesticides and to engage the public in the reregistration and tolerance reassessment processes for these chemicals. This open process follows the guidance developed by TRAC, a large multi-stakeholder advisory body that advised the Agency on implementing the new provisions of the FQPA. The reregistration and tolerance reassessment reviews for atrazine are following this new process.

Please note that the atrazine risk assessment and the attached interim RED concern only

this particular triazine. This interim RED presents the Agency's conclusions on the dietary and residential risks posed by exposure to atrazine alone. The Agency has also concluded its assessment of the ecological risk, with the exception of the potential atrazine effects on amphibian endocrinology and reproductive and developmental responses, and worker risks associated with the use of atrazine. Because the FQPA directs the Agency to consider available information on cumulative risk from substances sharing a common mechanism of toxicity, such as the toxicity expressed by the triazine herbicides through a common biochemical mechanism, the Agency will evaluate the cumulative risk posed by the entire triazine class of chemicals after considering the risks for the individual triazines. The Agency is working towards completion of a methodology to assess cumulative risk and the individual risk assessments for each triazine are likely to be necessary elements of any cumulative assessment. The Agency has decided to move forward with individual assessments and to identify mitigation measures necessary to address those human health and environmental risks associated with the current uses of atrazine. The Agency will issue the final tolerance reassessment decision for atrazine and finalize decisions on reregistration eligibility once the cumulative risks for all of the triazines are considered.

This document contains a generic and/or a product-specific Data Call-In(s) (DCI) that outline(s) further data requirements for this chemical. Note that a complete DCI, with all pertinent instructions, is being sent to registrants under a separate cover. Additionally, for product-specific DCIs, the first set of required responses is due 90 days from the receipt of the DCI letter. The second set of required responses is due eight months from the date of the DCI.

The Agency has determined that atrazine is eligible for reregistration provided that all the conditions identified in this document are satisfied, including implementation of the interim risk mitigation measures outlined in Section IV of the document. This determination does not include consideration of the cumulative risk from the use of the triazines. The Agency believes that certain current uses of atrazine pose unreasonable adverse effects to human health and the environment, and that such effects can be mitigated with the risk mitigation measures identified in this interim RED. Accordingly, the Agency recommends that registrants implement these interim risk mitigation measures immediately. Section V of this interim RED describes labeling amendments for end-use products and data requirements necessary to implement these interim mitigation measures. Instructions for registrants on submitting revised labeling and the time frame established to do so can be found in Section VI of this document.

Should a registrant fail to implement any of the risk mitigation measures outlined in this document, the Agency will undertake appropriate action to address concerns about the risks posed by atrazine. Where the Agency has identified any unreasonable adverse effect to human health or the environment, the Agency must take action to address this concern. At that time, any affected person(s) may challenge the Agency's action.

If you have questions on this document or the label changes necessary for reregistration, please contact the Chemical Review Manager, Kimberly Nesci at (703) 308-8059. For questions

about product reregistration and/or the Product DCI that accompanies this document, please contact Bonnie Adler at (703) 308-8523.

Sincerely,

Lois A. Rossi, Director
Special Review and
Reregistration Division

Attachment

Interim Reregistration Eligibility Decision
for
Atrazine

Case No. 0062

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GLOSSARY OF TERMS AND ABBREVIATIONS

AE	Acid Equivalent
a.i.	Active Ingredient
AGDCI	Agricultural Data Call-In
ai	Active Ingredient
aPAD	Acute Population Adjusted Dose
AR	Anticipated Residue
ARC	Anticipated Residue Contribution
BCF	Bioconcentration Factor
CAS	Chemical Abstracts Service
CI	Cation
CNS	Central Nervous System
cPAD	Chronic Population Adjusted Dose
CSF	Confidential Statement of Formula
CFR	Code of Federal Regulations
CSFII	USDA Continuing Surveys for Food Intake by Individuals
DCI	Data Call-In
DEEM	Dietary Exposure Evaluation Model
DFR	Dislodgeable Foliar Residue
DRES	Dietary Risk Evaluation System
DWEL	Drinking Water Equivalent Level (DWEL) The DWEL represents a medium specific (i.e., drinking water) lifetime exposure at which adverse, noncarcinogenic health effects are not anticipated to occur.
DWLOC	Drinking Water Level of Comparison.
EC	Emulsifiable Concentrate Formulation
EEC	Estimated Environmental Concentration. The estimated pesticide concentration in an environment, such as a terrestrial ecosystem.
EP	End-Use Product
EPA	U.S. Environmental Protection Agency
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFDCA	Federal Food, Drug, and Cosmetic Act
FQPA	Food Quality Protection Act
FOB	Functional Observation Battery
G	Granular Formulation
GENEEC	Tier I Surface Water Computer Model
GLC	Gas Liquid Chromatography
GLN	Guideline Number
GM	Geometric Mean
GRAS	Generally Recognized as Safe as Designated by FDA
HA	Health Advisory (HA). The HA values are used as informal guidance to municipalities and other organizations when emergency spills or contamination

	situations occur.
HAFT	Highest Average Field Trial
HDT	Highest Dose Tested
IR	Index Reservoir
LC_{50}	Median Lethal Concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. It is usually expressed as the weight of substance per weight or volume of water, air or feed, e.g., mg/l, mg/kg or ppm.
LD_{50}	Median Lethal Dose. A statistically derived single dose that can be expected to cause death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation). It is expressed as a weight of substance per unit weight of animal, e.g., mg/kg.
LEL	Lowest Effect Level
LOC	Level of Concern
LOD	Limit of Detection
LOAEL	Lowest Observed Adverse Effect Level
MATC	Maximum Acceptable Toxicant Concentration
MCLG	Maximum Contaminant Level Goal. The MCLG is used by the Agency to regulate contaminants in drinking water under the Safe Drinking Water Act.
mg/kg/day	Milligram Per Kilogram Per Day
mg/L	Milligrams Per Liter
MOE	Margin of Exposure
MP	Manufacturing-Use Product
MPI	Maximum Permissible Intake
MRID	Master Record Identification (number). EPA's system of recording and tracking studies submitted.
NA	Not Applicable
N/A	Not Applicable
NAWQA	USGS National Water Quality Assessment
NOEC	No Observable Effect Concentration
NOEL	No Observed Effect Level
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NR	Not Required
OP	Organophosphate
OPP	EPA Office of Pesticide Programs
OPPTS	EPA Office of Prevention, Pesticides and Toxic Substances
Pa	Pascal, the pressure exerted by a force of one newton acting on an area of one square meter.
PAD	Population Adjusted Dose
PADI	Provisional Acceptable Daily Intake
PAG	Pesticide Assessment Guideline
PAM	Pesticide Analytical Method
PCA	Percent Crop Area

PCO	Pest Control Operator
PDP	USDA Pesticide Data Program
PHED	Pesticide Handler's Exposure Data
PHI	Preharvest Interval
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRN	Pesticide Registration Notice
PRZM/ EXAMS	Tier II Surface Water Computer Model
Q_1*	The Carcinogenic Potential of a Compound, Quantified by the EPA's Cancer Risk Model
RAC	Raw Agriculture Commodity
RBC	Red Blood Cell
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RfD	Reference Dose
RQ	Risk Quotient
RS	Registration Standard
RUP	Restricted Use Pesticide
SAP	Science Advisory Panel
SCI-GROW	Tier I Ground Water Computer Model
SF	Safety Factor
SLC	Single Layer Clothing
SLN	Special Local Need (Registrations Under Section 24(c) of FIFRA)
TC	Toxic Concentration. The concentration at which a substance produces a toxic effect.
TD	Toxic Dose. The dose at which a substance produces a toxic effect.
TEP	Typical End-Use Product
TGAI	Technical Grade Active Ingredient
TLC	Thin Layer Chromatography
TMRC	Theoretical Maximum Residue Contribution
torr	A unit of pressure needed to support a column of mercury 1 mm high under standard conditions.
TRR	Total Radioactive Residue
UF	Uncertainty Factor
µg/g	Micrograms Per Gram
µg/L	Micrograms Per Liter
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UV	Ultraviolet
WHO	World Health Organization
WP	Wettable Powder
WPS	Worker Protection Standard

Executive Summary

EPA has completed its review of public comments concerning the revised atrazine risk assessments and is issuing its interim risk management decision for atrazine. The revised risk assessments are based on the Agency's review of available data on the currently registered uses of atrazine and public comments received during the reregistration process. The Agency invited stakeholders to provide proposals, ideas or suggestions on appropriate mitigation measures before the Agency issued its risk mitigation decision for atrazine. After considering the risks identified, public comments, and mitigation options proposed by several entities, the Agency developed its interim risk management decision for atrazine. This decision is discussed fully in this document and in a January 31, 2003, Memorandum of Agreement between the Agency and the primary technical registrant, Syngenta Crop Protection, Inc. The Agency expects the atrazine technical registrants to agree to adopt the risk management measures presented in the IRED and in the MOA. Neither the risk assessments nor the interim risk management measures include consideration of cumulative risks posed by all of the triazines and amphibian risk issues.

Atrazine is a triazine herbicide currently registered for use against broadleaf and some grassy weeds. Atrazine is currently registered for use on corn (field and sweet); guavas; macadamia nuts; sorghum; sugarcane; range grasses for the establishment of permanent grass cover on rangelands and pastures under USDA's Conservation Reserve Program (CRP) in OK, NE, TX, and OR; wheat (where application is to wheat stubble on fallow land following wheat harvests; wheat is not the target crop); conifer forests; Christmas tree farms; sod farms; golf courses and residential lawns (Southern turfgrasses). Given the specific nature of the lawn uses, much of atrazine's use on lawns is confined to Florida and the Southeast. Atrazine degrades into hydroxy compounds and chlorotriazine degradates. Atrazine was first registered in 1958 as an herbicide. Use data from 1990 to 1997 indicate that approximately 76.5 million pounds of atrazine active ingredient are used domestically each year.

The Food Quality Protection Act of 1996 (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and other substances that have a common mechanism of toxicity with other pesticides. The Agency has classified the triazine herbicides (atrazine, simazine, and propazine) and their common chlorinated degradates as having a common mechanism of toxicity. The Agency has not yet completed its cumulative risk assessment for the triazine class, but the cumulative risks of these chemicals will be considered in the future. At that time, the Agency's final tolerance reassessment decision for atrazine and the other triazines will be issued. The Agency may need to pursue further risk mitigation for atrazine to address any risks identified in the cumulative assessment for the triazines.

Overall Risk Summary

The Agency's human health risk and ecological risk assessments for atrazine indicate

risks of concern. Intermediate-term (seasonal) dietary risk from drinking water exceeds the Agency's level of concern (>100% cPAD) at the 99.9th exposure percentile for infants, children 1-6 years of age, and adults in 34 community water systems (CWS) primarily in the Midwest. Acute dietary drinking water risks, and acute and chronic dietary food risks (alone) are below the Agency's level of concern for the U.S. population and all population subgroups.

Further, there are some concerns for workers who mix, load and apply atrazine to agricultural and turf sites and for homeowners who apply atrazine products to home lawns. In addition, there are risks of concern for adults and children exposed to atrazine treated lawns after applications.

For ecological effects, the Agency has conducted a screening level assessment for terrestrial impacts and a refined exposure assessment for aquatic impacts of atrazine use. These assessments indicate that atrazine is likely to result in community- and population-level risk at 10 to 20 ppb. The ecological assessment does not address the potential for effects on amphibians endocrinology and reproductive and developmental responses. The Agency will consider amphibian risk after the Agency obtains further data and will address any risks identified in a revision to the IRED to be published by October 31, 2003.

To mitigate risks of concern posed by the uses of atrazine, the Agency considered the mitigation proposal submitted by the technical registrants, as well as comments and mitigation ideas from other interested parties, and has decided on a number of label amendments to address the dietary (drinking water), worker, and residential concerns. In addition, to further address drinking water concerns and to address ecological concerns, the Agency and the technical registrants have agreed to a performance standard for atrazine that must be met in community water systems, prohibition of use in watersheds if the standard is not met, and monitoring data requirements as described in the Memorandum of Agreement. Results of the risk assessments, the necessary label amendments to mitigate those risks, and information on the Agreement between the Agency and the technical registrants are presented in this IRED.

Dietary Risk (Food)

Acute risk estimates for food and drinking water and chronic food risk estimates do not exceed the Agency's level of concern; therefore, mitigation measures are not needed to address acute dietary risks or chronic food risk estimates.

Dietary Risk (Drinking Water)

Intermediate-term (seasonal) drinking water risk estimates do exceed the Agency's level of concern in 34 CWS primarily in the Midwest. The registrant has added three CWS to these 34 to make a total of 37 CWS that are of concern. To mitigate these risks, the Agency has determined that a performance standard that must be met in these CWS and prohibiting use in the watershed if the performance standard is not met is necessary to avoid unreasonable adverse effects. In addition, the Agency is requiring extensive monitoring data on these CWS and other

CWS that are in atrazine use areas.

To confirm that risks from atrazine in rural wells is not a concern, the Agency is requiring monitoring data for atrazine levels in rural wells in atrazine use areas.

Residential Risk

Residential and turf use results in risks of concern for children reentering treated atrazine turf and for homeowners applying product to turf using a bellygrinder.

To mitigate these risks, the Agency has determined that the following measures are necessary:

- Restrict the application of granular lawn products when using hand-held devices to spot applications only.
- Prohibit applications of granular lawn products by hand.
- Reduce the maximum 1 time application rate for liquid formulations on lawns and turf to 1 lb ai/A from 2 lb ai/A.
- Require that granular lawn products be watered in.

Occupational Risk

Occupational exposure to atrazine is of concern to the Agency. For agricultural and turf lawn care operator uses of atrazine, several mixer/loader/applicator risk scenarios currently exceed the Agency's level of concern at baseline PPE or label PPE. The Agency has determined that a number of measures are needed to mitigate these risks, as follows:

Agricultural Uses

- Require closed mixing and loading systems for the following scenarios:
  - Mixing and loading liquid formulations for aerial application at a rate greater than 3 lb ai/A
  - Mixing and loading dry flowable formulations for aerial application
- Require maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; protective eyewear (mixer/loaders) and a dust/mist respirator) for the following formulations:
  - Liquids
  - Dry Flowables
- Require that wettable powders be packaged in water soluble bags for both aerial and groundboom applications.
- Require closed cockpits for aerial applications
- Restrict the impregnation of bulk fertilizer to commercial facilities (prohibit on-farm impregnation)
- Restrict the impregnation of dry bulk fertilizer to 500 tons per day for no more than 30

days per year

- Reduce the maximum application rate for handlers applying liquids with rights-of-way sprayers to 1.0 lb ai/A
- Require closed cabs for flaggers, in accordance with current agricultural practices.

Lawn Care Operators

- Require the use of baseline PPE (long-sleeved shirt and long pants, shoes and socks) for the following formulations:
  - Granulars
- Require the use of baseline PPE plus gloves for the following formulations:
  - Water dispersable granules
  - Water soluble powders
- Require the use of the maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; and a dust/mist respirator) for the following formulations:
  - Liquids
- Reduce the maximum single application rate for liquid formulations on lawns and turf to 1 lb ai/A from 2 lb ai/A
- Require that granular lawn products be watered in

The Agency does not have risks of concern for workers reentering treated fields; therefore, no mitigation is needed.

Ecological Risk

Ecological risks are also of concern to the Agency. The environmental risk assessment suggests that exposure to atrazine could result in community-level and population-level effects in aquatic communities at concentrations of 10-20 ppb atrazine.

To address these risks, the Agency has determined that an ecological assessment process to identify waterbodies at risk and monitor these waterbodies for atrazine concentrations. In addition, it may be necessary to undertake mitigation in these vulnerable ecosystems. The specifics of this ecological program will be negotiated with the technical registrants and agreed to by April 30, 2003.

The ecological assessment does not address the potential for effects on amphibian endocrinology and reproductive and developmental responses. The Agency will consider amphibian risk after the Agency obtains further data on this issue. Any risks identified will be addressed by the Agency in a revision to the IRED to be published by October 31, 2003.

Conclusions

The Agency is issuing this interim Reregistration Eligibility Decision (IRED) for atrazine, as announced in a Notice of Availability published in the Federal Register. This IRED

includes guidance and time frames for implementing label changes for products containing atrazine. Note that the Agency has shortened the time period for implementation of risk mitigation measures outlined in this document and to establish monitoring programs so that the risks identified herein are addressed as quickly as possible. There is a 60-day comment period on this document. With the mitigation measures detailed in this document, the Agency has determined that, until the cumulative risks from all the triazines has been considered, most of the currently registered uses of atrazine may continue. Neither the tolerance reassessment nor the reregistration eligibility decision for atrazine can be considered final until the cumulative risk for all triazines is considered.

I. Introduction

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products containing active ingredients originally registered prior to November 1, 1984. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the U.S. Environmental Protection Agency (EPA or "the Agency"). Reregistration involves a thorough review of the scientific database supporting a pesticide's registration. The purpose of the Agency's review is to reassess the potential hazards and benefits arising from the currently registered uses of the pesticide; to determine if there is a need for additional data on benefits, health and environmental effects; and to determine whether the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

On August 3, 1996, the Food Quality Protection Act of 1996 (FQPA) was signed into law. This Act amends the Federal Food, Drug and Cosmetics Act (FFDCA) to require reassessment of all existing tolerances. The Agency had decided that, for those chemicals that have tolerances and are undergoing reregistration, the tolerance reassessment will be initiated through this reregistration process. It also requires that by 2006, EPA must review all tolerances in effect as of August 2, 1996 (the day before FQPA was enacted). FQPA also amends the FFDCA to require a safety finding in tolerance reassessment based on several factors, including an assessment of cumulative effects of chemicals with a common mechanism of toxicity. Atrazine belongs to a group of systemic herbicides called triazines that share a common mechanism of toxicity. Agency is continuing its reregistration program while it resolves the remaining issues associated with the implementation of FQPA.

This document presents the Agency's revised human health and ecological risk assessments; its progress toward tolerance reassessment; and the interim decision on the reregistration eligibility of atrazine. It is intended to be only the first phase in the reregistration process for atrazine. The Agency will eventually proceed with its assessment of the cumulative risk of the triazine pesticides and issue a final reregistration eligibility decision for atrazine.

The implementation of FQPA has required the Agency to revisit some of its existing views relating to the determination and regulation of dietary risk, and has also raised a number of new issues that need to be addressed. These issues were refined and developed through collaboration between the Agency and the Tolerance Reassessment Advisory Committee (TRAC), a committee that was composed of representatives from industry, environmental groups, and other interested parties.

This interim Reregistration Eligibility Decision document consists of six sections. Section I contains the regulatory framework for reregistration/tolerance reassessment. Section II provides a profile of the use and usage of the chemical. Section III gives an overview of the revised human health and environmental effects risk assessments resulting from public comments and other information. Section IV presents the Agency's interim decision on reregistration eligibility and risk management decisions. Section V summarizes the label

changes necessary to implement the risk mitigation measures outlined in Section IV. Section VI provides information on how to access related documents. Finally, the Appendices list Data Call-In (DCI) information. The revised risk assessments and related addenda are not included in this document, but are available on the Agency's web page: "www.epa.gov/pesticides/reregistration," and in the Public Docket.

II. Chemical Overview

A. Regulatory History

Atrazine was first registered in 1958 as an herbicide. On November 10, 1983, a Registration Standard for atrazine was issued. This document noted the Agency's concern about the dietary carcinogenic risk from ground and surface water contamination. The Registration Standard also required the submission of generic and product-specific data to support the continued registration of atrazine products. Since the Registration Standard was issued in 1983, there have been a total of 4 DCIs issued (September 1990, September 1992, March 1995, October 1995).

In 1988, EPA issued a preliminary notification of the Agency's intention to initiate Special Review under FIFRA based on concerns regarding the carcinogenic potential of atrazine and possible risks resulting from exposure to atrazine in the diet from treated food and drinking water.

In the early 1990s, atrazine's occurrence in the environment prompted the Environmental Protection Agency's Office of Water (OW) to regulate atrazine under the Safe Drinking Water Act (SDWA). In 1991 OW established a Maximum Contaminant Level (MCL) of 3 parts per billion (ppb) for atrazine. Under the SDWA, atrazine has been subject to compliance monitoring. OW has also established a one-day Health Advisory Level (HAL) for atrazine of 100 ppb.

In the early 1990s, the registrant voluntarily instituted several risk reduction measures to address concerns raised about surface water and groundwater contamination by atrazine. In 1990, the following measures were undertaken by the registrant to address groundwater exposure concerns:

- Reduction of the application rate for corn and sorghum to 3.0 lbs ai/acre from 4.0 lbs ai/acre.
- Reduction of the maximum rate for non-cropland and total vegetation control to 10 lbs ai/acre from 40 lbs ai/acre.
- Require that postemergence applications to corn and sorghum be made before they reach 12 inches in height.
- Deletion of rangeland, proso millet, and pineapple uses.
- Prohibition of chemigation (applying atrazine through irrigation systems).
- Institution of a well-head protection plan requiring 50 foot setbacks around all wells for mixing, loading, or applying atrazine-containing products.
- Institution of construction requirements for bulk storage facilities to prevent point source contamination from spills
- Classification of all atrazine-containing products (except for the lawn care, turf, and conifer uses) as Restricted Use Pesticides (RUPs).

In 1992, the following additional measures were undertaken to address concerns about atrazine contamination of surface water sources:

- Further reduction of the total seasonal application rates for corn and sorghum to 2.5 lbs ai/acre per year. This rate includes a 1.5 lbs ai/acre per year pre-emergence use and a 1.0 lbs ai/acre per year post-emergence use.
- Deletion of all uses for total vegetation control in non-cropland.
- Expansion of restricted use criteria to include surface water concerns.
- Expansion of the setback requirements, including: a 50 foot setback around surface water sources when workers are mixing and loading atrazine-containing products; a 66 foot application (ground and aerial) setback from points of entry where field surface water runoff enters surface water sources; and, a 200 foot application setback around lakes and reservoirs.

In November 1994, EPA initiated a Special Review for the triazine pesticides (atrazine, simazine and cyanazine; 59 *FR* 60412) based on cancer risk concerns for people potentially exposed to atrazine through consumption of food and drinking water, and lawn treatments. The basis for the Special Review also included cancer risk concerns for workers exposed to atrazine in various agricultural settings and application scenarios. At the time that the Special Review was initiated, atrazine and the other triazines were classified as Group C carcinogens (possible human carcinogens).

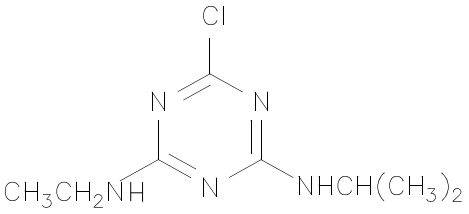
Further labeled use restrictions in 1996 reduced environmental exposure from tile-terraced fields containing standpipes, as follows:

- Restrictions against application within 66 feet of standpipes.
- A requirement that applications be incorporated to a depth of 2 to 3 inches.
- Restrictions against application to no-till fields unless practicing high crop residue management.

In August 2002, the Agency and NRDC jointly agreed to request that the court extend the deadline for the IRED to January 31, 2003 (Consent Decree (as amended) entered in Natural Resources Defense Council v. Whitman, Case Number C -99-3701 CAL, N. D. California (2002)). The new schedule includes the completion of an IRED by January 31, 2003 (this document), and a revised IRED by October 31, 2003, to consider a number of additional new studies on potential amphibian risk. The Agency also agreed to bring to the FIFRA Scientific Advisory Panel issues regarding amphibian effects and carcinogenicity.

B. Chemical Identification

- **Chemical Structure:**



- **Common name:** Atrazine
- **Chemical name:** 6-chloro-N2-ethyl-N4-isopropyl-1,3,5-triazine-2,4-diamine
- **Chemical family:** Triazines
- **Case number:** 0062
- **CAS registry number:** 1912-24-9
- **OPP chemical code:** 080803
- **Empirical formula:** $C_8H_{14}ClN_5$
- **Molecular weight:** 215.7
- **Vapor Pressure:** 40 *u*Pa at 20 °C
- **Technical registrants:** Agan Chemical Manufacturing, LTD.
  Dow AgroSciences
  Drexel Chemical Company
  Oxon Italia S.P.A.
  Platte Chemical Company Inc.
  Syngenta Crop Protection Inc.

Atrazine is a white crystalline solid with a melting point of 172-175° C, density of 0.35 g/mL, octanol/water partition coefficient (log P_{ow}) of 2.7645, and vapor pressure of 40 µPa at 20° C. Atrazine is moderately soluble in water (33 ppm at 25° C), and is soluble in octanol (0.82 g/100 mL), ether (0.86 g/100 mL), methanol (1.4 g/100 mL), ethyl acetate (2.5 g/100 mL), and chloroform (7.8 g/100 mL) at 20° C. Atrazine has four hydroxyatrazine compounds and three chlorinated atrazine compounds as metabolites. The three chlorinated metabolites are desethylated atrazine, desisopropyl atrazine, and diaminochlorotriazine (DACT).

C. Use Profile

Atrazine is a systemic triazine herbicide registered for the control of broadleaf weeds and some grassy weeds. Currently, atrazine is one of the two most widely used agricultural pesticides in the United States. An estimated average of approximately 64 to 76 million pounds of active ingredient are applied per year. Annually, 75% of all field corn, 58.5% of all sorghum, and 76% of all sugarcane grown are treated with atrazine. Most of atrazine applied to corn and sorghum is applied pre-emergence. The following information is based on the currently registered uses of atrazine that were originally being supported for reregistration. Appendix A at the end of this document presents a summary of eligible uses and revised use conditions.

Type of Pesticide: Triazine Herbicide

Summary of Use Sites:

Food: Atrazine is used on corn (field and sweet), guavas, macadamia nuts, sorghum, sugarcane, range grasses under USDA's Conservation Reserve Program (CRP), and wheat (where application is to wheat stubble on fallow land following wheat harvests; wheat is not the target crop)

Other Agricultural Sites: Atrazine is also used in conifer forests, on Christmas tree farms and on sod farms.

Residential: Atrazine is used on golf courses and residential lawns. Given the specific nature of the lawn uses, much of atrazine's use on lawns is confined to Florida and the Southeast.

Other Sites: Atrazine in used on range grasses for the establishment of permanent grass cover on rangelands and pastures under the Conservation Reserve Program (CRP) in four states: OK, NE, TX, and OR.

Public Health: None

Target Pests: Broadleaf and some grassy weeds.

Formulation Types Registered:

Formulated as a flowable concentrate, a water dispersable granular (dry flowable), a ready-to-use product, and a granular.

Method and Rates of Application:

Equipment: Atrazine may be applied by groundboom sprayer, aircraft, tractor-drawn spreader, rights-of-way sprayer, low pressure handwand,

backpack sprayer, lawn handgun, push-type spreader, and bellygrinder.

Rates**:** Maximum application rates range from 0.4 lb ai/A or lb ai/gal to 4.0 lb ai/A or lb ai/gal (conifer forests, sugarcane, Christmas tree farms, sod farms (FL), Bermuda grass highway rights-of-way). The number of maximum allowable applications ranges between 1 and 4 per season or year, when specified.

Timing:

Sugarcane: Applications to sugarcane are usually at planting (fall), in the spring after emergence, and an additional post-emergence application (often at layby (canopy closure)). However, these later applications are only used if pest pressure dictates need. Also, ratoon crops may face heavier weed pressure, and therefore additional applications are more likely during ratoon crops.

Corn: Applications to corn are most often pre-emergence (mid-April through mid-May in the major corn growing areas). Post-emergence applications are most likely to occur up to the end of June, until corn reaches 12" in height. There will be some variability in timing based on geographical regions.

Sorghum: Applications to corn are most often pre-emergence (mid-June to mid-July in the major sorghum growing areas). Post-emergence applications are most likely to occur up to the end of August. There will be some variability in timing based on geographical regions.

Use Classification: Most atrazine products are restricted use pesticides.

D. Estimated Usage of Pesticide

This section summarizes the best estimates of available pesticide usage information for atrazine from 1990 to 1997. A full listing of all uses of atrazine, with the corresponding use and usage data for each site, has been completed and is in the January 10, 2001 "Quantitative Usage Analysis for Atrazine" document available in the public docket and on the internet. The data, reported on an aggregate and site basis, reflect annual fluctuations in use patterns as well as the variability in using data from various information sources.

Estimates for total annual domestic use of atrazine averages approximately 76.5 million pounds of active ingredient. Crops with the highest weighted average percent crop treated are corn (75%), sugarcane (76%), sorghum (58.5%), sweet corn (processed) (58%) and sweet corn (fresh) (49%). In terms of pounds applied, corn (83%), sorghum (10%), and sugarcane (3%) account for the greatest use. Less than 2% of atrazine is believed to be applied in forestry, turf or other non-agricultural uses.

Table 1. Atrazine Estimated Usage for Representative Sites

Crop	Pounds Active Ingredient Applied (000) (Wt. Avg.)[1]	Estimated Maximum % Crop Treated	Weighted Average Percent Crop Treated
Food Crops			
Sweet Corn, Fresh	160	59.9	49.5
Sweet Corn, Processed	250	64.6	58.2
Sorghum	7,790	73.7	58.5
Corn	63,800	84.0	75.0
Winter Wheat	300	1.1	0.6
Sugar Cane	2550	95	76.0
Non-Food Crops			
Hay	150	0.7	0.4
Pasture	46	0.1	0.0
Summer Fallow	8	0.1	0.1
Woody Ornamentals	140	na	na
Forestry	48	na	na
Turf - Lawn Care Operators	600	na	na
Sod	160	na	na
Golf Courses	78	na	na

[1] Weighted Average is based on data for 1990-1997; the most recent years and more reliable data are weighted more heavily. Based on USDA/NASS and EPA proprietary data.

III. Summary of Atrazine Risk Assessments

The following is a summary of EPA's revised human health and ecological risk findings and conclusions for the triazine herbicide atrazine. These findings and conclusions are fully presented in the following documents, available on EPA's web page at www.epa.gov/pesticides and in the public docket:

- Reregistration Eligibility Science Chapter for Atrazine - Environmental Fate and Effects Chapter (April 22, 2002);
- Atrazine: HED's Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (April 16, 2002);
- Addendum and corrections to Occupational and Residential Exposure Chapter for Atrazine (May 23, 2002); and
- Atrazine: Addendum to Revised Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) (January 31, 2003).

These risk assessments for atrazine were presented at a Technical Briefing held on April 16, 2002, and followed by an opportunity for public comment on risk management. The risk assessments presented here form the basis of the Agency's risk management decision for atrazine only; the Agency must consider a cumulative assessment of the risks of all triazine pesticides before any final decisions can be made.

A. Human Health Risk Assessment

EPA issued its preliminary human health risk assessment for atrazine and its metabolites on February 14, 2001 (Phase 3 of the TRAC process). In response to comments and studies submitted during Phase 3, the risk assessment was updated and refined, and released on May 6, 2002. In addition, any new Agency policies were incorporated as appropriate. Major revisions to the human health risk assessment are listed below:

- Revisions to the occupational and residential risk assessments to incorporate more recent data and information received in the response to comments.
- Revisions to the dietary drinking water risk assessment to include additional monitoring data received from the registrant.
- A decision not to require tolerances for hydroxyatrazine.

Exposure scenarios considered in the human health assessment are acute, intermediate-term, and chronic dietary exposure through food plus drinking water; short-term residential exposures from residential applications of atrazine; acute, chronic, and short-term aggregate exposure from all sources (food, drinking water, and residential); and short and intermediate-term occupational exposures.

In the risk assessments presented in this document, the toxicity of atrazine and its chlorinated metabolites are considered to be equivalent; therefore, the risks associated with

exposure to atrazine and its chlorinated metabolites are presented together. The toxicity of the metabolite hydroxyatrazine is considered to be independent of the effects of atrazine; thus, the risks from exposure to hydroxyatrazine are presented independently.

1. Dietary Risk From Food

a. Toxicity and Carcinogenicity

1) Atrazine and the Chlorinated Metabolites

The atrazine toxicity database is extensive. The Agency has reviewed these toxicity studies and has a high degree of confidence in the scientific quality of the toxicity studies conducted with atrazine. Special studies examining the toxicology of atrazine have been performed by the registrant in addition to the required guideline studies. Additionally, EPA's National Health and Environmental Effects Laboratory (NHEERL) has performed studies investigating atrazine's neuroendocrine mode of action and related reproductive and developmental effects.

For the purposes of this risk assessment, the toxicity of atrazine's chlorotriazine metabolites is considered to be equivalent to that of parent atrazine and exposure to those metabolites may occur. Therefore, the chlorotriazine metabolites are included in the atrazine human health risk assessment.

In accordance with the 1999 Draft Guidelines for Carcinogen Risk Assessment, EPA's Cancer Assessment Review Committee (CARC) classified atrazine as "not likely to be carcinogenic to humans." The attenuation of the LH surge and estrous cycle disruptions appears to be a species, strain and sex specific effect occurring only in female Sprague-Dawley rats. The Agency's FIFRA Scientific Advisory Panel (SAP) convened in June 2000 determined that it is unlikely that atrazine's cancer mode of action in the Sprague-Dawley rat is operative in humans. The Agency also concluded that the mode of action is not relevant to humans. Although hypothalamic disruption of pituitary function (i.e., attenuation of the LH surge) and resulting estrous cycle disruption may be occurring in humans following atrazine exposure, the hormonal environment resulting from these events would be expected to be much different from the environment seen in the rat. The prolonged/increased exposure to estrogen and prolactin seen in the rat would not be expected to occur in humans. Consequently, a cancer risk assessment was not conducted for atrazine.

2) Hydroxyatrazine

Atrazine is metabolized to hydroxyatrazine by plants and bacteria. Animals do not metabolize atrazine to hydroxyatrazine; however, they may receive hydroxyatrazine in their diets through forages and fodders.

A limited toxicology database for hydroxyatrazine compounds is available.

Hydroxyatrazine appears to be less acutely toxic than the parent atrazine. The only effects seen in any of the submitted studies that may be attributable to a single dose were developmental alterations in the developmental rat study. The developmental alterations seen in this study were seen only at the high dose, were few in number, and were deemed to be not of toxicological significance. Thus, the Agency did not select an acute endpoint for hydroxyatrazine, and concludes that no toxicologically significant endpoint to represent a single exposure can be found in the toxicology database for hydroxyatrazine. Hydroxyatrazine has not been classified as to its carcinogenic potential by the Agency.

Further details on the toxicity of atrazine and its chlorinated and hydroxy metabolites can be found in the April 16, 2002, Revised Human Health Risk Assessment; the January 31, 2002, Addendum to the Revised Human Health Risk Assessment; and all supporting documents. An overview of the studies and safety factors used for the dietary risk assessment is outlined in Table 2.

b. FQPA Safety Factor

The FQPA safety factor is intended to provide up to an additional 10-fold safety factor (10X) to account for potential pre- and post-natal toxicity and the completeness of the data with respect to exposure and toxicity to infants and children.

1) Atrazine and the Chlorinated Metabolites

The FQPA Safety Factor of 10x was retained for atrazine and its chlorinated metabolites to protect the safety of infants and children in assessing risk from dietary (food and drinking water) exposures.

The Agency concluded that, as to dietary risk, the default 10x FQPA safety factor is required because of the absence of reliable evidence showing that a different safety factor would be protective of infants and children. The principal grounds for this conclusion are:

- residual concerns for the effects of the neuroendocrine mode of action described for atrazine on the development of the young. These concerns could not be accounted for in the determination of toxicity endpoints and traditional uncertainty factors to be used in risk assessment; and,

- residual concerns with regard to the drinking water exposure assessment. The various water monitoring data sources that exist for atrazine and its chlorinated metabolites indicate that exposure via drinking water sources is high in some of the systems that have been monitored. In addition, widespread low levels are commonly detected. Limitations in the extent, frequency, and compounds tested for in the monitoring data raise significant uncertainties regarding the level of exposure to atrazine and its metabolites.

The 10X FQPA safety factor is being applied across all aggregate risk assessments based

on estimated dietary exposures for all populations considered in these risk assessments.

For residential exposures, the FQPA safety factor was reduced to 3x. This is considered adequate to protect the safety of infants and children in assessing residential exposure and risks because the exposure concerns for drinking water included in the 10x FQPA safety factor for dietary exposure do not apply to residential exposure scenarios, although the concerns for the effect of the neuroendocrine mode of action on the development of the young remain. The assumptions inherent to the Agency's residential risk estimates based on screening-level procedures are conservative and protective. The 3x FQPA safety factor is being applied across all aggregate risk assessments based on estimated residential exposures for all populations considered in these risk assessments.

2) Hydroxyatrazine

The FQPA Safety Factor of 10x was removed for atrazine's hydroxymetabolites for the following reasons:

- There was no evidence of increased susceptibility in the prenatal developmental toxicity study in rats with hydroxyatrazine;
- There is no evidence of neurotoxicity from the submitted toxicity studies;
- The neuroendocrine effects described for atrazine are postulated to be part of a cancer mode of action for atrazine. Because hydroxyatrazine is non-carcinogenic, the current belief is that the neuroendocrine effects described for atrazine are not occurring following hydroxyatrazine exposure;
- The dietary and non-dietary exposure assessments do not underestimate the potential exposures for infants and children; and
- The drinking water exposure concerns expressed for atrazine and the chlorinated metabolites do not apply to hydroxyatrazine, given its dissimilar toxicological profile and environmental fate properties that indicate that hydroxyatrazine is less mobile in soil/water systems.

c. Population Adjusted Dose

The population adjusted dose (or PAD) is a term that characterizes the dietary risk of a chemical. The PAD reflects the Reference Dose (RfD), either acute or chronic, that has been adjusted to account for the FQPA safety factor (i.e., RfD/FQPA safety factor). The RfD is calculated by taking the no observed adverse effect level (NOAEL) from an appropriate study and dividing it by an uncertainty factor (i.e., NOAEL/UF). Acute and chronic PADs are equivalent to the acute and chronic RfDs divided by 10, respectively. A risk estimate that is less than 100% of the acute PAD (aPAD) or chronic PAD (cPAD) does not exceed the Agency's level of concern. In the case of atrazine, the FQPA safety factor of 10x was retained for dietary

exposures; therefore, the RfD is ten times greater than the PAD. The PADs are presented in Tables 2 and 3 below for atrazine and hydroxyatrazine, respectively.

Table 2. Summary of Toxicological Endpoints and Other Factors Used in the Dietary Risk Assessment of Atrazine and Its Chlorinated Metabolites

Exposure Scenario	Dose (mg/kg/day)	UF	FQPA SF	Endpoint	Study
Acute Dietary (females 13 to 50 yrs old)	NOAEL= 10 LOAEL = 70	100	10	Delayed ossification of certain cranial bones in fetuses, decreased body weight gain in adult	Developmental toxicity study in rat & rabbit (weight of evidence from four studies)
	Acute RfD = 0.1 mg/kg/day **Acute PAD** = 0.01 mg/kg/day				
Intermediate and Chronic	NOAEL = 1.8 LOAEL = 3.65	100	10	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge study-Rat
	Chronic RfD = 0.018 mg/kg/day **Chronic PAD** = 0.0018 mg/kg/day				

UF = Uncertainty Factor (100 is the result of a 10x for interspecies variability and 10x for intraspecies extrapolation); SF=Safety Factor; PAD = Population Adjusted Dose

Table 3. Summary of Toxicological Endpoints and Other Factors Used in the Human Dietary (Food) Risk Assessment of Hydroxyatrazine, a Metabolite of Atrazine

Exposure Scenario	Dose (mg/kg/day)	UF[1]	FQPA SF[1]	Endpoint	Study
Acute Dietary	None selected	na	na	An appropriate endpoint attributable to a single dose was not identified (no toxic effect seen)	None selected
	Acute RfD = Not Established				
Chronic Dietary	NOAEL = 1.0 LOAEL = 7.75	100	1	Histopathological lesions of the kidneys	Combined chronic toxicity/ carcinogenicity -Rat
	Chronic RfD = 0.01 **Chronic PAD** = 0.01 mg/kg/day				

UF = Uncertainty Factor (100 is the result of a 10x for interspecies variability and 10x for intraspecies extrapolation); SF=Safety Factor; PAD = Population Adjusted Dose

d. Exposure Assumptions

The Agency conducts dietary (food) risk assessments using the Dietary Exposure Evaluation Model (DEEM™). DEEM incorporates consumption data generated in USDA's Continuing Survey of Food Intake by Individuals (CSFII), 1989-92. For the assessment of dietary exposure to residues of atrazine, monitoring data generated through the USDA Pesticide Data Program (PDP) and through the Food and Drug Administration (FDA) Surveillance Monitoring Program were used for wheat grain. Anticipated residue values from crop residue field trial studies and information from metabolism studies were used for most crops. For guava, tolerance level residues were used.

For acute probabilistic dietary (food) risk assessments, the entire distribution of single-day food consumption events is combined with a distribution of residues to obtain a distribution of exposure in mg/kg/day. Chronic dietary (food) risk assessments use the three day average of consumption for each subpopulation combined with residues in commodities to determine average exposure in mg/kg/day.

e. Food Risk Characterization

Generally, a dietary (food) risk estimate that is less than 100% of the acute or chronic PAD does not exceed the Agency's risk concern. Acute and chronic risk estimates from exposures to food associated with the use of atrazine did not exceed the Agency's level of concern.

1) Atrazine and Its Chlorinated Metabolites

The percent acute PAD value for the relevant population subgroup considered under the acute risk assessment, females 13 to 50 years old, is less than 1 at the 99.9th percentile of exposure. The percent chronic PAD values for all exposed population subgroups were less than 1, as well. These estimates of risk based on one-day and long-term exposures to atrazine and its chlorinated metabolites from residues on food alone are below the Agency's level of concern.

2) Hydroxyatrazine

No acute toxicological endpoint was identified for hydroxyatrazine; therefore, an acute risk assessment for hydroxyatrazine and the hydroxylated metabolites was not conducted. The percent chronic PAD values were less than 1 for all population subgroups considered in the risk assessment. Therefore, estimates of risk based on long-term exposures to hydroxyatrazine from residues on food alone are below the Agency's level of concern.

2. Dietary Risk from Drinking Water

Exposure to pesticides from drinking water can occur through residues in ground water and surface water. In the assessment for atrazine, EPA considers both acute (one day), intermediate-term (seasonal), and chronic (annual) exposures to residues in drinking water risks and uses actual monitoring data to characterize those risks.

Drinking water risk from the application of atrazine is assessed based on exposures to combined residues of atrazine and the chlorinated metabolites. These are the only atrazine-related compounds expected to occur in drinking water in significant quantities. Extensive monitoring data are available for atrazine parent in finished drinking water, and some monitoring data are available for the chlorinated metabolites. This monitoring data is the basis for the Agency's drinking water risk assessment. To estimate the levels of chlorinated metabolites in areas where monitoring data is not available for those metabolites, the Agency developed a model based on the available monitoring data which the Agency believes provides a reasonable estimate of the levels of the chlorinated metabolites that could be expected in drinking water.

A qualitative assessment of exposure to the hydroxy metabolites of atrazine in drinking water has been conducted by the Agency. Exposure to these compounds is expected to be significantly less than exposure to atrazine and the chlorinated metabolites based on the characteristics of these metabolites. Therefore, the Agency has not included the hydroxy metabolites in its quantitative risk assessment for drinking water

Risk estimates for exposures to residues of atrazine and its chlorinated metabolites in drinking water are provided for populations receiving their drinking water from community water systems (CWS) using surface water, CWS using groundwater; and individual rural wells located in atrazine use areas. Exposure assessments were conducted for about 33 percent of the CWS using surface water in the United States, serving approximately 65 million people in 31 atrazine use states. These CWS represent about 99% of atrazine use. The Agency uses monitoring data for finished (i.e., treated) drinking water in the assessment presented here.

The Agency initially conducted a deterministic (screening-level) drinking water risk assessment for atrazine and its chlorinated metabolites. The initial assessment identified specific CWS and rural wells as having concentrations of atrazine and its chlorinated metabolites above the Agency's level of concern. The CWS of concern were assessed probabilistically to refine the risk estimates; insufficient data were available to refine the risk estimates for rural wells.

a. Drinking Water Levels of Comparison (DWLOC)

To determine the maximum allowable contribution of water containing pesticide residues permitted in the diet, EPA first looks at how much of the overall allowable risk is contributed by food (and if appropriate, residential uses) then determines a "drinking water level of comparison" (DWLOC) to determine whether modeled or monitoring levels exceed this level. The Agency uses the DWLOC as a surrogate to capture risk associated with exposure from pesticides in drinking water. The DWLOC is the maximum concentration in drinking water that,

when considered together with dietary (food) exposure, does not exceed a level of concern. Calculated DWLOCs are presented in Table 4 below.

The results of the Agency's drinking water analysis are summarized here. Details of this analysis are found in the HED Human Health Risk Assessment dated April 16, 2002, the EFED Environmental Risk Assessment dated April 20, 2002.

Table 4. Summary of Lowest DWLOC Values for Atrazine and Its Chlorinated Metabolites

Population Subgroup	DWLOC (ppb)	
	Acute (One Day) Exposure	Intermediate (Seasonal) and Chronic (Annual) Exposure
General Population	not available	68
Infants < 1 year old	not available	12.5
Children 1 to 6	not available	23
Children 7 to 12	not available	53
Females 13 to 50	298	60
Males 13 to 19	not available	68
Males 20 and over	not available	68
Seniors	not available	68

1) Community Water Systems (CWS) Using Surface Water

a) Acute Risk

Based on the Agency's deterministic assessment, the measured maximum one-day concentrations of atrazine plus estimates of the chlorinated metabolites in drinking water do not exceed the Agency's level of concern for acute effects, regardless of source, for any relevant population subgroup.

Based on the Agency's screening-level deterministic assessment, one-day concentrations less than the DWLOC of 298 ppb do not exceed the level of concern for acute effects. The maximum measured concentration of atrazine and its chlorinated metabolites in any CWS monitoring for atrazine from 1993 to 1998 was 89 ppb.

b) Intermediate-Term (Seasonal) and Chronic (Annual) Risk

As stated previously, the drinking water concerns expressed for atrazine and its chlorinated metabolites do not apply to hydroxyatrazine because of its toxicology profile and

environmental fate profile.

Under the Agency's screening-level assessment for intermediate-term and chronic exposures to atrazine and its chlorinated metabolites, 34 out of the 3670 CWS assessed were above the Agency's level of concern based on a comparison of average seasonal concentrations to the chronic infant DWLOC of 12.5 ppb. These CWS were identified with quarterly average concentrations of chlorotriazines above levels of concern for infants in one, two, or three years between 1993 and 2001. In addition, several of the 34 had annual average concentrations above the levels of concern for children 1 to 6 years old and adults.

A probabilistic exposure assessment was conducted for 39 CWS, most of which were identified as being of concern under the screening-level assessment, as listed above. Risk estimates based on a probabilistic exposure assessment that estimated 90-day average exposures to atrazine and the chlorinated metabolites indicate that 34 CWS have seasonal concentrations that exceed levels of concern for infants at the 99.9th percentile of exposure.

In total, 34 CWS serving ~230,000 to 240,000 people had 90-day average exposures that exceeded levels of concern for infants in one, two, three, or four years between 1993 and 2001. Risk estimates for these CWS ranged from 100% to 670% of the chronic PAD for infants at the 99.9th percentile of exposure, and several exceeded levels of concern for children 1 to 6 years old and adults as well. The CWS identified and the cPADs for these systems are listed in Table 5 below.

Table 5. Risk Estimates for High Seasonal Exposures to Atrazine in Finished Drinking Water at the 99.9th Percentile of Exposure* (Calandex™)

Community Water System (City/State)	Infant % cPAD	Children 1 - 6 % cPAD	Adult % cPAD
Chariton, IA	235	<100	<100
Sorento, IL	183	<100	<100
Flora, IL	211	<100	<100
W. Salem, IL	189	100	<100
Farina, IL	189	<100	<100
White Hall, IL	278	117	<100
Carlinville, IL	128	<100	<100
Gillespie, IL	550	222	172
Hettick, IL	544	222	172
Shipman, IL	<100	<100	<100
Palmyra-Modesto, IL	350	155	111
N. Otter Twp ADGPTV, IL	189	<100	<100

Community Water System (City/State)	Infant % cPAD	Children 1 - 6 % cPAD	Adult % cPAD
Kinmundy, IL	150	<100	<100
Salem, IL	528	267	200
Centralia, IL	255	100	<100
Hillsboro, IL	272	117	<100
Louisville, IL	344	122	<100
North Vernon, IN	200	117	<100
Omaha, IL	250	111	<100
Holland, IN	244	128	<100
Batesville, IN	261	111	<100
Scottsburg, IN	267	150	105
Lewisburg, KY	317	128	<100
Marion, KY	317	128	<100
Iberville, LA	261	117	<100
Dearborn, MO	555	228	155
Bucklin, MO	250	100	<100
Vandalia, MO	189	105	<100
Sardinia, OH	667	305	205
Delaware, OH	155	<100	<100
Clermont County, OH	144	<100	<100
Williamsburg, OH	289	122	<100
Mt. Orab, OH	200	<100	<100
Newark, OH	111	<100	<100

The Agency notes that the Shipman reservoir no longer serves as a drinking water source; in 1999 the town of Shipman was switched to an alternative source of drinking water. The drinking water source at White Hall was switched from surface water to groundwater in 1997. It is the Agency's understanding that Hettick, IL is also in the process of defining a new source for their drinking water needs and will close down the Hettick reservoir in the next couple of years.

The seasonal pulses of atrazine and the chlorinated metabolites detected in monitoring data that resulted in exposures above the Agency's level of concern spanned from several weeks to several months. Typically, for the year with exposures of concern, pulses lasted from early spring through the summer and into the fall, and some CWS had high pulses almost all year long. The higher concentrations occurring in the spring and early summer influence the 90-day

average concentrations all year long.

2) Groundwater

Risk estimates based on screening-level assessments for 14,500 CWS using groundwater (~33 percent of groundwater CWS in the U.S.) do not exceed the Agency's level of concern for acute or chronic effects.

Data to estimate concentrations of the chlorinated metabolites of atrazine in these CWS using groundwater in 21 major atrazine use states have been developed. The highest concentration of atrazine and the chlorinated metabolites measured in any CWS in the data set was ~11 ppb. The 99th percentile concentration value for chlorotriazines in CWS with prior detections of atrazine was 1.9 ppb. Both the maximum measured value and the 99th percentile value are less than the acute DWLOC of 298 ppb, and do not exceed the Agency's level of concern for acute effects.

The 50th percentile concentration value was 0.180 ppb for CWS with prior detections. The mean concentration value at the 95 percent upper confidence bound was 0.55 ppb for CWS with prior detections. Both are less than the lowest intermediate-term to chronic DWLOC of 12.5 ppb, and do not exceed the Agency's level of concern for chronic effects.

The Agency believes that CWS using groundwater are not impacted as heavily by atrazine use as CWS using surface water.

3) Domestic Rural Wells

Approximately 10% of the U.S. population receives their drinking water from rural wells, cisterns or springs. These sources of drinking water are not regulated under the SDWA. Acute exposures to atrazine and the chlorinated metabolites in drinking water from rural wells do not exceed the Agency's level of concern. The maximum measured concentration of atrazine plus the chlorinated metabolites in the rural drinking water wells in atrazine use areas monitored by the registrant was 18 ppb; much less than the acute DWLOC (females 13 to 50) of 298 ppb. In addition, chronic exposures of adult populations using rural wells for drinking water do not exceed the Agency's level of concern.

However, the Agency has some concerns for chronic exposures of infants and children drawing drinking water from rural wells located directly in atrazine use areas, i.e., adjacent to fields where atrazine was used. Eight wells out of 1505 wells monitored had residues of atrazine and the chlorinated metabolites approaching, equal to, or greater than the chronic DWLOC (infants <1 year old) of 12.5 ppb. The 1505 wells monitored were selected based on their location in areas with high atrazine use. Of these, eight wells were resampled in March 2001, one sample per well. All samples showed concentrations of atrazine and the chlorinated metabolites less than the DWLOC of 12.5 ppb.

Although the data indicate that levels are decreasing in these wells over time, the Agency continues to have uncertainty regarding subchronic and chronic exposures of infants using private rural wells in close proximity to atrazine use areas for the several reasons. It is difficult to interpret typical exposures in rural wells close to atrazine use areas based on two samples taken many years apart. There are approximately 13 million drinking water wells in the U.S., thus, the rural well survey (1,505 wells) is inadequate to fully assess exposures to the entire U.S. population that uses rural wells for drinking water. And finally, limited sampling from the wells in the survey results in a high level of uncertainty regarding exposures to atrazine and the chlorotriazine metabolites for the population using rural wells for drinking water.

3. Residential Risk

Atrazine is registered for use by homeowners to control weeds in turf grass. Homeowners mixing, loading, and applying atrazine products to their lawns may be exposed to atrazine through their skin and by inhaling dusts or sprays during application. Residential exposures are only applicable for those regions of the United States where atrazine is used on turf grass, generally the Southeast (including Florida).

Adults or children can also be exposed to atrazine after application has occurred through contact with treated lawns or other turf areas (i.e., golf courses). In this instance, inhalation exposures are not expected; however, post-application dermal exposures for homeowners and children (yard work, walking, playing, crawling) and incidental oral exposure for toddlers are possible. Exposure data are not available on atrazine's chlorinated metabolites and hydroxy metabolites; however, residues of the chlorinated metabolites and hydroxy metabolites are not expected to occur on the surfaces of plants. Therefore, any residential exposure to these metabolites would be minimal, and risks were not assessed.

The Agency recognizes that there may be concerns for the potential for children's exposure in the home as a result of agricultural uses of atrazine. Environmental concentrations of atrazine in homes may result from spray drift, track-in, or from redistribution of residues brought home on the farmworker's clothing. Potential routes of exposure for children may include incidental ingestion and dermal contact with residues on carpets/hard surfaces. Studies are currently being pilot-tested that will look for sources of major pesticide exposure (including exposure to atrazine) and will attempt to quantify these exposures.

Risk for all of the potentially exposed populations is measured by a Margin of Exposure (MOE). A MOE determines how close the amount of residue that individuals are exposed to come to a No Observed Adverse Effect Level (NOAEL), whether exposures are from the use of a pesticide or from pesticide residues after application. For atrazine, MOEs greater than 300 (10 interspecies uncertainty x 10 intraspecies variability x 3 FQPA) do not exceed the Agency's level of concern.

a. Toxicity

The toxicity of atrazine is integral to assessing the residential risk. The toxicological endpoints and other factors used in the residential risk assessment for atrazine are described below and summarized in Table 6.

As mentioned earlier, the FQPA safety factor for residential exposures was reduced to 3x. This is considered adequate to protect the safety of infants and children in assessing residential exposure and risks because the uncertainties relating to drinking water exposure and the existing monitoring data included in the 10x FQPA safety factor for dietary exposure do not apply to residential exposure scenarios. Concerns for the effect of the neuroendocrine mode of action on the development of the young remain. The assumptions inherent to the Agency's residential risk estimates based on screening-level procedures are conservative and protective. The 3x FQPA safety factor is being applied across all aggregate risk assessments based on estimated residential exposures for all populations considered in these risk assessments.

Table 6. Summary of Toxicological Endpoints and Other Factors Used in the Atrazine Residential Human Health Risk Assessment

Exposure Scenario	Dose (mg/kg/day)	UF[1]	FQPA Safety Factor	Endpoint	Study
Oral, Short-Term	NOAEL= 6.25 LOAEL = 12.5	100	3	Delayed preputial separation in male offspring after 30 days of dosing.	Pubertal assay (30-day) NHEERL published literature
Oral, Intermediate-Term	NOAEL = 1.8 LOAEL = 3.65	100	3	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge- Rat
Dermal, Short-Term[a]	NOAEL= 6.25 LOAEL = 12.5	100	3	Delayed preputial separation in male offspring after 30 days of dosing. Use of the dermal penetration factor yields a dose of 104 mg/kg/day.	Pubertal assay (30-day) NHEERL published literature
Dermal, Intermediate- and Long-Term[b]	NOAEL= 1.8 LOAEL = 3.65	100	3	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge- Rat

Table 6. Summary of Toxicological Endpoints and Other Factors Used in the Atrazine Residential Human Health Risk Assessment

Exposure Scenario	Dose (mg/kg/day)	UF[1]	FQPA Safety Factor	Endpoint	Study
Inhalation, Short-Term [c]	NOAEL= 6.25 LOAEL = 12.5	100	3	Delayed preputial separation in male offspring after 30 days of dosing.	Pubertal assay (30-day) NHEERL published literature
Inhalation, Intermediate and Long-Term[c]	NOAEL= 1.8 LOAEL = 3.65	100	3	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge-Rat

[1]UF = Uncertainty Factor (100 is the result of a 10x for interspecies variability and 10x for intraspecies extrapolation)
a = The NOAEL of 6.25 mg/kg/day is multiplied by a 3.6 dermal penetration factor.
b = 6% dermal absorption factor for route-to-route extrapolation.
c = 100% absorption factor for route-to-route extrapolation.
Residential = A MOE of 300 is required and includes the 3x FQPA Safety Factor

b. Exposure Assumptions

Residential exposures to atrazine are expected to be short-term in duration (1 to 30 days), based on label directions that specify no more than two applications of atrazine to home lawns. Exposures greater than 30 days are not expected because no currently registered residential use products would result in exposures of this duration due to the use pattern and turf residue dissipation data on atrazine.

Chemical-specific exposure data, including a Turf Transferable Residue study on atrazine, and data on residential handlers applying granular and liquid formulations submitted by the Outdoor Residential Exposure Task Force (ORETF) were used to assess the exposure to atrazine as a result of residential application. In addition, analyses were performed using the unit exposure values in the *Pesticide Handlers Exposure Database* (PHED), Version 1.1 (August 1998) and using standard assumptions (average body weight, work day, daily areas treated, volume of pesticide used, etc.).

The quality of the data and exposure factors represents the best sources of data currently available to the Agency for completing these kinds of assessments. For example, if appropriate chemical-specific exposure data are available for atrazine, those data are used instead of the more generic PHED data. The quality of the data used for each scenario assessed, standard procedures, and any assumptions made are further discussed in the April 16, 2002, Revised Human Health Risk Assessment; the August 2002 Revised Occupational and Residential Risk Assessment; and the January 31, 2003, Addendum to the Revised Human Health Risk Assessment available in the public docket and online.

Anticipated use patterns and application methods, range of application rates, and area of lawn treated per day were derived directly from current atrazine labels for residential products. Application rates specified on atrazine labels for residential uses range up to 2 pounds of active ingredient per acre on residential turf.

The Agency also considered exposure to adults or children entering or playing on treated lawns or entering homes after application of atrazine products (post-application exposure). These activities are expected to result in short-term exposure (1 to 30 days), based on atrazine turf residue dissipation data and atrazine's residential use pattern. These data show that atrazine has a half-life on turf of up to 5 days after spraying or 9 days after granular application, and requires several weeks to dissipate. However, the Agency does not expect exposures greater than 30 days, even considering the slow dissipation rates, because the label prohibits application more than twice per year.

Residential post-application exposure assessments assumed residents wear the following attire: short sleeved shirt, short pants, shoes and socks, and no gloves.

c. Residential Applicator Risk

The anticipated use patterns and current labeling for atrazine homeowner products indicate 5 major exposure scenarios for residential applicators, as follows:

(1) mixing/loading/applying liquid formulations using a backpack sprayer,
(2) mixing/loading/applying liquid formulations for application with a low pressure handwand,
(3) mixing/loading/applying liquid formulations for hose-end sprayer,
(4) loading/applying granular formulations with a push type spreader, and
(5) loading/applying granular formulations with a bellygrinder.

The Agency does not believe the addition of personal protective equipment (PPE) to residential handlers (as used for assessing occupational handler risk) is appropriate for homeowner handler exposure assessments. Homeowners often lack access to PPE and do not possess expertise in the proper use of PPE. As a result, homeowner handler assessments are completed using a single scenario based on the use of short-sleeved shirts and short pants, common homeowner attire during the pesticide application season. In addition, as mentioned above, only short-term exposures were assessed, as the Agency does not believe homeowners who apply atrazine will be exposed for more than a few consecutive days.

All of the residential handler exposure scenarios considered in the risk assessment, with the exception of the scenario for application of granular formulations via a bellygrinder as a broadcast application, were below the Agency's level of concern (MOEs > 300). MOEs calculated for each homeowner handler scenario are presented in Table 7, as follows:

Table 7. Homeowner Uses and Risk Concerns (combined dermal & inhalation MOEs)

Scenario	Rate (lb ai/A)	Short-Term MOE
(1) Mixing, loading, and applying liquid formulations via backpack sprayer	2	28,000
(2) Mixing, loading, and applying liquid formulations via low pressure handwand	2	1,600
(3) Mixing, loading, and applying liquid formulations via hose-end sprayer	2	640[a]
(4) Loading and applying granular formulations via push type spreader	2	1,100[a]
(5) Loading and applying granular formulations via bellygrinder	2	65 (broadcast) 1,400 (spot treatment)

[a] Calculated using ORETF Unit Exposure Values

d. Post-Application Residential Risk

Atrazine can be used on home lawns, golf courses, and on other turf areas where exposure to adults and children may occur. Dermal exposure to atrazine may result from entering the treated area, performing yard work (e.g., mowing), playing or performing other recreational activities (e.g., golfing) on the treated areas. In addition, incidental oral post-application exposure to children may occur from "hand-to-mouth" (i.e., ingestion of grass, soil and/or granular pellets; or hand-to-mouth contact) exposure when reentering treated lawns.

The Agency does not expect post-application inhalation exposure to atrazine to occur because of low chemical vapor pressure and dilution of vapor outdoors. Thus, this exposure was not assessed. Handler study data support this conclusion.

Representative turf reentry activities include, but are not limited to:

(1) Adults involved in a low exposure activity, such as golfing or walking on treated turf.
(2) Adults mowing or other moderate contact activity, for 1-2 hours.
(3) Adults involved in a high exposure activity, such as heavy yard work (doses similar to occupational scenarios for cutting and harvesting sod).
(4) Children involved in high exposure activities on turf.

The Agency has risk concerns for post-application residential exposures to children from incidental oral contact. In children exposed to treated lawns after application of liquid atrazine formulations, hand-to-mouth activities and combined oral exposures result in MOEs above the Agency's level of concern. MOEs are 210 for hand-to-mouth activities and 200 for combined oral exposures. In addition, for children exposed to treated lawns after granular applications, the Agency has concerns for incidental ingestion of granules. The MOEs for this scenario range from 16 to 110.

Table 8: Residential Short-Term Post-Application Risk Estimates from Atrazine Application to Lawns

Scenario		Application Rate (lb ai/A)	MOE			
			Liquid		Granular	
			GA	NC	GA[1]	FL[1]
Adult						
Dermal	Turf Contact	2	510		4300	1200
	Walking, Golfing	2	7400		62,000	17,000
	Push Mowing Lawn	2	15,000		120,000	34,000
Child						
Dermal	Turf Contact	2	310		2,600	690
Oral	Hand to Mouth Activity	2	**210**		950	
	Turfgrass/Object Mouthing	2	3300			
	Ingestion of Soil	2	62,500			
	Combined[2]	2	**200**		730	
	Ingestion of Granules	2	n/a		16-31 (1.5% ai) 57-110 (0.42% ai)	

[1] The MOEs presented here represent non-irrigated turf. As these MOEs were acceptable, irrigated turf MOEs, generally higher than non-irrigated, were not presented.

[2] Combined includes Hand-to-mouth activity, turfgrass/object mouthing; and ingestion of soil. Ingestion of granules is not included because this is considered an infrequent, episodic event.

Adults may reasonably be expected to perform more than one activity on treated lawns in a single day, but an eight-hour duration of exposure is unlikely. Therefore, it is reasonable to aggregate the exposures from playing/gardening (highest exposure rate), walking, and mowing (lower exposure rate) for a single MOE. The MOE for all post-application adult exposures combined is 460 and is above the Agency's level of concern. It is also possible that an adult would apply herbicide spray to a lawn and then play on it or mow it later that day. In such an event, the aggregated dermal MOE for the day would be slightly lower than the target 300 for that day (MOE=270), based on the liquid application study values, but not based on the granular residue data. However, this not very likely and is considered a high-end estimate of exposure.

It is likely that dermal and oral incidental exposures may occur in the same day for children playing on atrazine-treated lawn. It can be seen from the MOEs presented in Table 8 that the incidental hand-to-mouth (licking fingers) exposure estimate constitutes most of this oral exposure. The overall MOE of 200 is only slightly less than the MOE of 210 for the hand-to-mouth estimate. The individual dermal and oral routes of exposure each exceed the level of concern, and aggregating these estimates results in an even lower MOE. Ingestion of granules is not aggregated because it is considered an infrequent, episodic event.

4. Aggregate Risk

Aggregate risk assessments have been conducted for acute, short-term, and intermediate-term to chronic exposures to atrazine and the chlorinated metabolites. Aggregate risk assessments look at the combined risk from dietary exposure (food and drinking water) and non-occupational (e.g., residential, golfers, etc...). The acute aggregate risk assessment combines exposures to atrazine and the chlorinated metabolites in food and drinking water. The short-term aggregate risk assessment combines exposures to atrazine and the chlorinated metabolites in food and drinking water with residential exposures to atrazine, *per se*, occurring between 1 and 30 days after use of atrazine products at home. The intermediate-term and chronic aggregate risk assessment combines exposures to atrazine and the chlorinated metabolites in food and drinking water alone because intermediate-term (30 days to several months) and chronic (several months to lifetime) exposure scenarios for the registered non-occupational uses of atrazine are not expected.

Although a risk assessment for exposures to atrazine's hydroxylated metabolites in food was conducted, risk assessments aggregating exposures to atrazine's hydroxylated metabolites in food, drinking water, and in residential settings were not. There is limited data on hydroxyatrazine in water, and exposure to the hydroxy metabolites of atrazine in drinking water is not expected to be significant relative to the chlorinated metabolites. In addition, the Agency does not expect exposure to hydroxyatrazine from applications of atrazine to turf because hydroxyatrazine is formed within plant tissues, not on plant surfaces.

a. Acute Aggregate Exposure and Risk Estimates

The aggregate risk assessment for acute exposures to atrazine and the chlorinated metabolites combines high-end one-day exposures through food and drinking water alone. The Agency does not believe that high-end exposures through food, drinking water, and residential use will all occur on the same day. Therefore, acute aggregate risk estimates are the same as those presented for acute drinking water risks. Exposure to atrazine from food sources and drinking water do not exceed the Agency's level of concern for acute dietary risk for any relevant subgroup, as described previously in Section III.A.2.a.3.

b. Intermediate-Term and Chronic Aggregate Exposure and Risk Estimates

The aggregate risk assessment for intermediate-term and chronic exposures to atrazine and the chlorinated metabolites combines estimates of high-end seasonal or long-term average exposures to atrazine in drinking water with long-term average exposures to atrazine in food. Neither intermediate-term nor long-term (chronic) exposures are expected to occur in the home from residential uses of atrazine. Therefore, intermediate-term and chronic aggregate risk estimates are the same as those presented for intermediate-term and chronic drinking water risks (see section III.A.2.a.3). Infants and children are potentially at risk from exposures to combined residues of atrazine plus its chlorinated metabolites from 34 CWS using surface water based on available monitoring data. Aggregate intermediate-term and chronic exposures in CWS using groundwater are not of concern.

c. Short-Term Aggregate Exposure and Risk Estimates

Short-term estimates of aggregate risk were calculated for adult applicators and children and adults exposed to residues of atrazine after application to home lawns. Short-term aggregate

risk estimates that include residential exposures are only applicable for those regions of the United States where atrazine is used on turf grass (residential and golf courses), generally the Southeast (including Florida).

The theoretical upper limit in drinking water for short-term exposures is referred to as a short-term DWLOC and is based on exposure estimates for adults and children from average residues of atrazine in food and exposure to high-end atrazine residues during application or immediately after application of atrazine to lawns. If the short-term DWLOC values are greater than the measured average concentrations for atrazine residues in surface water and groundwater, there is no concern for short-term aggregate exposures to atrazine residues through food, drinking water, and non-occupational uses. Measured concentrations of atrazine residues in surface water and groundwater from monitoring data (as presented earlier in this document) were compared to the calculated short-term DWLOCs.

1) Adult Handlers

Short-term estimates of aggregate risk to adults applying atrazine products to the lawn and garden combines exposures through the dermal, dietary (food and drinking water), and inhalation routes. These exposures have a common toxic effect, delayed puberty as a biomarker for neuroendocrine effects.

Table 9 below presents the results of the Agency's short-term aggregate risk assessment for adult handlers of atrazine. Of the five exposure scenarios evaluated, only applications of granular formulations of atrazine applied over 0.5 acres with a belly-grinder results in aggregate exposures that exceed the Agency's level of concern.

Aggregate short-term DWLOC values are presented for the five adult handler scenarios in Table 9. The first four DWLOCs presented are greater than the measured maximum weekly concentration of 89 ppb atrazine and the chlorotriazines in finished drinking water; thus, these scenarios are not of concern to the Agency. A DWLOC of 0 is assigned for adults applying via belly grinder because this residential scenario alone exceeds the Agency's level of concern; thus, this scenario is also of concern when aggregated with dietary and drinking water routes of exposure.

Table 9. Short Term Aggregate DWLOCs - Adults applying atrazine at 2 lb ai/A to lawns.

Exposure Scenario	Aggregate MOE (Dermal and Inhalation)	Short Term DWLOC (ppb)
(1) Mixing, loading, and applying liquid formulations via backpack sprayer	28,000	219
(2) Mixing, loading, and applying liquid formulations via low pressure handwand	1,600	273
(3) Mixing, loading, and applying liquid formulations via hose-end sprayer	640	105
(4) Loading and applying granular formulations via push-type spreader	11,000	159
(5) Loading and applying granular formulations via belly grinder	65	0

2) Adult Post-Application

Short-term estimates of aggregate risk for adults from post-application exposures combine dietary exposure and post-application dermal exposures after atrazine lawn treatment . Short-term dermal and dietary exposures have a common toxic effect: delayed puberty as a biomarker for neuroendocrine effects.

Table 10 summarizes the results of the Agency's aggregate risk assessment for short-term exposures of adults exposed to atrazine-treated lawns immediately after application. Short-term aggregate risk estimates do not exceed the Agency's level of concern. Weekly concentrations of atrazine and the chlorotriazine metabolites have been measured in drinking water up to 89 ppb; since this concentration is less than the remaining DWLOCs, the aggregate risk is acceptable.

Table 10. Short Term Aggregate DWLOCs - Adults exposed to atrazine after application to lawns at 2 lb ai/A.

Exposure Scenario (formulation)	Dermal MOE	Short Term DWLOC (ppb)
Dermal Turf Contact (liquid)	510	130
Dermal Turf Contact (granular)	1200	157
Dermal Contact Walking/Playing Golf (liquid)	7,800	210
Dermal Contact Walking/Playing Golf (granular)	16,000	215
Dermal Contact Pushing Lawn Mower (liquid)	16,000	214
Dermal Contact Pushing Lawn Mower (granular)	35,000	217

3) Child Post-Application

Short-term estimates of aggregate risk to toddlers from post-application residential exposure to atrazine combine dietary exposures with post-application dermal and incidental oral exposures after atrazine lawn treatment.

Aggregate risk estimates for short-term exposures to toddlers playing on liquid atrazine-treated lawns exceed EPA's level of concern. Risks to children from aggregated oral residential post-application exposures (hand-to-mouth transfer of residues, grass and soil ingestion activities by toddlers on grass) are of concern for liquid formulations (MOE = 200); therefore, any aggregation through the dermal, inhalation or dietary pathways would result in risk estimates that further exceed the Agency's level of concern.

Toddlers' risk estimates from individual or aggregated (combined) pathways for incidental oral exposures based on granular formulations do not exceed the Agency's levels of concern; i.e., a MOE of 730. Toddlers' risk estimates from dermal exposures based on granular formulations also do not exceed the Agency's levels of concern; i.e., MOEs of 690 (for applications that are not watered-in immediately after application and 2000 for applications that are watered-in immediately after application). Combined dermal and incidental oral exposures for toddlers result in a MOE of 350 or greater and also do not exceed the Agency's level of

concern. Short-term DWLOCs for toddlers' post application aggregate exposures, inclusive of dermal, incidental oral, and dietary (food + drinking water) exposures, do not exceed HED's level of concern for granular formulations watered-in after application to turf. Short-term DWLOCs for toddlers' post application aggregate exposures exceed the Agency's level of concern for granular formulations.

Exposure to atrazine through ingestion of granules by toddlers result in MOEs of 16 to 110. Granule ingestion by toddlers is considered an episodic event (a stand alone incident) and has not been aggregated with either other incidental oral exposures or dermal and dietary exposures.

Table 11 below presents the short-term aggregate MOEs and DWLOCs for toddlers exposed to atrazine after lawn applications.

Table 11. Short-Term Aggregate DWLOCs - Toddlers exposed to atrazine after liquid and granular applications to lawns.

Type of Exposure	Formulation/Application Rate (lbs ai/acre)	Dermal MOE	Aggregate Incidental Oral MOE	Short-Term DWLOC (ppb)
Dermal Contact on Turf	2 lb ai/acre (liquid)	310	200	zero
Dermal Contact on Turf	1 lb ai/acre (liquid)	610	390	zero
Dermal Contact on Turf	2 lb ai/acre (granular) without watering-in	690	730	12 - 14
Dermal Contact on Turf	2 lb ai/acre (granular) with watering-in	2000	730	35 - 39

5. Occupational Risk

Workers handling pesticide products can be exposed to atrazine through mixing, loading, and/or applying this pesticide, and through reentering treated sites. Occupational handlers of atrazine include: individual farmers and other growers who mix, load, and/or apply pesticides; commercial, professional, or custom agricultural applicators; commercial pest control operators; and lawn care and turf management professionals. The post-application occupational risk assessment considered exposures to workers entering treated sites in agriculture. Risk for all of these potentially exposed populations is measured by a Margin of Exposure (MOE) which determines how close the occupational or residential exposure comes to a No Observed Adverse Effect Level (NOAEL). Generally, MOEs greater than 100 do not exceed the Agency's risk concern.

a. Toxicity

The toxicity of atrazine is integral to assessing the occupational risk. The Agency has conducted short-term and intermediate-term dermal and inhalation exposure assessments for the occupational handler. In addition, the Agency has conducted short-term post-application dermal and inhalation exposure assessments. Long-term (chronic) occupational exposures are not anticipated based on atrazine's use pattern.

All risk estimates are based on the most current toxicity information available for atrazine, including a 21-day dermal toxicity study. The toxicological endpoints, and other factors used in the occupational risk assessments for atrazine are summarized in Table 12 below. Please note that the occupational dermal and inhalation endpoints are the same as those used in the dietary drinking water assessment and in the residential risk assessment.

A dermal absorption factor of 6% (rounded up from 5.6%) was selected, based on a human study in which 10 volunteers were exposed to a single topical dose of atrazine. An inhalation absorption factor of 100% is applied. The FQPA Safety Factor is not applicable to the Occupational Risk Assessment.

Table 12. Summary of Toxicological Endpoints and Other Factors Used in the Atrazine Occupational Risk Assessment

Exposure Scenario	Dose (mg/kg/day)	UF[1]	Endpoint	Study
Dermal, Short-Term[a]	NOAEL= 6.25 LOAEL = 12.5	100	Delayed preputial separation in male offspring after 30 days of dosing. Use of the dermal penetration factor yields a dose of 104 mg/kg/day.	Pubertal assay (30-day) NHEERL published literature
Dermal, Intermediate-Term[b]	NOAEL= 1.8 LOAEL = 3.65	100	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge- Rat
Inhalation, Short-Term [c]	NOAEL= 6.25 LOAEL = 12.5	100	Delayed preputial separation in male offspring after 30 days of dosing.	Pubertal assay (30-day) NHEERL published literature
Inhalation, Intermediate-Term[c]	NOAEL= 1.8 LOAEL = 3.65	100	Attenuation of pre-ovulatory lutenizing hormone (LH) surge, as a biomarker indicative of hypothalamic function disruption	Six-month LH surge-Rat

[1]UF = Uncertainty Factor (100 is the result of a 10x for interspecies variability and 10x for intraspecies extrapolation)
a = The NOAEL of 6.25 mg/kg/day is multiplied by a 3.6 dermal penetration factor.
b = 6% dermal absorption factor for route-to-route extrapolation.
c = 100% absorption factor for route-to-route extrapolation.

Atrazine has low acute dermal and inhalation toxicity. It is non-irritating to skin, minimally irritating to the eyes and is not a skin sensitizer. It is classified under Category III for acute oral toxicity. Table 13 summarizes the acute toxicity of atrazine.

Table 13. Summary of Results from Acute Toxicity Studies of Technical Atrazine

Guideline No.	Test	Results	Toxic Category
81-1	Acute Oral LD_{50} - rat	LD_{50} > 1,869 mg/kg (M&F combined)	III
81-2	Acute Dermal LD_{50} - rat	LD_{50} > 2,000 mg/kg (M&F combined)	III

Guideline No.	Test	Results	Toxic Category
81-3	Acute Inhalation LC_{50} - rat	LC_{50} > 5.8 mg/L (M&F combined)	IV
81-4	Eye Irritation - rabbit	Non-irritant	IV
81-5	Dermal Irritation - rabbit	Non-irritant	IV
81-6	Dermal Sensitization	Non-sensitizer	---

b. Occupational Exposure

Several chemical-specific studies that were submitted to the Agency by the technical registrant were used together were used to assess the occupational handler risks from use of atrazine for most exposure scenarios. Exposure studies submitted to the Agency by the Outdoor Residential Exposure Task Force (ORETF) were also used in the occupational (and non-occupational) risk assessments for applicators.

In addition, the Agency generated MOEs to assess risk to commercial handlers engaged in impregnating atrazine onto dry bulk fertilizer using dermal and inhalation unit exposure data from the *Pesticide Handlers Exposure Database* (PHED), Version 1.1 (August 1998). The PHED scenario for mixing/loading liquids using a closed system were used as a surrogate to estimate these exposures. However, such an exposure surrogate is less appropriate for estimating exposures due to transferring the treated dry bulk fertilizer from an auger truck to the application equipment. There are no data or reasonable surrogate available for this operation.

Three chemical-specific studies, one of dislodgeable foliar residue on corn, and two of transferable turf residues (TTR), were submitted to the Agency and used in the post-application occupational risk assessment. In addition, transfer coefficients used were based on data submitted by the Agricultural Reentry Task Force (ARTF), where possible. Most of the atrazine used in agriculture is applied to corn and sorghum early in the season, either before weeds emerge or when the crops are quite small, generally less than 12 inches high. This, and the degree of mechanization in cultivating these crops, leads the Agency to conclude that post-application exposure to workers is low.

Anticipated use patterns and application methods, range of application rates, and daily amounts treated were derived from current labeling. Maximum application rates specified on atrazine labels were 2.0 lb ai/A, with a few exceptions. Maximum label rates were used to estimate handler exposure. The Agency uses acres treated per day values that are thought to represent an eight-hour workday for a particular type of application equipment or a specific crop.

Occupational handler exposure assessments are conducted by the Agency using different levels of personal protection. The Agency typically evaluates all exposures with baseline protection and then adds additional protective measures using a tiered approach to obtain an appropriate MOE (i.e., going from minimal to maximum levels of protection). The lowest suite of personal protective equipment (PPE) is baseline PPE. If required (i.e., MOEs are less than 100), increasing levels of risk mitigation PPE are applied. If MOEs are still less than 100, engineering controls (EC) are applied. The levels of protection that formed the basis for calculations of exposure from atrazine activities include:

- Baseline: Long-sleeved shirt and long pants, shoes and socks
- PPE: Baseline + coveralls, chemical-resistant gloves, and a dust/mist respirator (see table for specifics by scenario)
- Engineering controls: Engineering controls, such as closed cab tractor for application scenarios, or a closed mixing and loading system such as a farm closed mechanical transfer system for liquids or a package based system. Some engineering controls are not feasible for certain scenarios. Some formulation types qualify as engineering controls for the purpose of controlling exposure during mixing and loading, such as water soluble packets.

c. Occupational Handler Risk Summary

Inhalation and dermal exposure to atrazine can result from occupational use. The Agency assessed dermal and inhalation risks (MOEs) for each crop currently registered for atrazine. For atrazine, occupational MOEs greater than 100 are not of risk concern to the Agency.

1) Agricultural Handler Risk

The Agency has determined that there is potential atrazine exposure to mixers, loaders, applicators, and other handlers using atrazine in accordance with the current use patterns. Fourteen major agricultural handler exposure scenarios were identified for atrazine, as listed below. The major handler scenarios involved multiple crops and application rates, resulting in several different exposure estimates. The largest agricultural use of atrazine involves the mixing, loading and application of atrazine to row crops and results in the largest potentially exposed occupational population.

(1a) mixing/loading liquid formulations for aerial application,
(1b) mixing/loading liquid formulations for groundboom application,
(1c) mixing/loading liquid formulations for rights-of-way sprayer application to roadside,
(1e) mixing/loading/incorporating liquid formulations into liquid and dry bulk fertilizer (commercial & on-farm techniques),
(2a) mixing/loading dry flowable formulations for aerial application,
(2b) mixing/loading dry flowable formulations for groundboom application,
(2c) mixing/loading dry flowable formulations for rights-of-way sprayer application to roadside,
(3) loading granular formulations,
(4) applying liquids with aircraft,
(5) applying liquids with groundboom sprayer,
(6) applying liquids to roadsides with rights-of-way sprayer,
(8) applying impregnated dry bulk fertilizer with a tractor-drawn spreader,
(9) applying granular formulations with a tractor-drawn spreader,
(15) flagging for aerial spray applications
(16a) mixing/loading wettable powder formulations for aerial application; and
(16b) mixing/loading wettable powder formulations for groundboom application.

PPE requirements on current atrazine labels are typically long-sleeved shirt, long pants,

shoes, socks and waterproof gloves. Mixers and loaders must also wear protective eyewear. (mixers/loaders).

As summarized in Table 14, occupational risks are of concern (i.e MOEs < 100) for some scenarios even when maximum PPE are utilized. Handler risks are also of concern for a few scenarios with engineering controls. Engineering controls are considered to be the maximum feasible mitigation. These involve several scenarios for the incorporation of atrazine into liquid or dry bulk fertilizer, handlers mixing and loading wettable powders for application to 350 acres of sugarcane at 4 lb ai/A, and handlers applying liquids with a right of way sprayer to 40 acres of roadsides at 2 lb ai/A.

Table 14. Occupational Handler Aggregate (Dermal plus Inhalation) Margins of Exposure (PHED)

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
Mixer/Loader									
(1a) Liquid formulations for aerial application	Conifer forests Christmas tree farms	4	350	2	0.4	248	61	520	130
	Sugarcane	4	350	2	0.4	248	61	520	130
		2.6		3	0.7	381	94	800	200
	Chemical fallow	3	1200	1	na	96	na	200	na
			350	2	0.6	330	82	690	170
		1.4	1200	1	na	206	na	430	na
			350	5	1.3	708	170	1500	370
	CRP or grasslands	2	1200	1	na	144	na	300	na
			350	4	0.9	495	120	1000	260
	Corn Sorghum	2	1200	1	na	144	na	300	na
			350	4	0.9	495	120	1000	260
		1	1200	2	na	289	na	610	na
			350	7	2	991	240	2100	520
	Sod Farms	4 (FL)	350	2	0.4	248	61	520	130
		2	350	4	1	495	120	1000	260
(1b) Liquid formulations for groundboom application	Macadamia nuts Guava Conifers	4	80	8	2	1084	270	2300	560
	Sugarcane	4	80	8	2	1084	270	2300	560
		2.6	80	12	3	1667	410	3500	870

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
	Chemical Fallow	3	450	2	na	257	na	540	na
			200	4	1	578	140	1200	300
		1.4	450	4	na	550	na	1200	na
			200	9	2	1238	310	2600	640
	CRP or grasslands	2	450	3	na	385	na	810	na
			200	6	2	867	210	1800	450
	Corn Sorghum	2	450	3	na	385	na	810	na
			200	6	2	867	210	1800	450
		1	450	6	na	771	na	1600	na
			200	12	3	1734	430	3600	900
	Roadsides	1	40	62	15	8669	2100	18,000	4500
		2		31	8	4335	1100	9100	2300
	Sod farms	4 (FL)	80	8	2	1084	270	2300	560
		2	80	16	4	2167	540	4600	1100
(1c) Liquid formulations for rights-of-way sprayer	Roadsides	1	40	62	15	8669	2100	18,000	4500
	Bermuda grass rights-of-way	2	40	31	8	4335	1100	9100	2300
(1e) Incorporating liquid formulations into liquid or dry bulk fertilizer	Commercial fertilizer for corn, sorghum (PHED data)	2	960 tons	see engineering controls				**64**	na
			500 tons					120	**36**
		1	960 tons					120	na
			500 tons					230	**72**
	Commercial fertilizer for corn, sorghum (Helix study data)	2	500 tons	see engineering controls				170	**67**

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
		1		see engineering controls				350	130
	On-farm fertilizer for corn, sorghum	2	160	8	na	700	na	1900	na
		1	160	15	na	1400	na	3800	na
(2a) Dry flowable for aerial application	Conifer forests Christmas tree farms	4	350	66	16	105	26	380	130
	Sugarcane	4	350	66	16	105	26	380	130
		2.6	350	100	25	161	40	580	140
	Chemical fallow	3	1200	26	na	41	na	150	na
			350	88	22	140	35	500	120
		1.4	1200	55	na	87	na	320	na
			350	190	47	300	74	1100	270
	CRP or grasslands	2	1200	38	na	61	na	220	na
			350	130	33	210	52	750	190
	Corn Sorghum	2	1200	38	na	61	na	220	na
			350	130	33	210	52	750	190
		1	1200	77	na	122	na	440	na
			350	260	65	420	100	1500	370
	Sod farms	4 (FL)	350	66	16	105	26	380	130
		2	350	130	33	210	52	750	190
(2b) Dry flowable for groundboom application	Macadamia nuts Guava Conifers	4	80	290	71	459	110	1600	410
	Sugarcane	4	80	290	71	459	110	1600	410

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
		2.6	80	440	110	706	170	2500	630
	Chemical fallow	3	450	68	na	109	na	400	na
			200	150	38	245	61	880	220
		1.4	450	150	na	233	na	840	na
			200	330	82	525	130	1900	470
	CRP or grasslands	2	450	100	na	163	na	580	na
			200	230	57	367	91	1300	330
	Corn Sorghum	2	450	100	na	163	na	580	na
			200	230	57	367	91	1300	330
		1	450	210	na	326	na	1200	na
			200	460	110	734	180	2600	650
	Roadsides	1	40	2300	570	3672	910	13,000	3300
		2	40	1200	290	1836	450	6600	1600
	Sod farms	4(FL)	80	290	71	459	110	1600	410
		2	80	580	140	918	230	3300	820
(2c)Dry flowable for rights-of-way	Roadsides	1	40	2300	570	3672	910	13,000	3300
		2	40	1200	290	1836	450	6600	1600
(3) Granular formulations	Sod farms	2	80	1200	310	5023	1200	62,000	15,000
(16a) Wettable powders for aerial application	Sugarcane	4	350	1.2	5.2	17	4.1	580	93
		2.6		1.8	3	26	6.3	380	140
	Chemical Fallow	3	1200	0.5	na	6.5	na	150	na

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
		1.4		1	na	14	na	310	na
	Corn, Sorghum	2	1200	0.7	na	9.7	na	220	na
			350	2.4	4	33	8.2	750	190
		1	1200	1.4	na	19	na	440	na
			350	4.7	7	66	16	1500	370
(16b) Wettable powders for groundboom application	Macadamia nuts	4	40	10	16	150	36	3300	820
	Sugarcane	4	200	2.1	3	29	7.2	660	160
	Sod farms (FL)	4	80	5.2	8	73	18	1600	410
Applicator									
(4) Applying liquids with aircraft	Conifer forests Christmas tree farms	4	350	See engineering controls				850	210
	Sugarcane	4	350	See engineering controls				850	210
		2.6	35					1300	320
	Chemical fallow	3	1200	See engineering controls				330	na
			350					1100	280
		1.4	1200					710	na
			350					2400	600
	CRP or grasslands	2	1200	See engineering controls				500	na
			350					1700	420
	Corn Sorghum	2	1200	See engineering controls				500	na
			350					1700	420
		1	1200					990	na

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
			350					3400	840
	Sod farms	4 (FL)	350	See engineering controls				850	210
		2	350					1700	420
(5) Applying liquids by groundboom	Macadamia nuts Guava Conifers	4	80	860	210	1690	420	4000	980
	Sugarcane	4	80	860	210	1690	420	4000	980
		2.6	80	1300	330	2600	640	6100	1500
	Chemical fallow	3	450	200	51	401	99	940	na
			200	460	110	901	220	2100	520
		1.4	450	440	110	858	210	2000	na
			200	990	240	1931	480	4500	1100
	CRP or grasslands	2	450	310	76	601	150	1400	na
			200	690	170	1352	330	3200	790
	Corn Sorghum	2	450	310	76	601	150	1400	na
			200	690	170	1352	330	3200	790
		1	450	610	150	1202	300	2800	na
			200	1400	340	2704	670	6400	1600
	Roadsides	2	40	3500	850	6759	1700	16,000	3900
		1	40	6900	1700	13519	3300	32,000	7900
	Sod farms	4(FL)	80	860	210	1690	420	4000	980
		2	80	1700	430	3380	840	8000	2000

Scenario	Crop/Use Site	Rate[1]	Acres	Levels of Protection					
				Baseline		PPE[2]		ECs	
				Short Term	Inter-mediate Term	Short Term	Inter-mediate Term	Short Term	Inter-mediate Term
(6) Applying liquids with a right of way sprayer	Roadsides	2	40	67	16	300	74	not feasible	
		1	40	130	33	601	150	not feasible	
(8) Applying impregnated fertilizer with a tractor-drawn spreader	Corn Sorghum	2	320	190	na	660	na	1000	na
			160	380	na	1300	na	1900	na
		1	320	380	na	1300	na	1900	na
			160	900	na	2600	na	4000	na
(9) Applying granular product with a tractor-drawn spreader	On-farm fertilizer for corn, sorghum	2	200	610	150	2221	550	3200	790
			80	1500	380	5553	1400	7900	2000
		1	200	1200	300	4442	1100	6400	1600
			80	3000	750	11,100	2700	16,000	4000
Flagger									
(15) Flagging sprays	Conifer forest Christmas tree farms	4	350	310	76	466	120	910	220
	Sugarcane	4	350	310	76	466	120	910	220
		2.6	350	480	120	717	180	1400	350
	Chemical fallow	3	350	410	100	621	150	1200	300
		1.4	350	880	220	1331	330	2600	640
	CRP or grasslands	2	350	620	150	931	230	1800	450
	Corn Sorghum	2	350	620	150	931	230	1800	450
		1	350	1200	310	1863	460	3600	900
	Sod farms	4 (FL)	350	310	76	466	120	910	220
		2	350	620	150	931	230	1800	450

[1] lb ai/A or lb ai/gal

[2] PPE Includes long-sleeved shirt and long pants, coveralls, chemical resistant gloves, and a respirator.
(16a) and (16b) are listed using minimum ppe (single layer, gloves, dust/mist respirator).

[3] pounds of fertilizer treated per day

2) Lawn Care Operator Handler Risk

The Agency has determined that there is potential for atrazine exposure to Lawn Care Operators (LCOs) and other handlers mixing, loading and/or applying atrazine to turf in accordance with the current use pattern. Fifteen major exposure scenarios have been identified and are listed below.

(1b) mixing/loading liquid formulations for groundboom application,
(1d) mixing/loading liquid formulations for lawn handgun application (LCO),
(2b) mixing/loading dry flowable for groundboom application,
(3) loading granular formulations,
(5) applying liquids with groundboom sprayer,
(7) applying with a lawn handgun or compressed air sprayer,
(9) applying granular formulations with a tractor-drawn spreader,
(10) mixing/loading/applying with a backpack sprayer,
(11) mixing/loading/applying liquid formulations with a low pressure handwand,
(12a) mixing/loading/applying liquids with a lawn handgun or compressed air sprayer,
(12b) mixing/loading/applying WDG formulations with a lawn handgun,
(12c) mixing/loading/applying water soluble powder formulations with a lawn handgun,
(13) loading/applying granular formulations with a push type spreader, and
(14) loading/applying granular formulations with a bellygrinder.

The risk assessments for these scenarios are summarized in Table 15 below. With the use of PPE (long sleeved shirt and long pants, coveralls, chemical resistant gloves, and a respirator), all scenarios are acceptable.

Table 15. Lawn Care Operator Margins of Exposure

Scenario	Crop/ Use Site	Rate (lb ai/A)	Acres	Levels of Protection					
				Baseline		PPE		ECs	
				Short term	Inter-mediate term	Short term	Inter-mediate term	Short term	Inter-mediate term
Mixer/Loader									
(1b) Liquid formulations for groundboom application	golf course turf	2	40	31	8	4335	1100	9100	2300
(1d) Liquid formulations for lawn handgun application	lawn, golf courses	2	100	12	3	1734	430	3600	900
(2b) Dry flowable for groundboom application	golf course turf	2	40	1200	290	1836	450	6600	1600
(3) Granular formulations (loading)	golf course turf	2	40	2500	610	10,047	2500	120K	31,000

Scenario	Crop/ Use Site	Rate (lb ai/A)	Acres	Levels of Protection					
				Baseline		PPE		ECs	
				Short term	Inter-mediate term	Short term	Inter-mediate term	Short term	Inter-mediate term
Mixer/Loader/Applicator									
(10) Liquid via backpack sprayer	lawns, golf courses	2	1	see PPE		428	110	not feasible	
(11) Liquid via low-pressure handwand	lawns, golf courses	2	1	7	2	1549	380	not feasible	
(12a) Liquid via lawn handgun and compressed air sprayer	lawns, golf courses	2	5	see PPE		1400 gloves	340 gloves	not feasible	
(12b) WDG via lawn handgun	lawns, golf courses	2	5	see PPE		1100 gloves	290 gloves	not feasible	
(12c) WSP via lawn handgun	lawns, golf courses	2	5	see PPE		920 gloves	230 gloves	not feasible	
(13) Granular via push type spreader (ORETF)	lawns, golf courses	2	5	1500	380	2100 gloves	520 gloves	not feasible	
(14) Granular via belly grinder	lawns, golf courses	2	1	330	82	616	150	not feasible	
Applicator									
(5) Applying liquids by groundboom	golf course turf	2	40	3500	850	6759	1700	16,000	3900
(7) Applying liquids with a handgun (ORETF)	lawns, golf courses	2	5	see PPE		980 gloves	240 gloves	not feasible	
(9) Applying granular formulations with a tractor-drawn spreader	golf course turf	2	40	3000	750	11,100	2700	16,000	4000

3) Post-Application Occupational Risk

Post-application exposure to workers through entry into agricultural fields treated with atrazine was also considered in the occupational risk assessment. These activities result in potential short-term exposures. All post-application risk estimates were below the Agency's level of concern. MOEs ranged from 100 to 220,000.

4) Epidemiology Data

An epidemiology study was conducted of workers at the Syngenta St. Gabriel plant where atrazine is manufactured. That study reported a statistically significant increase in the incidence of prostate cancer among plant workers. The Agency, upon review of this study, requested additional information on the exposure profile of the employees diagnosed with prostate cancer and this information was provided and reviewed. Based on this review, it appears that most of the increase in prostate cancer incidence at the St. Gabriel plant is likely due to intensive prostate specific antigen (PSA) screening of employees conducted as part of the company's "Wellness Program." The study was insufficiently large and has limitations that prevent ruling out atrazine as a potential contributor to the increase observed. On balance, however, a role for atrazine seems unlikely because prostate cancer was found primarily in active employees who received intensive PSA screening; there was no increase in advanced tumors or mortality; and proximity to atrazine manufacturing did not appear to be correlated with risk.

Atrazine has also been tied to inflammation of the prostate in laboratory animals and changes in testosterone levels at high doses. However, neither condition has been tied to the increased risk of prostate cancer and the Agency concludes the animal data do not provide biologically plausible evidence to support atrazine as a cause of prostate cancer.

Other cancers besides prostate were found to have an elevated, though not statistically significant, increase in risk at the St. Gabriel plant. Other studies have suggested an increased risk for ovarian, breast, and other cancers, including non-Hodgkin's lymphoma. However, these studies are at best preliminary and should not serve as a basis for implicating atrazine as a human carcinogen due to their methodological limitations.

In addition, the Agency understands that Syngenta will be conducting a case control study on male employees at the St. Gabriel plant to examine the relationship between atrazine exposure estimates and the presence or absence of prostate cancer among cases and controls. We expect to receive and review this study during the third quarter of 2003 and to incorporate the results into the October revision to the IRED.

Further, the National Cancer Institute's (NCI) preliminary analysis of the National Institute of Environmental Health Sciences (NIEHS) Agricultural Health Study has found no association between prostate cancer and atrazine in one of the largest and best-designed epidemiological studies ever conducted. NCI expects to publish a final analysis this summer. The Agency will fully consider additional results from the NCI analysis when it becomes available.

B. Environmental Risk Assessment

A summary of the Agency's environmental risk assessment is presented below. For detailed discussions of all aspects of the environmental risk assessment, see the April 22, 2002, Reregistration Eligibility Science Chapter for Atrazine - Environmental Fate and Effects Chapter and the "Steeger Document" available in the public docket and on the internet at www.epa.gov/pesticides/reregistration. There were no major revisions to the ecological risk assessment.

1. Environmental Fate and Transport

Atrazine is mobile and persistent in the environment and, as such, atrazine is expected to be present in surface water and groundwater. This is confirmed by widespread detection in surface water and groundwater. The main route of dissipation is microbial degradation under aerobic conditions.

Atrazine can reach nearby non-target plants, soil, and surface water via spray drift during application. Atrazine is applied directly to target plants during foliar application or directly to soil during the more frequent pre-plant and pre-emergent applications. Atrazine can be transported indirectly to soil due to incomplete interception during foliar application and washoff subsequent to foliar application. Atrazine is unlikely to undergo rapid degradation on foliage because atrazine is resistant to abiotic hydrolysis (stable at pHs 5, 7, and 9), resistant to direct aqueous photolysis (stable under sunlight at pH 7), and is only moderately susceptible to degradation in soil (aerobic laboratory half-lives of 3-4 months). For aquatic environments reported half-lives were much longer. In an anaerobic aquatic study, atrazine's overall half-life, water half-life, and sediment half-life were given as 608, 578, and 330 days, respectively.

Atrazine is also unlikely to undergo rapid volatilization from foliage because it has a relatively low Henry's Law constant (2.6×10^{-9} atm·m^3/mol). But this may be offset by atrazine's relatively low octanol/water coefficient (Log K_{ow} = 2 .7), and soil/water partitioning coefficents (Freundlich K_{ads} values < 3 and often < 1). In addition, atrazine has relatively low adsorption characteristics; this indicates that atrazine may undergo substantial washoff from foliage.

In terrestrial field dissipation studies performed in Georgia, California, and Minnesota, atrazine dissipated with half lives of 13, 58, and 261 days, respectively. The differences between these reported half-lives could be attributed to the temperature variation between the studies in which atrazine was seen to be more persistent in colder climate. Long term field dissipation studies also indicated that atrazine could persist over a year in such climatic conditions. A forestry field dissipation study in Oregon (aerial application of 4 lb ai/A) estimated an 87 day half-life for atrazine on exposed soil, a 13 day half-life in foliage, and a 66 day half-life on leaf litter.

Atrazine metabolites, desethylatrazine (DEA) and desisopropylatrazine (DIA) were detected in all anaerobic aquatic metabolism studies submitted, and hydroxyatrazine and diaminochloroatrazine (DACT) were detected in all but one of the anaerobic aquatic metabolism studies submitted. Desethylhydoxyatrazine (DEHA) and desisopropylhydroxyatrazine (DIHA) were also detected in one of the aerobic studies. All of the chlorinated metabolites and hydroxy compounds detected in laboratory metabolism studies were present at much less than 10% of applied atrazine; thus, are not considered by the Agency to be "major degradates."

For studies limited to several months, the relative concentrations of the metabolites in soil were generally as follows: DEA>DIA>DACT~hydroxyatrazine. However, for an aerobic soil metabolism study and an anaerobic aquatic metabolism study both lasting a year, the concentration of hydroxyatrazine was comparable to that of DEA over the last few months of the studies. In addition, some literature indicates that higher quantities of hydroxyatrazine can be formed in soil and in sediment under acidic conditions. Other hydroxy compounds have only rarely been detected in lab studies.

The soil/water partitioning of atrazine, DEA, DIA, and DACT are relatively low as shown by Freundlich adsorption coefficients of < 3 and often < 1 for 4 different soils. The Freundlich adsorption constants for hydroxyatrazine are substantially greater, being approximately 2 for sand, but 6.5, 12.1, and 390 for a sandy loam, loam, and clay soil, respectively. No adsorption/desorption data are available for other hydroxy-triazine degradates. However, the higher soil/water partitioning exhibited by hydroxyatrazine compared to atrazine suggests that the other hydoxy-triazines are likely to exhibit higher soil/water partitioning than corresponding chloro-triazine degradates.

In a limited study on atrazine and its chlorodegradates in surface water source CWS, the detection of all was relatively widespread. However, atrazine predominated with the relative order of concentrations generally being as follows: atrazine>>DEA>DIA~DACT.

In a 1999 study of rural wells, the four hydroxy compounds were detected. Hydroxyatrazine was detected the most frequently and generally at the highest level, but not to the same extent as atrazine or the chlorinated metabolites. Unlike in surface water, where atrazine concentrations were generally much greater than chlorotriazine concentrations, the DEA and DACT concentrations in rural wells were often comparable to those of atrazine. The relative order of concentrations found in rural wells was generally atrazine~DEA~DACT>DIA>hydroxyatrazine .

The relatively widespread detection of atrazine and various chlorinated metabolites in the surface water study on metabolites and in the 1999 rural well study is consistent with the widespread use of atrazine, the persistence of atrazine and the mobility of atrazine and its chlorinated metabolites. The lower frequency of detection and generally lower levels of the hydroxyatrazine in the rural well study is consistent with its higher soil/water partitioning than atrazine and the chlorinated metabolites.

The available fate and ground water data indicate that hydroxy compounds are unlikely to significantly contaminate surface water. They are not appreciably formed in soil, and they are likely to exhibit higher soil/water partitioning than corresponding chlorinated metabolites. In addition, they were detected much less frequently and at much lower levels than the chlorinated metabolites in rural wells. However, hydroxyatrazine was detected at concentrations up to 6.5 ppb in 6% of rural wells sampled. Also, there have been reported concentrations of hydroxyatrazine in soil sometimes approaching and possibly in some cases (e.g., acidic soils) exceeding that of DEA.

Atrazine should be somewhat persistent in groundwater and in surface water with relatively long hydrologic residence times where advective transport is limited. The reasons for this are the resistence of atrazine to abiotic hydrolysis and to direct aqueous photolysis, its only moderately susceptibility to biodegradation, and its limited volatilization potential as indicated by a relatively low Henry's Law constant. Atrazine has been observed to remain at elevated concentrations longer in some reservoirs than in flowing surface water or in other reservoirs with presumably much shorter hydrologic residence times in which advective transport greatly limits its persistence.

The relatively low soil/water partitioning of atrazine and chlorinated metabolites indicates that their concentrations in or on suspended and bottom sediment will be in equilibrium with the residues in the water column. However, despite relatively low soil/water partitioning,

limited data indicated that activated carbon can be effective in reducing atrazine and its triazine metabolite concentrations by several fold, depending upon the frequency and conditions of its use.

Volatility as a route of field dissipation raises concerns about the atmospheric fate of atrazine, its aerial transport and whether aerial deposition poses the potential for risks to non-target terrestrial plants. The potential for adverse effects on sensitive, non-target crops and plants from atmospheric deposition is uncertain. Atrazine has been widely detected in rainfall, with the highest concentrations occurring in the Midwestern corn belt during the application season (mid-April through mid- July). In addition, DEA and DIA were also detected in rainfall together with atrazine. High ratios of DEA to atrazine were attributed to atmospheric degradation. Mass deposition of atrazine and its metabolites is higher in the midwestern corn belt, and decreases with distance away from the corn belt.

2. Risk to Terrestrial Organisms

The Agency's ecological risk assessment compares toxicity endpoints from ecological studies to estimated environmental concentrations (EECs) based on environmental fate characteristics and pesticide use data. To evaluate the potential risk to non-target organisms from the use of atrazine products, the Agency calculates a Risk Quotient (RQ) by determining the ratio of the EEC to the toxicity endpoint values, such as the median lethal dose (LD50) or the median lethal concentration (LC50). These RQ values are then compared to the Agency's levels of concern (LOCs) to determine whether or not a chemical, when used as directed, has the potential to cause adverse effects to non-target organisms. In general, the higher the RQ, the greater the concern. When the RQ exceeds the LOC for a particular category (e.g., endangered species), the Agency presumes a risk of concern to that category of non-target organisms. The LOCs and the corresponding risk presumptions are presented in Table 16.

Table 16. LOCs and Associated Risk Presumptions

If...	Then the Agency presumes....
Birds and Mammals	
Acute RQ > LOC of 0.5	acute risk
Acute RQ > LOC of 0.2	risk that may be mitigated through restricted use classification
Endangered Species Acute RQ > LOC of 0.1	acute effects may occur in endangered species
Chronic RQ > LOC of 1	chronic risk and chronic effects may occur in non-target organisms
Aquatic Animals	
Acute RQ > LOC of 0.5	acute risk
Acute RQ > LOC of 0.1	risk that may be mitigated through restricted use classification
Endangered Species Acute RQ > LOC of 0.05	acute effects may occur in endangered species
Chronic RQ > LOC of 1	chronic risk and chronic effects may occur in non-target organisms
Terrestrial and Semi-Aquatic Plants	

Acute RQ > LOC of 1	acute risk
Acute RQ > LOC of 1	risk that may be mitigated through restricted use classification
Endangered Species Acute RQ > LOC of 1	acute effects may occur in endangered species
Chronic RQ > LOC of 1	chronic risk and chronic effects may occur in non-target organisms

a. Toxicity (Hazard) Assessment

Atrazine is practically non-toxic to slightly toxic to birds and mammals, and relatively non-toxic to honey bees.

As expected for a herbicide, atrazine is toxic to non-target plants. Terrestrial plant seedling germination tests indicate that cucumber is the most sensitive dicot and oats is the most sensitive monocot. Terrestrial plant seedling emergence tests indicate that the dicot most sensitive to atrazine is carrot, and the monocots most sensitive to atrazine are oats and ryegrass. Terrestrial plant vegetative vigor tests indicate that the most sensitive dicot is cucumber and the most sensitive monocot is onion.

The acute and chronic toxicity values used to assess risks are presented in Tables 17 and 18 below.

Table 17. Summary of Toxicity Data for Terrestrial Animals

Species	Acute Toxicity (ppm)				Chronic Toxicity (ppm)	
	LD_{50}	Acute Oral Toxicity	5-day LD_{50}	Subacute Dietary Toxicity	NOAEC/ LOAEC	Affected Endpoints
Atrazine						
Northern bobwhite quail *Colinus virginianus*	940	slightly toxic	>5,000	practically non-toxic	225/675	decreased egg production, increase in defective eggs, decreased embryo viability, decreased body weight
Honey bee *Apis meliferus*	96.69	relatively non-toxic	--	--	--	--
Laboratory rat (mg/kg)	1,869 - 3,080	practicall y non-toxic	--	--	50	See health effects endpoints

Table 18. Summary of Toxicity Data for Non-Target Terrestrial Plants

Species	Seedling Germination Toxicity		Seedling Emergence Toxicity		Vegetative Vigor Toxicity	
	EC25/ EC05	Endpoint	EC25/ NOAEC	Endpoint	EC25/ NOAEC	Endpoint
Monocots						

Table 18. Summary of Toxicity Data for Non-Target Terrestrial Plants

Species	Seedling Germination Toxicity		Seedling Emergence Toxicity		Vegetative Vigor Toxicity	
	EC25/ EC05	Endpoint	EC25/ NOAEC	Endpoint	EC25/ NOAEC	Endpoint
Oat - *Avena sativa*	1.8/0.12	reduction in radical length	0.0004/ 0.0025	reduction in dry wt.	2.4/2.0	reduction in dry wt.
Onion - *Allium cepa*	<4.0/<4.0	no effect	0.009/ 0.005	reduction in dry wt.	0.61/0.5	reduction in dry wt.
Dicots						
Carrot - *Daucus carota*	<4.0/<4.0	no effect	0.003/ 0.0025	reduction in dry wt.	1.7/2.0	reduction in plant height
Cucumber - *Cucumis sativus*	0.80/0.60	reduction in radical length	0.013/ 0.005	reduction in dry wt.	0.008/ 0.005	reduction in dry weight

b. Exposure and Risk - Birds and Mammals

The Agency's acute ecological risk assessment for terrestrial wildlife considers exposure to atrazine from the ingestion of residues on food. Terrestrial EECs were derived for the three major crops using the maximum labeled use rates (4 lb ai/A for sugarcane and 2 lb ai/A for corn and sorghum) and the highest value measured for foliar dissipation half-life from the application of atrazine to turf in the Southeastern United States: 17 days. Since foliar dissipation half-lives are used in estimating these EECs, the EECs better represent post-emergent applications than pre-plant and pre-emergence applications made directly to soil.

No acute LOCs are exceeded for mammals; however, in some scenarios, restricted use and endangered species LOCs are exceeded. RQ values for small mammals are cited in the table below. Acute endangered species LOCs are exceeded for small herbivorous mammals (RQ range: 0.0092 - 0.13) at 1.1 and 1.2 lb ai/A. All acute avian RQs are significantly below all LOCs indicating that there is negligible potential for acute risks to birds

The chronic LOC is exceeded for birds (RQ range: 0.08 - 4.3) and mammals (RQ range: 1.6 - 96) suggesting the potential for chronic risks to mammals and birds from atrazine applied at typical and maximum use rates.

It is important to consider that exposure of birds and mammals to atrazine applied as a pre-plant or pre-emergent herbicide is primarily a result of ingestion of earthworms and other soil organisms that can serve as a food source and inadvertent ingestion of soil. Methods are not available to determine the levels of atrazine that could occur in soil and in earthworms and other soil organisms that are used as food sources by birds and mammals. The resulting levels of atrazine in soil and soil organisms that can serve as a source of food for birds and mammals are expected to be considerably lower than estimated levels in plants used as food sources. As such, risk quotients based on EECs from maximum foliar dissipation half-life data, as presented in this document, are over-estimates for birds and mammals that are exposed from ingestion of soil

organisms.

The primary effects of concern for herbicides and wildlife are indirect.

Table 19. Acute and Chronic Risk Quotients for Terrestrial Organisms

Organism	Size of Organism (grams)	Range of EEC (ppm)	Acute RQ	Subacute Dietary RQ	Chronic RQ (Repro)
Sugarcane: 1 Preplant Aerial Application 4 lb ai/A (maximum labeled use rate)					
Mammalian Herbivores	15	60 - 960	0.031 - 0.49	--	1.2 - 19.2
Mammalian Insectivores	15	60 - 540	0.031 - 0.27		
Mammalian Granivores	15	60	0.0067		
Avian Species		60 - 960	--	<0.012 - <0.19	0.27 - 4.3
Sugarcane: 1 Preplant Aerial Application 2.6 lb ai/A (typical use rate)					
Mammalian Herbivores	15	39 - 624	0.020 - 0.32	–	0.78 - 12.48
Mammalian Insectivores	15	39 - 151	0.020 - 0.08		
Mammalian Granivores	15	39	0.0044		
Avian Species		39 - 624	--	<0.0078 - <0.12	0.17 - 2.8
Corn and Sorghum: 1 Preplant Aerial Application at 2.0 lb ai/A (maximum labeled rate)					
Mammalian Herbivores	15	30 - 480	0.015 - 0.24	--	0.6 - 9.6
Mammalian Insectivores	15	30 - 270	0.015 - 0.14		
Mammalian Granivores	15	30	0.34		
Avian Species		30 - 480	--	<0.0060 - <0.096	0.13 - 2.1
Corn: 1 Preplant Aerial Application at 1.1 lb ai/A (typical use rate)					
Mammalian Herbivores	15	16.5 - 264	0.0084 - 0.13	--	0.3 - 5.28
Mammalian Insectivores	15	16.5 - 148.5	0.0084 - 0.075		
Mammalian Granivores	15	16.5	0.0019		
Avian Species		16.5 - 264	--	<0.0033 - <0.053	0.73 - 1.2
Sorghum: 1 Preplant Aerial Application at 1.2 lb ai/A (typical use rate)					
Mammalian Herbivores	15	18 -288	0.0092 - 0.15	--	0.36 - 5.76
Mammalian Insectivores	15	18 - 162	0.0092 - 0.082		
Mammalian Granivores	15	18	0.0020		
Avian Species		18 - 288	--	<0.0036 - <0.058	0.08 - 1.1

c. Exposure and Risk - Terrestrial Plants

Atrazine applications to crop and non-crop areas result in exposure to non-target plants in areas adjacent to treated fields via spray drift and/or runoff. The Agency's assessment compares standard residue values for runoff and drift for exposure and compares these exposure values to toxicity data available for non-target species. Spray drift levels for ground and aerial applications are 1 and 5 percent, respectively. Atrazine is highly mobile in soils and has a low soil-water partitioning coefficient and a water solubility value of about 33 ppm. Its runoff is estimated at 2 percent. The scenario for plants growing in dry areas receive runoff from 1 hectare to 1 hectare, while a 1-hectare wet area receives runoff from 10 hectares. All plant toxicity values are present as pounds active ingredient per acre (lbs ai/A). The EC25 values are used to calculate risk quotients for the typical non-target plants and the NOAEC values are used for endangered and threatened plant species. Although the Agency currently only has data on crop species, the results are assumed to represent a range of wild plants. The assessment assumes that terrestrial plants living in wetter habitats are at greater risk because they are exposed to runoff more than drier areas. The assessment resulted in exceedences for ground and aerial applications of atrazine at typical and maximum labeled rates. RQs based on the maximum labeled use rate are presented in Table 20 below.

RQs from three test species exceed the typical plant LOC from spray drift alone (cucumber, soybeans, and cabbage), 8 test species (in dry areas) or 9 test species (in wetter areas) exceeded the LOC from spray drift plus runoff. Both monocot and dicot species have exceeded the level of concern.

Endangered species exceedences for direct effects on terrestrial plants indicate potential risks to endangered species. RQs from 9 test species exceeded the endangered species LOC from spray drift alone or from spray drift plus runoff. The level of concern for endangered terrestrial plant species is exceeded for both monocots and dicots. These results indicate concern for endangered plant species growing in areas adjacent to atrazine-treated fields from combined spray drift and runoff.

A ground application of 2 lbs ai/A poses a diminished risk to adjacent crops compared to 4 lb ai/A applications, but only one of these species (i.e., soybeans from spray drift) would no longer exceed the acute level of concern. At the typical corn use rate of 1.1 lbs ai/A, the non-target crops at risk are cucumbers from spray drift, 7 out of 9 non-target species growing in dry habitats, and all 9 non-target species, if grown in semi-aquatic habitats. Risk quotients for endangered plant species indicate concern for endangered species growing in areas adjacent to atrazine-treated fields from combined spray drift and runoff.

Table 20. Risk Quotients for Terrestrial Plants

Crop	4 lbs ai./A; Aerial Application						4 lbs ai./A; Ground Application					
	Spray Drift (5%)		Spray Drift + Runoff				Spray Drift (1%)		Spray Drift + Runoff			
	Typ	ES[1]	Dry Areas		Wet Areas		Typ	ES	Dry Areas		Wet Areas	
			Typ	ES	Typ	ES			Typ	ES	Typ	ES
Carrot	0.12	0.10	83	99	230	270	0.024	0.02	40	48	280	340
Oats	0.083	0.10	62	99	170	270	0.017	0.02	30	48	210	340
Ryegrass	<0.05	<0.05	62	50	170	140	<0.01	<0.01	30	24	210	170
Lettuce	0.61	0.80	50	50	140	140	0.12	0.16	24	24	170	170
Onion	0.33	0.40	28	50	76	140	0.066	0.08	13	24	93	170
Cucumber	25	40	19	50	52	140	5.0	8.0	9.2	24	65	170
Soybean	7.7	10	1.3	9.9	3.5	27	1.5	2.0	0.63	4.8	4.4	34
Cabbage	14	40	18	25	49	68	2.9	8.0	8.6	12	60	84
Tomato	0.28	0.40	7.3	25	20	68	0.056	0.08	3.5	12	25	84
Corn	<0.05	<0.05	<0.06	<0.06	<0.17	<0.17	<0.01	<0.01	<0.03	<0.03	<0.21	<0.21

1 ES - Endangered Species; Typ. - Typical Species

3. Risk to Aquatic Species

To assess the risks to aquatic plants and animals from the use of atrazine, the Agency first conducted a screening-level RQ assessment similar to that described above for terrestrial organisms. This screening-level assessment was conducted only for freshwater species. The Agency also conducted a refined assessment to further evaluate the potential risks to aquatic organisms and local communities and populations. Estuarine and saltwater species were assessed as part of the refined assessment.

a. Toxicity (Hazard) Assessment

Atrazine is slightly to moderately toxic to freshwater fish and slightly to highly toxic to freshwater invertebrates. Atrazine is slightly to moderately toxic to estuarine/marine fish and slightly to very highly toxic to estuarine/marine invertebrates. Tables 21 and 22 summarizes the endpoints used in the screening-level risk assessment of aquatic animals and plants.

Table 21. Summary of Toxicity Data for Aquatic Organisms

Species	Acute Toxicity (ppb)		Chronic Toxicity (ppb)	
	96-hr LC_{50}	Acute Toxicity	NOAEC/ LOAEC	Affected Endpoints
Freshwater Fish				
Rainbow trout - *Oncorhynchus mykiss*	5,300	moderately toxic	--	--
Brook trout - *Salvelinus tontinalis*	6,300	moderately toxic	65/120	reduced mean length, mean body weight
Freshwater Invertebrates				
Midge - *Chironomus tentans*	720	highly toxic	110/230	reduction in pupation and adult emergence
Scud - *Gammarus fasciatus*	5700	moderately toxic	60/140	reduction in development
Mysid shrimp - *Americamysis bahia*	1000	highly toxic	80/190	reduction in adult survival
	5400	moderately toxic		

Table 22. Summary of Toxicity Data for Non-Target Aquatic Plants

Species	Short Term Exposure (10 days or less)		Longer Term Exposure (>10 days)	
	Concen-tration (ppb)	Response	Concen-tration (ppb)	Response
Freshwater Vascular Plants				
Duckweed - *Lemna gibba*	170	50% reduction in growth	37	50% reductio in growth (LOAEC = 3.4, 19% reduction in growth; NOAEC < 3.4)
			43	50% reduction in growth (NOAEC = 10)
Freshwater Non-Vascular Plants				
Chlorophyceae - *Kirchneria subcapitata (Selenastrum capricornutum)*	49	50% reduction in cell growth (NOAEC = 16)	--	--

b. Exposure and Risk

For the screening-level assessment, to assess potential risk to aquatic animals and plants in ponds, the Agency uses a computer model to predict the EECs of atrazine in water. Peak EECs are compared to acute toxicity endpoints to derive acute RQs. Normally, chronic RQs are derived using 96-hour and 21- to 90-day EECs, corresponding to the duration of the test. For atrazine, 21-day EECs were generally used for chronic exposures, because the difference in EEC values is small. To estimate chronic risk to fish, both 21-day and 90-day EECs were used. EECs are presented in Table 23 below. Calculated RQs of concern are summarized below and presented in Table 23.

Table 23. EECs Used in the Atrazine Aquatic Risk Assessment for Ponds

Crop	Use Rates (lb ai/A)	Atrazine EEC Values ppb (µg/L)				
		Peak Conc.	96-hour Average	21-day Average	60-day Average	90-day Average
Sugarcane	4.0	205	204	202	198	194
	2.6	133	133	131	129	126
Corn	2.0	38.2	38.0	37.2	35.5	34.2
	1.1	21.0	20.9	20.5	17.7	18.8
Sorghum	2.0	72.7	72.3	70.6	67.7	65.9
	1.2	43.6	43.4	42.4	40.6	39.5

For the sugarcane scenarios, atrazine applied at either the 2.6 lbs/ai/A or 4.0 lbs ai/A rate exceeds the levels of concern for acute toxicity to aquatic plants, restricted use for aquatic invertebrates, and endangered species for aquatic invertebrates and aquatic vascular plants. In addition, the chronic LOC is exceeded for aquatic plants, fish and aquatic invertebrates resulting from both the maximum use rate and the typical use rate for sugarcane.

For the 2.0 lb rate corn scenario, atrazine exceeds the levels of concern for acute toxicity for aquatic plants and for endangered species for aquatic invertebrates and aquatic vascular plants. The acute RQs for freshwater fish, and the chronic RQs for freshwater fish and aquatic invertebrates do not exceed levels of concern. For the 1.1 lb. rate corn scenario, atrazine exceeds the LOC for endangered species for aquatic vascular plants. The remaining calculated RQs do not exceed levels of concern.

For the 2.0 lb rate sorghum scenario, atrazine exceeds the LOC for acute toxicity for aquatic plants, restricted use for aquatic invertebrates, endangered species for aquatic invertebrates, and aquatic vascular plant species. The levels of concern for chronic effects are exceeded by chronic RQs for aquatic plants, fish and aquatic invertebrates. For the 1.2 lb. Rate sorghum scenario, atrazine exceeds the LOC for acute toxicity for vascular plants, endangered species for aquatic invertebrates, and endangered species for aquatic vascular plants. The acute and chronic RQs for freshwater fish and aquatic invertebrates do not exceed levels of concern.

Table 24. Acute and Chronic Risk Quotients for Freshwater Aquatic Species

Organism	Acute		Chronic	
	EEC (ppb)	RQ	EEC (ppb)	RQ
Sugarcane: 1 Preplant Aerial Application at 4.0 lb ai/A				
Freshwater Fish	205	0.039	194 - 202	2.9 - 3.1
Aquatic Invertebrate		0.28	202	3.4
Freshwater Vascular Plant		5.5	--	--
Freshwater Vascular Plant (NOEC)*		>60.3	--	--
Freshwater Algae		4.2	--	--
Sugarcane: 1 Preplant Aerial Appliation at 2.6 lb ai/A				
Freshwater Fish	133	0.025	126 - 133	1.9 - 2.0
Aquatic Invertebrate		0.18	131	2.2
Freshwater Vascular Plant		3.6	--	--
Freshwater Vascular Plant (NOEC)*		>39.1	--	--
Freshwater Algae		2.7	--	--
Corn: 1 Preplant Aerial Application at 2.0 lb ai/A				
Freshwater Fish	38.2	0.0072	34.2 - 37.2	0.53 - 0.58
Aquatic Invertebrate	38.2	0.053	37.2	0.63
Freshwater Vascular Plant	37.2	1.0		
Freshwater Vascular Plant (NOEC)*	37.2	>11	--	--
Freshwater Algae	38.2	0.78	--	--
Corn: 1 Preplant Aerial Application at 1.1 lb ai/A				
Freshwater Fish	21.0	0.0040	18.8 - 20.5	0.29 - 0.32
Aquatic Invertebrate	21.0	0.029	20.5	0.34
Freshwater Vascular Plant	20.5	0.56	--	--
Freshwater Vascular Plant (NOEC)*	20.5	>6.0	--	--
Freshwater Algae	21.0	0.43	--	--
Sorghum: 1 Preplant Aerial Application at 2.0 lb ai/A				
Freshwater Fish	72.7	0.014	65.9 - 70.6	1.0 - 1.1

Table 24. Acute and Chronic Risk Quotients for Freshwater Aquatic Species

Organism	Acute		Chronic	
	EEC (ppb)	RQ	EEC (ppb)	RQ
Aquatic Invertebrate	72.7	0.10	70.6	1.2
Freshwater Vascular Plant	72.7	2.0	--	--
Freshwater Vascular Plant (NOEC)*	72.7	>21	--	--
Freshwater Algae	72.7	1.5	--	--
Sorghum: 1 Preplant Aerial Application at 1.2 lb ai/A				
Freshwater Fish	43.6	0.0082	39.5 - 42.4	0.61 - 0.65
Aquatic Invertebrate	43.6	0.061	42.4	0.71
Freshwater Vascular Plant	43.6	1.2	--	--
Freshwater Vascular Plant (NOEC)*	43.6	>13	--	--
Freshwater Algae	43.6	0.89	--	--

* Endangered species RQ calculation

In addition to the risks described above, indirect effects on fish and aquatic invertebrates may be severe due to the loss of up to 60 to 95 percent of the vegetative cover, which provides habitat to conceal young fish and aquatic invertebrates from predators. Numerous studies have described atrazine's ability to inhibit photosynthesis, change community structure, and cause the mortality of aquatic flora at concentrations between 20 and 500 ppm.

4. Refined Aquatic Assessment

The refined atrazine aquatic risk assessment focuses on aquatic plants and invertebrates and the potential for effects on sensitive plant species to result in community-level impacts that affect a range of aquatic organisms. The assessment is broken down by the type of water body (i.e., small static fresh water bodies such as ponds, flowing fresh water such as streams and rivers, larger bodies of fresh water such as lakes and reservoirs, and estuarine and marine habitats). Exposure for these three types of aquatic environments was estimated using PRZM-EXAMS modeling simulations (ponds) and monitoring data (streams, lakes and reservoirs, and estuarine/marine environments - refined aquatic assessment). The April 22, 2002, Environmental Fate and Effects Chapter presents figures that plot atrazine concentrations against exceedence probabilities to illustrate the effects that are likely or estimated to occur in these aquatic environments.

The Agency's refined aquatic risk assessment is based on ecotoxicological data, microcosm and mesocosm studies, and the monitoring data described above. A large number of laboratory, microcosm, mesocosm, and actual field studies found in the literature suggest that atrazine concentrations measured in the environment could reach levels that are likely to have negative impact on sensitive aquatic species and communities.

Tables 25, 26 and 27 summarize the toxicological endpoints used in the refined risk assessment.

Table 25. Key Endpoints for the Lentic Freshwater Environment (e.g., reservoirs, lakes). The Endpoints Chosen for Use in the Refined Risk Assessment are Bolded.

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
Fish	Lab	Acute Fish (96-hours) LC50 = 5,300 µg/L	Rainbow trout / Mortality	Fish Mortality Estimated to Occur at **5,300 µg/L**
	Lab	Chronic Fish (44-weeks) NOAEC = 65 µg/L; LOAEC= 120 µg/L; MATC= 88 µg/L	Brook trout / [7.2 % red. mean length, 16 % red. mean body weight]	Reduction in Fish Growth Estimated to Occur at **88 µg/L**
	Distribution of Lab Data	10th centile value = 62 µg/L	Freshwater Aquatic Animal Chronic Data	**Fish Population Reductions Estimated to Occur at 62 µg/L**
	Field (mesocosms)	96% Reduction in # of Young Fish Occurred at 20 µg/L (Caused by Loss of Food and Habitat)	Bluegill sunfish	**Fish Populations Likely to be Reduced at 20 µg/L due to Loss of Food and Habitat**
Invertebrates	Lab	Acute Invertebrate (48-hour) LC_{50} = 720 µg/L	Midge / Mortality	Invertebrate Mortality Estimated to Occur at **720 µg/L**
	Lab	Chronic Invertebrate (48-hour) NOAEC = 60 µg/L; LOAEC= 140 µg/L; MATC= 92 µg/L	Scud / [25 % red. in development of F_1 to seventh instar]	Reduction in Invertebrate Populations Estimated to Occur at **92 µg/L**
	Distribution of Lab Data	10th centile value = 62 µg/L	Freshwater Aquatic Animal Chronic Data	**Reduction in Invertebrate Populations Estimated to Occur at 62 µg/L**
	Field	59-65% Reduction in Daphnid population growth occurred at 10 µg/L over 18-days	Daphnids	**Invertebrate Populations Likely to be Reduced at 10 µg/L**
Non-Vascular Plants	Lab	Acute Algae (1-week) EC_{50} = 1 µg/L	Four species [41-93% reduction in chlorophyll production]	Reduction in Primary Production Estimated to Occur at **1 µg/L**
	Distribution of Lab Data	10th centile value = 32 µg/L for acute effects on phytoplankton, and 2.3 µg/L for chronic effects on plants	Freshwater Aquatic Plant Data	**Acute Effects on Phytoplankton Estimated at 32 µg/L and Reductions in Primary Production Estimated to Occur at 2.3 µg/L**
	Microcosm	23% Reduction in gross primary production 10 µg/L (at day 2); recovery by day 7	phytoplankton	Reduction in Primary Production Estimated to Occur at **10 µg/L**
	Field	42% Reduction in phytoplankton biomass (at days 2-7) occurred at 20 µg/L	phytoplankton	**Reduction in Primary Production Likely to Occur at 20 µg/L**
Vascular Plants	Lab	Acute (14-days) EC_{50} = 37 µg/L	Duckweed [50% reduction in growth]	Reduction in Macrophytes Estimated to Occur at **37 µg/L**
	Distribution of Data	10th centile value = 18 µg/L for acute effects on macrophytes, and 2.3 µg/L for chronic effects on plants	Freshwater Aquatic Plant Data	**Acute Effects on Macrophytes Estimated at 18 µg/L and Reductions in Macrophyte Populations Estimated to Occur at 2.3 µg/L**

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
	Mesocosm	60% Reduction of macrophyte vegetation occurred at 20 µg/L; by May of following year, 95% Reduction of macrophytes	Macrophytes	**Reduction in Macrophytes (number & diversity) Likely to Occur at 20 µg/L**

Table 26. Key Endpoints for the Lotic Freshwater Environment (e.g., streams). The Endpoints Chosen for Use in the Refined Risk Assessment are Bolded.

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
Fish	Lab	Acute Fish (96-hours) LC50 = 5,300 µg/L	Rainbow trout / Mortality	Fish Mortality Estimated to Occur at **5,300** µg/L
	Lab	Chronic Fish (44-weeks) NOAEC = 65 µg/L; LOAEC= 120 µg/L; MATC= 88 µg/L	Brook trout / [7.2 % red. mean length, 16 % red. mean body weight]	Reduction in Fish Growth Estimated to Occur at **88 µg/L**
	Distribution of Lab Data	10th centile value = 62 µg/L	Freshwater Aquatic Animal Chronic Data	**Fish Population Reductions Estimated to Occur at 62 µg/L**
Invertebrates	Lab	Acute Invertebrate (48-hour) LC_{50} = 720 µg/L	Midge / Mortality	Invertebrate Mortality Estimated to Occur at **720 µg/L**
	Lab	Chronic Invertebrate (48-hour) NOAEC = 60 µg/L; LOAEC= 140 µg/L; MATC= 92 µg/L	Scud / [25 % red. in development of F_1 to seventh instar]	Reduction in Invertebrate Populations Estimated to Occur at **92 µg/L**
	Distribution of Lab Data	10th centile value = 62 µg/L	Freshwater Aquatic Animal Chronic Data	**Invertebrate Population Reductions Estimated to Occur at 62 µg/L**
	Outdoor Stream	Significant Increase in daytime and nighttime invertebrate drift occurred at 22 µg/L due to increased predation	various species of stream dwelling invertebrates	**Invertebrate Populations Likely to be Reduced at 22 µg/L**
Non-Vascular Plants	Lab	Acute Algae (1-week) EC_{50} = 1 µg/L	Four species [41-93% reduction in chlorophyll production]	Reduction in Primary Production Estimated to Occur at **1 µg/L**
	Distribution of Lab Data	10th centile value = 32 µg/L for acute effects on phytoplankton, and 2.3 µg/L for chronic effects on plants	Freshwater Aquatic Plant Data	**Acute Effects on Phytoplankton Estimated at 32 µg/L and reductions in primary production estimated to occur at 2.3 µg/L**
	Stream (first order adjacent to corn field in Canada)	79% (mean) Reduction in Total Phytoplankton Counts at 2.62 µg/L (mean; range = 0.211 - 13.9)	phytoplankton	**Reduction in Primary Production Likely to Occur at 2.62 (0.211 - 13.9) µg/L**

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
	Outdoor Artificial Streams	Depression of Photosynthesis at 10 µg/L	Various species of stream algae. Photosynthesis reduction measured by open water oxygen methods.	**Reduction in Primary Production Likely to Occur at 10 µg/L**
Vascular Plants	Lab	Acute (14-days) EC_{50} = 37 µg/L	Duckweed [50% reduction in growth]	Reduction in Macrophytes Estimated to Occur at **37 µg/L**
	Distribution of Lab Data	10th centile value = 18 µg/L for acute effects on macrophytes, and 2.3 µg/L for chronic effects on plants	Freshwater Aquatic Plant Data	**Acute Effects on Macrophytes Estimated at 18 µg/L and Reductions in Macrophytes Estimated to Occur at 2.3 µg/L**

Table 27. Key Endpoints for the Estuarine/Marine Environment (e.g., estuaries, tidal , marshes). Endpoints Chosen for Use in the Refined Risk Assessment are Bolded.

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
Fish	Lab	Acute Fish (96-hours) LC50 = 2,000 µg/L	Sheepshead minnow / Mortality	Fish Mortality Estimated to Occur at **2,000 µg/L**
	Lab	Chronic Fish NOAEC = 1,900 µg/L; LOAEC= 3400 µg/L; MATC= 2542 µg/L	Sheepshead minnow [89 % red. Juv. survival]	Reduction in Fish Populations Estimated to Occur at **2542 µg/L**
	Distribution of Lab Data	10th centile value = 23 µg/L	Saltwater Aquatic Animal Chronic Data	**Fish Population Reductions Estimated to Occur at 23 µg/L**
Invertebrates	Lab	Acute Invertebrate LC_{50} = 94 µg/L	Copepod (*Acartia tonsa*)	Invertebrate Mortality Estimated to Occur at **94 µg/L**
	Distribution of Lab Data	10th centile value = 23 µg/L	Saltwater Aquatic Animal Chronic Data	**Invertebrate Population Reductions Estimated to Occur at 23 µg/L**
	Lab	Chronic Invertebrate NOAEC = 80 µg/L; LOAEC= 190 µg/L; MATC= 123 µg/L	Mysid [37 % red. Adult survival]	Reduction in Invertebrate Populations Estimated to Occur at **123 µg/L**
Non-Vascular Plants	Lab	Acute (120-hours) Algae LC_{50} = 22 µg/L	Algae (Chrysophyceae; *Isochrysis galbana*)	Algae Mortality Estimated to Occur at **22 µg/L**
	Distribution of Lab Data	10th centile value = 27 µg/L for acute effects on phytoplankton, and 9.1 µg/L for chronic effects on plants	Saltwater Aquatic Plant Data	**Acute Effects on Phytoplankton Estimated at 27 µg/L and Reductions in Primary Production Estimated to Occur at 9.1 µg/L**
Vascular Plants	Lab	Significant reduction in dry weight occurred at 10 µg/L (calculated MATC from NOAEC=7.5 and LOAEC=14.3)	Sago Pondweed	Reduction in Macrophytes Estimated to Occur at **10 µg/L**
	Distribution of Lab Data	10th centile value = 9.1 µg/L for chronic effects on plants	Saltwater Aquatic Plant Data	**Reductions in Macrophytes Estimated to Occur at 9.1 µg/L**

Key Group of Non-target Organisms	Type of Study	Measurement Endpoint	Test Organisms / Effect	Assessment Endpoint
	Microcosm	16% Reduction in Tuber formation; 55% Reduction in Biomass over reproductive season at 4 µg/L	Wild Celery (*Vallisneria Americana*)	**Reduction in Macrophytes Likely to Occur at 4 µg/L**

a. Ponds

Based on modeling simulations, it is possible that for months every year, atrazine concentrations in ponds from use on sorghum and sugarcane exceed the levels at which studies have shown reductions in fish and invertebrate populations, macrophytes, and primary production (>20ppb). For corn, modeling simulations indicate that atrazine concentrations in ponds exceed the levels at which studies have shown reductions in fish populations, invertebrate populations, macrophytes, and primary production in 70 to 83% of the years. From 70 to 75% of the years, atrazine concentrations in ponds from use on sugarcane exceed the levels at which reproduction studies have shown reductions in invertebrate populations and fish growth. For sorghum, the percentage of exceedences are from 2.8 and <5% of the years.

b. Lakes and Reservoirs

Monitoring data in lakes and reservoirs have indicated that a number of drinking water sites have atrazine concentrations greater than 20 ppb in the finished water. This is the level at which reductions in fish populations, invertebrate populations, macrophytes, and primary production has been observed in simulated field studies.

c. Streams

The highest atrazine concentrations occur in brief pulses following rain events and are usually associated with the next rain event after an application. Atrazine concentrations in streams vary frequently, depending on usage and rainfall patterns, and vary from watershed to watershed, depending on the size of the watershed, the intensity of agricultural activity, and the flow volume and location of the watershed.

Reductions in invertebrate populations and primary production were likely to occur in 12 to 34% of the 129 Midwestern streams sampled following atrazine applications in 1989. In addition, based on simulated field testing and laboratory testing macrophytes may be reduced in 52 to 63% of the streams sampled in the weeks following atrazine applications. Reduction in primary production is also possible at these levels. Later in the season, concentrations that would affect primary production and macrophytes were seen in only 1% of the 143 streams sampled. Based on sampling in 1995, reduction in invertebrate populations are primary production are likely to occur in 17 to 35% of the 50 Midwestern streams sampled following atrazine applications. In addition, based on laboratory testing, macrophytes may be reduced in 64% of the streams sampled following atrazine applications.

The highest pulse concentrations seen in streams exceed many of the assessment endpoints for non-target organisms. While the duration of these high concentrations is not likely to be long since pulses of runoff tend to move quickly downstream, they may last for hours, especially during the Spring and during runoff events when many fields in a watershed are being

treated with atrazine around the same time. Thus, it is possible that reductions in invertebrate populations and primary production could occur as a result of post-application stream contamination from the Spring application of atrazine. The frequency of such reductions occurring may be low considering the frequency of the pulses above 10 ppb and depending upon the flow volume of each stream. The frequency of similar reductions occurring in rivers is probably lower than for streams since the peaks and average concentrations of atrazine are lower in rivers.

Based on NAWQA monitoring data for 40 agricultural sites, 11 to 35% of the 40 sites exceed atrazine concentrations at which invertebrate populations and primary production occur, based on the maximum atrazine concentrations seen. NAWQA monitoring data, however, were not designed to time monitoring to correspond with atrazine treatment and may underestimate concentrations likely to be present in streams.

d. Estuaries

Based on maximum atrazine concentrations in Louisiana, 77% of the sites sampled exceed concentrations at which reductions in macrophytes occur. This falls to 26 to 61% for the mean concentration. About 30% of the sites based on maximum concentrations and about 7% based on mean concentrations exceed the concentrations at which reductions in fish and invertebrate populations occur.

Maximum atrazine concentrations in the Chesapeake Bay exceed levels that are likely to reduce macrophytes for 8% of the site and year combinations sampled. Atrazine could be contributing to reductions in submerged aquatic vegetation at certain sites in the Bay. It is possible that atrazine and other herbicides are a source of stress to aquatic vegetation. This, combined with eroding sediment could negatively affect estuarine ecosystems.

5. Risk to Endangered Species

Endangered species LOCs are exceeded for terrestrial plants, birds and small mammals from the agricultural uses of atrazine. However, risks to endangered birds and mammals are not anticipated from the dietary residues based on the methods and timing of atrazine applications. The risk exceedences for endangered terrestrial plants are based on spray drift and runoff into the habitats for terrestrial and semi-aquatic plants.

Endangered aquatic species LOCs are exceeded for some agricultural uses of atrazine. Acute risks to endangered freshwater invertebrates and aquatic vascular plants are exceeded for all crop uses except for the typical use rate on corn (1.1 lb ai/A.) Chronic levels of concern for endangered species are exceeded for fish and aquatic invertebrate reproduction for all use rates, except for corn and the typical use rate on sorghum.

Atrazine was included in the formal Section 7 consultations with FWS for the rangeland/pastureland and the forest cluster reviews in 1984. The Biological Opinions for both reviews stated that these uses of atrazine would jeopardize the continued existence of over 60 species of plants associated with rangeland and ten species of plants associated with forests. Atrazine was also included in the sorghum cluster review in 1983, and the Biological Opinion found possible jeopardy to several species of fish plus one insect (loss of habitat) and one plant species.

In addition, atrazine was one of 109 active ingredients included in the reinitiated Biological Opinion of 1989 from the FWS. This Opinion was primarily for aquatic species. In this Opinion, FWS found jeopardy to nine species of freshwater fish, two freshwater crustaceans, four amphibians and twelve species of plants for its uses on field crops, rangeland and forests. FWS provided "Reasonable and Prudent Alternatives" (RPAs) for each jeopardized species and "Reasonable and Prudent Measures" (RPMs) for 43 non-jeopardized species to minimize incidental take of these latter species. These consultations and the findings expressed in the Opinions, however, are based on old labels and application methods, less refined risk assessment procedures and an older approach to consultation which is currently being revised through interagency collaboration.

When the regulatory changes recommended in this IRED are implemented and the ecological effects and environmental fate data are submitted and accepted by the Agency, the Reasonable and Prudent Alternatives and Reasonable and Prudent Measures in the Biological Opinion(s) may need to be reassessed and modified based on the new information.

The Agency is currently engaged in a Proactive Conservation Review with FWS and the National Marine Fisheries Service under section 7(a)(1) of the Endangered Species Act. The objective of this review is to clarify and develop consistent processes for endangered species risk assessments and consultations. Subsequent to the completion of this process, the Agency will reassess the potential effects of atrazine use to federally listed threatened and endangered species. At that time the Agency will also consider any regulatory changes recommended in the IRED that are being implemented. Until such time as this analysis is completed, the overall environmental effects mitigation strategy articulated in this document and any County Specific Pamphlets described in Section IV which address atrazine, will serve as interim protection measures to reduce the likelihood that endangered and threatened species may be exposed to atrazine at levels of concern.

The potential adverse effects of atrazine on homing and reproduction in endangered salmon and other anadromous fish species is currently uncertain. The laboratory study of olfactory function in mature Atlantic salmon parr and the effect of atrazine in the range of 0.5 μg/L for sensing female hormones in urine and behavior to ground salmon skin is notable. This is so especially if the effects are significant on salmon reproduction at such a low atrazine concentration, because existing concentrations in streams inhabited by endangered salmonids may exceed this level for prolonged periods. Atrazine concentrations are likely to be their highest in the late spring and early summer following applications, at a time when salmon are returning from the ocean to spawn. It is unclear from the results of the test by Moore and Waring (1998) whether the effect on olfactory function is manifested in mature adult salmon and what effect it might have on reproduction and recruitment. These data are preliminary and additional studies are necessary to determine if there are adverse atrazine effects on adult salmon homing and adult male milt production responses to female hormones in ovulating female urine. Further study is also needed on whether those effects could be significant to reproduction and recruitment.

6. Ecological Incident Reports

The Agency received 109 ecological incident reports on atrazine between 1991 and 2001. Of the 109 incidents, thirteen are classified as "Unlikely," 50 are listed as "Possible," and two are "Unrelated." In only one case, a 1996 cotton use in Louisiana, were casualties (fish) analyzed for atrazine residues. Shad and carp tested positive for atrazine, but the conclusion was that atrazine was unlikely to be the cause of mortality. Forty of the 109 incidents are considered "Probable," and four incidents are listed as "Highly Probable." The 4 incidents listed as "Highly Probable" include 3 home lawn use incidents and 1 corn use incident. The corn use incident reported affecting 100 bass and 100 bream resulting from a registered use. The three home lawn incidents were lawn applications that affected the turf itself; two were concluded to be accidental misuse, and the third was a registered use that affected grass and non-target plants.

The forty "Probable" incidents include: 16 cases affecting corn; 11 affecting grass; 11 fish kills; 1 bird kill; and affects on ornamentals, fruit trees, berries, garden, oats, vegetation around an atrazine/cyanazine-treated field (runoff), and greenhouse plants (pond irrigation water). Four "probable" incidents are classified as accidental misuse: two cases from corn use, pears, raspberry and oats and grass and ornamentals; and two lawn misuse cases affecting grass and bluegrass.

Atrazine alone is not very toxic to the birds, mammals, and aquatic animals cited in most of these incidents. In none of these cases has evidence been provided that firmly demonstrate that atrazine has produced the reported effects. In many cases, the inference of these reported incidents to atrazine effects is likely due to the wide spread use of atrazine and the proximity of the atrazine application and timing to the occurrence to the incident. About 60 percent of the reported fish kills listed under atrazine in the incident record occur during the Spring when atrazine is applied, soils are saturated and heavy rainfall is frequent. Heavy runoff may carry atrazine, other pesticides and organic loads into surface waters. The high volume and wide-spread use of atrazine increases the probability of co-occurrence of fish kills with atrazine applications.

7. Endocrine Disruption

Atrazine has been associated with sub-lethal effects in aquatic organisms and amphibians in research presented in the open, peer-reviewed literature. These include potential effects on endocrine-mediated processes in frogs at ~ 0.1 µg/L and in largemouth bass at ~ 50 µg/L, as well as olfactory effects in salmon at ~ 0.5 µg/L. In addition, some studies have been conducted to address this issue and found that these effects were not demonstrated.

The Agency's ecological risk assessment does not suggest that endocrine disruption, or potential effects on endocrine-mediated pathways, be regarded as an regulatory endpoint at this time. Nor does the Agency have evidence to state that there is no reliable evidence that atrazine causes endocrine effects in the environment. Based on the existing uncertainties in the available database, atrazine should be subject to more definitive testing once the appropriate testing protocols have been established. The Agency is aware that several pertinent studies are being performed at this time by researchers that may to reduce some of the uncertainties in understanding potential atrazine effects on amphibian endocrinology and reproductive and developmental responses. The Agency has committed to provide these studies along with other available studies, a summary of the available data and methodologies and various data analyses

for an external scientific review by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Science Advisory Panel (SAP) at a public meeting which is scheduled for June, 2003. The Agency anticipates that the results from this SAP meeting will provide significant input to enable it publish an amendment to this IRED in October 2003 which will address the issue of the potential effects of atrazine on amphibian endocrinology and development.

IV. Interim Risk Management and Reregistration Decision

A. Determination of Interim Reregistration Eligibility

Section 4(g)(2)(A) of FIFRA calls for the Agency to determine whether products containing a specific active ingredient are eligible for reregistration after submission of the relevant data. The Agency has previously identified and required the submission of the generic data (*i.e.*, data specific to an active ingredient) to support reregistration of products containing atrazine.

The Agency has completed its assessment of the ecological and occupational risks associated with the use of currently registered pesticides containing the active ingredient atrazine, as well as an atrazine-specific dietary risk assessment and residential risk assessment that have not considered the cumulative effects of the triazines, as a class. The ecological assessment does not address the potential for effects on amphibian endocrinology and reproductive and developmental responses. As mentioned above, the Agency will publish an amendment to this IRED in October 2003 which will address the issue. Based on a review of the generic data, other special studies, and public comments on the Agency's assessments, EPA has sufficient information on the human health and ecological effects of atrazine to make interim decisions as part of the tolerance reassessment process under FFDCA and reregistration under FIFRA, as amended by FQPA. The Agency has determined that atrazine products, based on currently approved labeling, pose unreasonable dietary, residential, occupational, and ecological risks. However, the Agency believes that these risks can be mitigated through routine changes to pesticide labeling and through actions designed to further prevent risks from occurring that are described in a Memorandum of Agreement with the registrants. Accordingly, the Agency has determined that the active ingredient atrazine is eligible for reregistration provided that: (i) the additional data needs that the Agency has identified are addressed; (ii) the risk mitigation measures outlined in this document are adopted, and label amendments are made to reflect these measures; (iii) the consideration of cumulative risk for the triazines supports a final reregistration eligibility decision; and (iv) the Memorandum of Agreement is implemented. Further mitigation measures and additional data requirements may be warranted following the completion of the stakeholder process outlined in this document.

Although the Agency has not yet considered the cumulative risk for the triazines, the Agency is issuing this interim assessment now in order to identify risk reduction measures that are necessary to support the continued use of atrazine. Based on its current evaluation of atrazine alone, the Agency has determined that atrazine products, unless labeled and used as specified in this document, would present risks inconsistent with FIFRA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take regulatory action to address the risk concerns from use of atrazine.

At the time that a cumulative assessment is conducted, the Agency will address any outstanding risk concerns. For atrazine, if all changes outlined in this document are incorporated into the labels and the Memorandum of Agreement is implemented, then all currently identified risks will be mitigated. However, because this is an interim RED, the Agency may take any necessary further actions to finalize the reregistration eligibility decision for atrazine after assessing the cumulative risk of the triazine class. Such an incremental approach to the reregistration process is consistent with the Agency's goal of improving the transparency of the reregistration and tolerance reassessment processes. By evaluating each triazine in turn and

identifying appropriate risk reduction measures, the Agency is addressing the risks from use of all of the triazines in as timely a manner as possible.

Because the Agency has not yet considered cumulative risk for all of the triazines, this reregistration eligibility decision does not fully satisfy the reassessment of the existing atrazine food residue tolerances as called for by the Food Quality Protection Act (FQPA). When the Agency has completed the cumulative assessment, atrazine tolerances will be reassessed. At that time, the Agency will reassess atrazine along with the other triazine pesticides to complete the FQPA requirements and make a final reregistration eligibility determination for atrazine. By publishing this interim decision on reregistration eligibility and requesting mitigation measures now for the individual chemical atrazine, the Agency is not deferring or postponing FQPA requirements; rather, EPA is taking steps to assure that uses that exceed FIFRA's unreasonable risk standard do not remain on the label longer than is necessary, pending completion of the cumulative assessment required under FQPA. This decision does not preclude the Agency from making further FQPA determinations or tolerance-related rulemakings that may be required on this pesticide or any other in the future.

If the Agency determines, before finalization of the interim RED, that any of the determinations described in this interim RED are no longer appropriate, the Agency will pursue appropriate action, including, but not limited to, reconsideration of any portion of this interim RED.

Label changes that are necessary to adequately mitigate the risks of atrazine use are described in Section V of this document. Appendix A summarizes the uses of atrazine that are eligible for reregistration. Appendix B identifies the generic data requirements that the Agency reviewed as part of its determination of reregistration eligibility, and lists the submitted studies that the Agency found acceptable.

B. Summary of Phase 5 Comments and Responses

When making its interim reregistration decision, the Agency took into account all comments received during Phases 3, 4, and 5 of the Public Participation Process for atrazine. These comments are available in the docket in their entirety. Numerous letters were received commenting on the atrazine risk assessments during Phase 5 of the public process. Comments that addressed human health and ecological concerns were received from the technical registrants (Syngenta Crop Protection, Inc., and Sipcam Agro USA); state and other regulatory agencies (California Department of Pesticide Regulation, California Regional Water Quality Control Board, State of New York Office of the Attorney General, Connecticut Office of the Attorney General,U.S. Department of the Interior, Fish and Wildlife Service); environmental and advocacy groups (Natural Resources Defense Council [NRDC], People for the Ethical Treatment of Animals, Beyond Pesticides/NCAMP, Center for Regulatory Effectiveness; universities (Yale University; Texas Tech University; U.C. Berkeley); grower and agricultural advocacy groups (National Agricultural Aviation Association, Sugar Cane Growers Cooperative of Florida, Weed Science Society of America, Triazine Network, Marion County Farm Bureau, American Farm Bureau Federation, Illinois Farm Bureau, Louisiana Farm Bureau Federation, Ohio Farm Bureau Federation, Minnesota Farm Bureau); water advocacy groups (American Water Works Association); and many private citizens and growers. Comments were received on the following topics:

- Toxicology and Mode of Action of Atrazine and Endpoints Chosen;
- Carcinogenicity of Atrazine;
- Ecological Risks of Atrazine;
- Exposure to Atrazine and its Degradates;
- Other Atrazine Regulations;
- Occupational and Residential Exposure to and Risk from Atrazine;
- Atrazine Treatment Costs; and
- Benefits of the Use of Atrazine.

These comments have been addressed and the assessments refined as appropriate by the Agency. Response to Comments documents addressing most of these comments are available in the public docket and on the Agency's web page at http://www.epa.gov/pesticides/reregistration.

Two comments that were received are being addressed in the IRED, as follows: comments from the The New York State Office of the Attorney General (NYOAG) on the Endangered Species Act (ESA) and consultations with the U.S. Fish and Wildlife Service (FWS) and comments from the Center for Regulatory Effectiveness on the new Data Quality Act (DQA)

Comment: The NYOAG commented to the Agency that EPA must initiate consultations with the FWS because EPA's issuance of a reregistration decision for atrazine triggers the ESA consultation requirement and stated that the ESA requires that the Agency consider any existing FWS biological opinion.

Response: Atrazine has been reviewed on several occasions by the FWS as described in Section III above under the discussion on endangered species. Currently, the Agency is developing a proposal to implement its Endangered Species Protection Program (ESPP). The Agency is soliciting public opinion on this proposal through issuance of a Federal Register Notice, Endangered Species Protection Program Field Implementation, December 2, 2002. The Agency obtained input on several key aspects of the program in a workshop held in September 2002 that included the pesticide industry, pesticide user groups, and environmental advocacy organizations. An Advance Notice of Proposal Rulemaking (ANPR), Endangered Species and Pesticide Regulation, was issued jointly by the Agency, the Department of Interior and the Department of Commerce on January 24, 2003. The ANPR is soliciting comments regarding methods to make the consultation process more efficient.

Comment: The Center for Regulatory Effectiveness commented on November 25, 2002, requesting correction under the Environmental Protection Agency's (EPA) Information Quality Guidelines. This Request for Correction was filed on behalf of the Kansas Corn Growers Association, the Triazine Network, and the Center for Regulatory Effectiveness. The complaint alleges that the April 22, 2002, Environmental Risk Assessment for Atrazine does not comply with the "Data Quality Act" because the document "states that atrazine causes endocrine effects in various organisms including frogs." The comment requests that the environmental risk assessment be corrected to state that there is no reliable evidence that atrazine causes "endocrine effects" in the environment and that there can be no reliable, accurate or useful information regarding atrazine's endocrine effects until and unless there are test methods for those effects that

have been properly validated.

Response: After reviewing the questions raised in the request, the Agency has decided that some minor clarifications of the April 2002 Environmental Risk Assessment for Atrazine may help to avoid any future misunderstanding of the Agency's position on the environmental effects of atrazine. Any such clarifications will be included in a revised *Environmental Risk Assessment for Atrazine*. This Request for Correction is further addressed in the Agency's Response to Comments document available in the public docket and on the Agency's web page at http://www.epa.gov/pesticides/reregistration.

The Agency is providing a 60-day public comment period on this IRED. While all comments are welcome, those with specific data or information bearing on the risk and benefit assessments are most useful.

C. Regulatory Position

1. FQPA Assessment

a. "Risk Cup" Determination

As part of the FQPA tolerance reassessment process, EPA assessed the risks associated with this triazine. The assessment was for this individual triazine, and does not attempt to fully reassess these tolerances as required under FQPA. FQPA requires the Agency to evaluate food tolerances on the basis of cumulative risk from substances sharing a common mechanism of toxicity, such as the toxicity expressed by the triazine pesticides through a common biochemical interaction. The Agency will evaluate the cumulative risk posed by the entire class of triazines once the policy concerning cumulative assessments is fully resolved.

EPA has determined that risk from exposure to atrazine exceeds its own "risk cup" for the currently registered uses of atrazine. In reaching this determination, EPA has considered the available information on the special sensitivity of infants and children, as well as dietary (food and drinking water) and residential exposure to atrazine. However, if the use of atrazine is modified, the Memorandum of Agreement is implemented, and any other mitigation measures outlined in this document are implemented, the Agency believes that risks from the use of atrazine will not exceed the Agency's level of concern (i.e., atrazine uses will "fit" within its risk cup). Therefore, the atrazine tolerances can remain in effect until a full reassessment of the cumulative risk from all triazines is completed.

b. Tolerance Summary

Tolerances for residues of atrazine *per se* are established under 40 CFR §180.220(a)(1). Tolerances for atrazine and its chlorinated metabolites are established under 40 CFR §180.220(a)(2).

The Agency has determined that the tolerance expression in 40 CFR §180.220(a)(1) must be changed to reflect the combined residues of atrazine and its chlorinated metabolites, and that all tolerances based on atrazine and its chlorinated metabolites should be placed together under 40 CFR § 180.220 (a)(1). A summary of atrazine tolerance reassessments is presented in Table 28. Reassessments are based on tolerances redefined as atrazine and its chlorinated metabolites.

The Agency has also determined that tolerance expressions for the combined residues of each of the four hydroxy compounds are not needed.

The Agency will commence proceedings to revoke and modify existing tolerances, and to correct commodity definitions. The establishment of a new tolerance or raising tolerances will be deferred, pending consideration of cumulative risk for the triazines. "Reassessed" does not imply that all of the tolerances have been fully reassessed as required by FQPA, since these tolerances may only be fully reassessed once the cumulative risk assessment of all triazine pesticides is considered, as required by the statute. Rather, this IRED provides reassessed tolerances for atrazine in/on various commodities, supported by all the submitted residue data, only for atrazine. EPA will finalize these tolerances after considering the cumulative risks for all triazine pesticides. The Agency's tolerance summary is provided in Table 28.

<u>Tolerances Listed Under 40 CFR §180.220(a)(1)</u>

Tolerances for residues in/on sweet corn forage and fodder can be lowered to 4.0 ppm and 2.0 ppm, respectively, to 1.5 ppm for field/pop corn forages, and to 0.5 ppm for field/pop corn fodder and the designation "fodder" should be revised to "stover." The tolerances for residues in/on corn, fresh, K+CWHR and corn grain can be decreased to 0.20 ppm, each based on combined nondetectable residues at 0.05 ppm for atrazine and each chloro-metabolite. The tolerance for residues in/on macadamia nuts can be lowered to 0.20 ppm based on combined nondetectable residues at 0.05 ppm for atrazine and each chloro-metabolite. Tolerances for residues in/on sorghum forage and fodder can be lowered to 0.50 ppm, each; the designation "fodder" should be revised to "stover." The tolerance for residues in/on sorghum grain can be lowered to 0.20 ppm based on combined nondetectable residues at 0.05 ppm for atrazine and each chloro-metabolite. The tolerances for residues in/on wheat fodder, grain, and straw can be lowered to 1.5, 0.10, and 0.50 ppm, respectively; the designation "fodder" should be revised to "forage." The tolerance for sugar cane can be lowered to 0.20 ppm based on combined nondetectable residues at 0.05 ppm for atrazine and each chlorinated metabolite. The tolerances for residues in/on sugarcane, forage and fodder, should be revoked, as these are no longer regulated as livestock feed items. The tolerance for residues in/on guavas is adequate.

Existing tolerances for residues in commodities from cattle, goats, horses, and sheep (0.02 ppm) must be increased to 0.10 ppm include combined residues of atrazine and chlorinated

metabolites. Tolerances have been reassessed based on animal feeding study data.

The tolerances for commodities from hogs, poultry, and eggs can be revoked as there is no reasonable expectation of finite residues.

Syngenta proposes lowering the tolerances for sweet and field corn forages to 1.5 ppm, and the tolerance for sorghum forage to 0.25 ppm. For postemergent treatments, the registrant proposes a change from a 30-day PHI to a 45-day PHI for sweet corn and sorghum forages, and from a 30-day PHI to a 60-day PHI for field corn forage. For preemergent treatments on sorghum, they propose a change from a 45-day PHI to a 60-day PHI. Preemergent treatments on sweet and field corn will retain the existing 45-day and 60-day PHI, respectively. Existing labels contain 21 and 30-day PHIs for corn and sorghum forages.

The Agency has reassessed the tolerance for sweet corn forages at 4.0 ppm based on field trial data showing the highest chlorotriazine residues detected at 3.2 ppm after one treatment, and a 30-day PHI. Syngenta states that a sweet corn forage tolerance of 1.5 ppm is supported by data representing a 45-day PHI. Maximum chlorotriazine residues on sweet corn forage harvested 45 days after postemergent treatments at the 1X rate expected to result in the highest residues (0.5 + 2.0 lbs ai/A) were approximately 1.15 ppm. The Agency concludes that if labels for postemergent sweet corn use are amended to allow a minimum PHI of 45 days, the tolerance for sweet corn forage be lowered to 1.5 ppm.

The Agency has already reassessed the tolerance for field corn forage at 1.5 ppm based on the highest chlorotriazine residues detected at 1.1 ppm after a 1X treatment, at either a 30-day or a 60-day PHI. Maximum chlorotriazine residues on field corn forage harvested 60 days after postemergent treatments at the 1X rate expected to result in the highest residues (0.5 + 2.0 lbs ai/A) were approximately 1.11 ppm. The Agency concludes that all atrazine labels for postemergent field corn should be amended to allow a minimum PHI of 60 days.

The tolerance for sorghum forage has already been reassessed at 0.5 ppm based on field trial data showing the highest chlorotriazine residues detected at 0.22 ppm after a 1X treatment, and a 23-day PHI. Maximum chlorotriazine residues on sorghum forage harvested 30 and 45 days after postemergent treatments at the 1X rate were approximately 0.35 ppm and 0.09 ppm, respectively. Maximum chlorotriazine residues on sorghum forage harvested 45 and 60 days after preemergent treatments at the 1X rate were approximately 0.12 and 0.16 ppm, respectively. The Agency concludes that if all atrazine labels for postemergent sorghum use are amended to allow a minimum PHI of 45 days, and for preemergent sorghum use to allow a minimum PHI of 60 days, the tolerance for sorghum forage be lowered to 0.25 ppm.

The Agency has recalculated the maximum theoretical dietary burden (MTDB) for dairy cattle based on a reassessed sweet corn forage tolerance of 1.5 ppm. The resulting MTDB for dairy cattle is approximately 2.0 ppm chlorotriazines. Extrapolating the results from cattle feeding studies to this MTDB results in a reassessed milk tolerance of 0.03 ppm. If all atrazine labels are amended to the proposed PHIs discussed above for sweet and field corn forage and sorghum forage, the milk tolerance can be lowered to 0.03 ppm, based on available feeding studies and residue data.

Tolerances Needed Under 40 CFR §180.220(a)(1)

The Agency proposes establishing a tolerance for residues of atrazine and the chlorinated metabolites in wheat hay based on existing wheat forage residue data, and taking into account any concentration of residues during drying processes for hay. Alternatively, the registrant may submit field trials to determine an appropriate tolerance level for residues in/on wheat hay.

An additional processing study is required for sugarcane, in order to determine the need for a separate tolerance for residues in molasses.

Tolerances Currently Listed Under 40 CFR §180.220(a)(2) To Be Placed Under 40 CFR §180.220(a)(1)

The Agency recommends that the established tolerances for residues of atrazine in or on orchard grass and orchard grass, hay be revoked, as these uses are not being supported. The Agency also recommends the revocation of the 15 ppm tolerance for Perennial rye grass and that the use be cancelled. In addition, the tolerance for Grass, range should be revoked and a crop group tolerance for Crop Group 17 (Grass, Forage, Fodder, and Hay) should be established under 180.220(a)(1), that will cover range grasses. Residue data on representative grasses to support the crop group tolerance are recommended. This will include residue data on bermuda grass, bluegrass, and bromegrass or fescue from 12 trials (four for each cultivar) conducted in concordance with the current label rates. If the registrant(s) do not wish to support a crop group tolerance with new residue data, the existing tolerances should be revoked and the uses cancelled.

Table 28. Tolerance Reassessment Summary for Atrazine

Commodity	Established Tolerance, ppm	Reassessed Tolerance, ppm	Comments [*Correct Commodity Definition*]
Tolerances Listed Under 40 CFR §180.220(a)(1)[1]			
Cattle, fat	0.02	0.10	Reassessed tolerances based on reassessed sweet corn forage tolerance of 4.0 ppm. Registrant recommended lowering tolerances for sweet corn forage to 1.5 ppm pending amendment of all atrazine labels for postemergent sweet corn use to allow a minimum PHI of 45 days.
Cattle, mbyp	0.02	0.10	
Cattle, meat	0.02	0.10	
Corn, fodder, field	15	0.5	*corn, field, stover*
Corn, fodder, pop	15	0.5	*corn, pop, stover*
Corn, fodder, sweet	15	2.0	*corn, fresh, stover*
Corn, forage, field	15	1.5	Amend all atrazine labels for postemergent and preemergent field corn use to require a minimum PHI of 60-days.
Corn, forage, pop	15	1.5	
Corn, forage, sweet	15	1.5	Amend all atrazine labels for postemergent and preemergent sweet corn use to require a minimum PHI of 45 days.
Corn, fresh, K+CWHR	0.25	0.20	

Table 28. Tolerance Reassessment Summary for Atrazine

Commodity	Established Tolerance, ppm	Reassessed Tolerance, ppm	Comments [*Correct Commodity Definition*]
Corn, grain	0.25	0.20	
Eggs	0.02	Revoke	The Agency concludes that there is no reasonable expectation of finding quantifiable atrazine residues in eggs or the meat, fat, or meat byproducts of poultry
Goats, fat	0.02	0.10	Reassessed tolerances based on reassessed sweet corn forage tolerance of 4.0 ppm. Registrant recommended lowering tolerances for sweet corn forage to 1.5 ppm pending amendment of all atrazine labels for postemergent sweet corn use to allow a minimum PHI of 45 days.
Goats, mbyp	0.02	0.10	
Goats, meat	0.02	0.10	
Guava	0.05	0.05	
Hogs, fat	0.02	Revoke	No reasonable expectation of finding quantifiable atrazine residues in the meat, fat, or meat byproducts of hogs.
Hogs, mbyp	0.02	Revoke	
Hogs, meat	0.02	Revoke	
Horses, fat	0.02	0.10	Reassessed tolerances based on reassessed sweet corn forage tolerance of 4.0 ppm. Registrant recommended lowering tolerances for sweet corn forage to 1.5 ppm pending amendment of all atrazine labels for postemergent sweet corn use to allow a minimum PHI of 45 days.
Horses, mbyp	0.02	0.10	
Horses, meat	0.02	0.10	
Macadamia nuts	0.25	0.20	
Milk	0.02	0.03	All atrazine labels must be amended to the proposed PHIs for sweet and field corn forage and sorghum forage.
Poultry, fat	0.02	Revoke	The Agency concludes that there is no reasonable expectation of finding quantifiable atrazine residues in eggs or the meat, fat, or meat byproducts of poultry.
Poultry, mbyp	0.02	Revoke	
Poultry, meat	0.02	Revoke	
Rye, grasses, perennial	15	Revoke	Uses are restricted to the Conservation Reserve Program (CRP) lands in OK, OR, NE, and TX. Restrictions on grazing and cutting for hay apply.
Sheep, fat	0.02	0.10	Reassessed tolerances based on reassessed sweet corn forage tolerance of 4.0 ppm. Registrant recommended lowering tolerances for sweet corn forage to 1.5 ppm pending amendment of all atrazine labels for postemergent sweet corn use to allow a minimum PHI of 45 days.
Sheep, mbyp	0.02	0.10	
Sheep, meat	0.02	0.10	
Sorghum, fodder	15	0.50	*Sorghum, stover*
Sorghum, forage	15	0.25	Amend all atrazine labels for postemergent sorghum use to require a minimum PHI of 45 days, and for preemergent sorghum use to require a minimum PHI of 60 days.
Sorghum, grain	0.25	0.20	
Sugarcane	0.25	0.20	
Sugarcane, fodder	0.25	Revoke	Not a significant livestock feed item

Table 28. Tolerance Reassessment Summary for Atrazine

Commodity	Established Tolerance, ppm	Reassessed Tolerance, ppm	Comments [*Correct Commodity Definition*]
Sugarcane, forage	0.25	Revoke	Not a significant livestock feed item
Wheat, fodder	5	1.5	*Wheat, forage*
Wheat, grain	0.25	0.10	
Wheat, straw	5	0.50	
Tolerances Listed Under 40 CFR §180.220(a)(2) To be Places Under 40 CFR §180.220(a)(1)[1]			
Grasses, orchardgrass	15	Revoke	Uses on orchard grass are not supported by the basic produce
Grasses, orchardgrass, hay	15	Revoke	Uses on orchard grass are not supported by the basic producer
Grasses, range	4	TBD	Uses are restricted to the Conservation Reserve Program (CRP) lands in OK, OR, NE, and TX. Restrictions on grazing and cutting for hay apply. However, these grasses may be fed during drought and emergencies. Registrant may establish a crop group tolerance under Crop Group 17. Residue data on representative crops are recommended. Once data are submitted a crop group tolerance should be established under 180.220(a)(1). Table 2 of OPPTS 860.1500 Crop Field Trials calls for 12 trials (four for each cultivar). Existing tolerances are believed to be unsupportable based on today's data requirements. If the registrant(s) do not wish to support a crop group tolerance with new residue data, the existing tolerances will be revoked and the uses cancelled.
Tolerances Needed Under 40 CFR §180.220(a)(1)[1]			
Sugarcane molasses	none	TBD[2]	Additional data are required to determine the need for a separate tolerance.
Wheat, hay	none	5	This tolerance is based on residue data for wheat forage, taking into account concentration of residues as forage is dried to hay. Alternatively, the registrants may provide residue data on wheat hay from field trials.
Tolerances to be Proposed Under 40 CFR §180.220(d)			
[Indirect residues in foliage of legume vegetables]	none	TBD	Additional data are required to determine the need for indirect residue tolerance(s).

[1]Tolerances reassessed based on combined residues of atrazine, G30033, G-28279, and G-28273.
[2]TBD = To be determined. Reassessment of tolerance(s) cannot be made at this time because additional data are required.
[3]Tolerances based on combined residues of 2-hydroxy-4-ethylamino-6-isopropylamino-s-triazine (G-34048), 2-amino-4-hydroxy-6-isopropylamino-s-triazine (GS-17794), 2-amino-4-hydroxy-6-ethylamino-s-triazine (GS-17792), and 2,4-diamino-6-hydroxy-s-triazine (GS-17791).

2. Codex Harmonization

The Codex Alimentarius Commission has not proposed or established maximum residue limits (MRLs) for residues of atrazine in/on agricultural commodities. Therefore, there are no issues regarding harmonization or compatibility of U.S. tolerances with Codex MRLs.

3. Endocrine Disruptor Effects

EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there were scientific bases for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP).

When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, atrazine may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

4. Labels

A number of label amendments, in addition to the existing label requirements, are necessary in order for atrazine products to be eligible for reregistration. The Agency has determined that these measures, in addition to the existing label requirements, will adequately reduce risks.

Provided the following risk management measures are incorporated in their entirety into labels for atrazine-containing products, the Agency finds that all currently registered uses of atrazine are eligible for interim reregistration, pending consideration of cumulative risks of the triazines. While all uses are eligible at this time, the cotton use will be phased out over five years. The regulatory rationale for each of the risk management measures outlined below is discussed immediately after this list of required risk management measures.

a. Agricultural Use Exposure Reduction Measures

For agricultural use, the following measures are required, in addition to the existing label requirements to address risks of concern.

Dietary (Drinking Water)

- Require the following statement:
  "ANY USE OF THIS PRODUCT IN AN AREA WHERE USE IS PROHIBITED IS A VIOLATION OF FEDERAL LAW. Before using this product, you must consult the Atrazine Watershed Management Information Center (AWMIC) to determine whether the use of this product is prohibited in your watershed. AWMIC can be accessed through [website], [mailing address] or [1-800-toll-free number]. If use of this product is prohibited in your watershed, you may return this product to your point of purchase or contact [insert name of registrant] for a refund."

Occupational - Agricultural Uses

- Require closed mixing and loading systems for the following scenarios:
  - Mixing and loading liquid formulations for aerial application at a rate greater than 3 lb ai/A
  - Mixing and loading dry flowable formulations for aerial application
- Require maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; protective eyewear (mixer/loaders) and a dust/mist respirator) for the following formulations:
  - Liquids
  - Dry Flowables
- Require that wettable powders be packaged in water soluble bags for both aerial and groundboom application.
- Require closed cockpits for aerial applications
- Restrict the impregnation of bulk fertilizer to commercial facilities (prohibit on-farm impregnation)
- Restrict the impregnation of dry bulk fertilizer to 500 tons per day for no more than 30 days per year
- Reduce the maximum application rate for handlers applying liquids with rights-of-way sprayers to 1.0 lb ai/A
- Require closed cabs for flaggers, in accordance with current agricultural practices.

Other

- Require a 60-day PHI for preemergent and postemergent field corn forage uses
- Require a 45-day PHI for preemergent and postemergent sweet corn forage uses
- Require a 60-day PHI for preemergent uses and a 45-day PHI for postemergent sorghum forage uses

b. Non-Agricultural Use Exposure Reduction Measures

Occupational Risks - LCOs

- Require the use of baseline PPE (long-sleeved shirt and long pants, shoes and socks) for the following formulations:
  - Granulars
- Require the use of baseline PPE plus gloves for the following formulations:
  - Water dispersable granules
  - Water soluble powders
  - Dry flowable
- Require the use of the maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; and a dust/mist respirator) for the following formulations:
  - Liquids
- Reduce the maximum single application rate for liquid formulations on residential lawns and turf to 1 lb ai/A from 2 lb ai/A
- Require that granular lawn products be watered in

Residential

- Restrict the application of granular lawn products when using hand-held devices to spot applications only
- Prohibit applications of granular lawn products by hand
- Reduce the maximum 1 time application rate for liquid formulations on lawns and turf to 1 lb ai/A from 2 lb ai/A
- Require that granular lawn products be watered in

c. Label Harmonization

As described in Section III under the discussion of the regulatory history of atrazine, a number of risk mitigation measures have been instituted over the years to address exposure to atrazine. While most product labels have adopted these measures there are some that continue to reflect use patterns prior to the implementation of these risk mitigation measures. The listing below identifies measures that are not fully implemented on all current product labels. All of these measures, in addition to new label requirements as defined by this IRED, are needed on atrazine labels in order for products to be eligible for reregistration.

- Atrazine products containing >4% active ingredient must be classified as restricted use
- Maximum application rates for corn and sorghum must be as follows:
  - If no atrazine was applied prior to corn/sorghum emergence, apply a maximum of 2 lb ai/A broadcast. If a postemergence treatment is required following an earlier herbicide application, the total atrazine applied may not exceed 2.5 lb ai/A per calendar year
  - 2.0 lb ai/A as a single preemergence application on soils that are not highly erodible or highly erodible soils if 30% of the soil is covered with plant residues; or

- 1.6 lb ai/A as a single preemergence application on highly erodible soils if <30% of the surface is covered with plant residues; or
- If no atrazine was applied prior to corn/sorghum emergence, apply a maximum of 2 lb ai/A broadcast.

- Maximum application rates per use (other than corn and sorghum) must be as follows:
  - Chemical Fallow - 3 lb ai/A; one application per season (or 1.5 lb ai/A on soils in North and South Dakota with a pH >7.5; and 2 lb ai/A on soils in ND & SD with a pH <7.5)
  - Roadsides 1 lb ai/A; one application per year
  - Conservation Reserve Program 2 lb ai/A
  - Sugarcane 4 lb ai/A (single application); 10 lb ai/A (per year)
  - Guava 4 lb ai/A (per application); 8 lb ai/A (per year)
  - Sod 4 lb ai/A (muck or peat soils) or 2 lb ai/A (sandy soil); 2 applications per season
  - Macadamia Nuts 4 lb ai/A
  - Conifers 4 lb ai/A
- Delete all uses for non-cropland and total vegetation control
- Prohibit use in chemigation systems
- Prohibit storage; use; and mixing and loading within 50 feet of all wells, including abandoned wells, drainage wells, and sink holes
- Prohibit mixing and loading within 50 feet of intermittent streams and rivers. If land is highly erodible, the buffer must be planted to the crop or seeded with grass or other suitable crop.
- Prohibit application within 66 feet of points of entry of surface water to perennial or intermittent streams and rivers. If land is highly erodible, the buffer must be planted to the crop or seeded with grass or other suitable crop.
- Prohibit application within 200 feet of natural or impounded lakes and reservoirs. If land is highly erodible, the buffer must be planted to the crop or seeded with grass or other suitable crop.
- Require that one of the following restrictions be used in applying atrazine to tile-terraced fields containing standpipes
  - Do not apply within 66 feet of standpipes in tile-outletted terraced fields
  - Apply this product to the entire tile-outletted terraced field and immediately incorporate it to a depth of 2-3 inches in the entire field
  - Apply this product to the entire tile-outletted terraced field under a no-till practice only when a high crop residue management practice is practiced. High crop residue management is described as a crop management practice where little or no crop residue is removed from the field during and after crop harvest.
- Require that atrazine prepacks clearly list the accepted rate limits and provide accurate mixing instructions to prevent mixing with other atrazine products and application at an unacceptable rate, and bear the following statement:

  "When tank-mixing or sequentially applying atrazine or products containing atrazine to corn or sorghum, the total pounds of atrazine applied (lbs ai/A) must not exceed the specific seasonal rate limits from preemergence, or postemergence,

or preemergence +postemergence applications as noted in the use limitation table in the use directions."

D. Regulatory Rationale

The following is a summary of the rationale for managing risks associated with the current uses of atrazine. The Agency has discussed these measures with the technical registrants and in all cases the registrants have agreed to the measures presented here. Where labeling revisions are warranted, specific language is set forth in the summary tables of Section V of this document.

1. Human Health Risk Mitigation

a. Dietary (Food)

The acute and chronic dietary risks from atrazine residues on food are well below the Agency's level of concern at the 99.9th percentile of exposure. Therefore, no mitigation measures are necessary at this time.

b. Dietary (Drinking Water)

1) Community Water Systems (CWS)

The Agency has identified 34 surface water CWS with levels of atrazine that have exceeded the Agency's current DWLOC (12.5 ppb as a 90-day average) at least once since frequent monitoring for atrazine began in 1993. The 12.5 DWLOC was used as a screening tool to identify specific CWS that were of concern to the Agency. The registrant has since added 3 CWS to the list of CWS of concern. These 37 CWS have been targeted for intensive monitoring, risk mitigation, and probabilistic risk assessments.

The 12.5 ppb DWLOC was also used as a tool to establish a trigger value based on SDWA compliance monitoring data by which CWS with potential high-end seasonal exposures could be identified in the future. The Agency considered available data from SDWA compliance monitoring and determined that a trigger value of 2.6 TCT provides an appropriate early warning. If annual average concentrations of atrazine and its chlorinated metabolites (total chlorotriazines - TCT) in a surface water CWS reach 2.6 ppb, this triggers weekly (during the use season) and biweekly (during the remainder of the year) monitoring of that CWS for TCT concentrations.

The 12.5 ppb DWLOC is based on an endpoint of 1.8 mg/kg/day and a 1000 fold uncertainty factor. The uncertainty factor includes a 10x factor for interspecies variation; a 10x factor for intraspecies variability, and a 10x FQPA Safety Factor. The 10x FQPA safety factor was applied to account for the uncertainties associated with atrazine's toxic effects on the developing child and the extent and magnitude of exposure to atrazine in drinking water.

Community water systems found to be potentially impaired by atrazine, as predicted by exceedences of an annual average of 2.6 ppb based on SDWA compliance monitoring data, and

the 37 CWS identified above will be subject to an intensive monitoring program that includes weekly sampling for atrazine during the use season and biweekly sampling for atrazine during the remainder of the year. This monitoring program will determine the maximum 90-day average TCT concentration with sufficient accuracy to allow removal of that portion of the 10x FQPA safety factor associated with residual uncertainties regarding the extent and magnitude of drinking water exposure, thereby reducing the 10x FQPA safety factor to 3x for the risk assessments conducted in those community water systems for which there is available, reliable drinking water exposure data.

For those specific CWS undergoing or preparing to undergo intensive monitoring, uncertainties regarding the extent and magnitude of exposure to chlorotriazines no longer exist; this supports a reduction in the FQPA safety factor to 3x for those CWS. Based on this, the Agency has recalculated the DWLOC using a total risk assessment 300x uncertainty factor for those CWS currently undergoing or targeted for future intensive monitoring. For these CWS, the DWLOC becomes 37.5 ppb for total chlorotriazines based on an endpoint of 1.8 mg/kg/day, and a 300x uncertainty factor reflecting a 10x factor for interspecies variation, a 10x factor for intraspecies variability, and a 3x FQPA safety factor. The 3x FQPA safety factor reflects residual uncertainties associated with atrazine's toxic effects on the developing child only. For CWS without intensive monitoring as described above, the screening level DWLOC remains 12.5 ppb for total chlorotriazines.

As such, the Agency is establishing 37.5 ppb TCT (as a 90-day average) as a performance standard that must be met in CWS that are being intensively monitored. The Agency believes that its usual mitigation measures for pesticide chemicals (e.g., reduction in label rates, labeled use restrictions, etc.) are not appropriate in the case of atrazine because of the nature of the chemical. Exceedences do not appear to be linked to nation-wide use practices that can be amended on the label. Based on atrazine monitoring data, the Agency's risk assessment for atrazine has determined that drinking water risks from atrazine use are localized problems and, as such, lend themselves to a localized mitigation plan. In addition, this localized approach is consistent with the conclusions from a February 2000 FIFRA Scientific Advisory Panel meeting (Partial Report May 25, 2000. Report Number 2000-01). This approach is also consistent with the intent of the Agency's recent January 2003 Water Quality Trading Policy that encourages solutions within watersheds, provides incentives and encourages actions, and provides flexibility to meet local challenges and accountability to ensure improvements.

The Agency's approach to these CWS is as follows:

- For 2 CWS that were identified in the screening-level assessment and are of concern to the Agency, Shipman, IL, and Hettick, IL, the Agency understands that these CWS will no longer be using the reservoir that has shown unacceptable atrazine levels as a water source for the community in the future.

- For 8 CWS that were identified in the screening-level assessment as being most vulnerable, the Agency is requiring frequent monitoring data. If an exceedence of 37.5 is detected in raw drinking water (pre-treatment) in any of these watersheds, further use of atrazine will be prohibited in that watershed.

- For all remaining CWS, the Agency is requiring frequent monitoring data if an annual average of 2.6 total chlorotriazines is triggered through SDWA compliance monitoring data. If an exceedence is detected in raw drinking water (pre-treatment) twice in any watershed, further atrazine use will be prohibited in that watershed.

- Frequent monitoring will continue annually for five years (minimum) and may only cease if no 90-day rolling average exceeds the performance standard of 37.5 ppb total chlorotriazines during the five year period.

Based on the monitoring programs, the registrants are being required to submit annual reports to the Agency that include the results of that year's analysis. Atrazine registrants must notify EPA in writing of any raw water exceedance within 30 days of date of the last water sample included in that result.

As part of the Agency's mitigation program for atrazine, registrants are also being required to submit to the Agency written mitigation plans for the 8 CWS of concern (or any other CWS that has an exceedence in the future) describing mitigation measures to be implemented and a strategy for communication with growers within the watershed and quarterly progress reports describing the measures taken during that quarter in each CWS.

An important element of the mitigation program is the ability of the Agency to quickly prohibit use of atrazine in watersheds that have exceeded the applicable performance standard. This is possible because the mitigation program includes a mechanism that does not require lengthy administrative proceeding before the use prohibition goes into effect. The principle registrants of atrazine have agreed to this measure. Without this voluntary measure, it may have been necessary for the Agency to seek immediate cancellation of atrazine.

In order to implement this agreement, the atrazine registrants will place the following language on their labels:

> "ANY USE OF THIS PRODUCT IN AN AREA WHERE USE IS PROHIBITED IS A VIOLATION OF FEDERAL LAW. Before using this product, you must consult the Atrazine Watershed Management Information Center (AWMIC) to determine whether the use of this product is prohibited in your watershed. AWMIC can be accessed through [website], [mailing address] or [1-800-toll-free number]. If use of this product is prohibited in your watershed, you may return this product to your point of purchase or contact [insert name of registrant] for a refund."

The atrazine registrants will establish an Atrazine Watershed Management Information Center (AWMIC) that:

- will provide detailed information on what Watershed Areas have become subject to a prohibition on Atrazine use. Only information approved by EPA may be included in the AWMIC.
- shall be accessible to the public daily, including weekends and holidays, through a toll-free telephone number available 24 hours a day and seven days a week, a

World Wide Web site, and a regular mailing address. Contact information for the AWMIC will be included on all Atrazine product labels.

- shall be updated to include any Watershed Areas for which use is prohibited
- will prominently display information regarding use prohibitions in a manner that is simple and convenient for users to access and understand.

This localized drinking water mitigation program will ensure that mitigation actions taken in watersheds of concern are providing results in raw drinking water and will prevent any exceedences from occurring or going undetected in the future. The January 31, 2003, Memorandum of Agreement with the atrazine technical registrants provides further details on this mitigation plan, including the specifics of the monitoring programs being established and the mechanism by which use prohibitions will be implemented.

This program allows the Agency to make a safety finding because future exceedences in raw water trigger use prohibitions in the watershed of concern. Since this exceedence is in raw, not finished water, treatment of water by CWS operators to meet the MCL may prevent actual exposures above the Agency's level of concern. In addition, the Agency does not expect future exceedences to occur because of the responsible use programs being implemented and coordinated by the registrants as product stewardship. The Agency feels that the risk of use prohibitions is a strong incentive for atrazine users and the registrants to make every effort to prevent exceedences. The performance standard approach makes the prevention of atrazine water contamination the responsibility of the user, but will not result in unacceptable risks.

2) Rural Drinking Water Wells

To confirm that rural drinking water wells will not have atrazine levels that exceed the Agency's level of concern, the Agency will be requiring that the registrant(s) develop and conduct a program for the monitoring of rural wells. The Agency is requiring that the registrants define a protocol for monitoring total chlorotriazine levels in rural wells by April 30, 2003. The protocol must identify the number of wells to be sampled, the frequency of monitoring, the duration and timing of monitoring, and the timing of submission of data. The Agency may take appropriate regulatory action if EPA determines that additional label restrictions for the protection of rural drinking water wells are necessary.

b. Residential Risk Mitigation

1) Residential Handler Risk

Residential handler risks were considered for homeowners who mix, load, and apply atrazine products to home lawns.

One residential handler risk scenario was above the Agency's level of concern, the broadcast application of granular formulations with a bellygrinder. To address these concerns, the following risk mitigation measures are needed in order for EPA to conclude that atrazine products are eligible for reregistration:

- Restrict the application of granular lawn products when using hand-held devices to spot applications only.
- Prohibit applications of granular lawn products by hand.

2) Residential Post-Application Risk

Residential post-application risks were considered for individuals that reenter lawns and golf courses treated with atrazine.

The Agency has risk concerns for incidental oral exposures in children to atrazine residues. For lawns treated with liquid formulations of atrazine, the Agency has concerns for hand-to-mouth exposures alone (MOE = 210) and for combined oral routes of exposure (hand-to-mouth, turfgrass & object mouthing, and ingestion of soil; MOE = 200). For lawns treated with granular formulations, the Agency has concerns for incidental ingestion of granules.

To address those concerns, the risk mitigation measures listed below are necessary. These mitigation measures make it possible for EPA to conclude that atrazine products are eligible for reregistration. The mitigation measures are as follows:

- Reduce the maximum 1 time application rate for liquid formulations on lawns and turf to 1 lb ai/A from 2 lb ai/A.
- Require that granular lawn products be watered in.

At the 1 lb ai/A rate for liquid formulations of atrazine, the short term MOE for hand-to-mouth and combined incidental oral exposures becomes acceptable individually (420 and 370, respectively). If granular lawn products are watered in, the short-term MOE for ingestion of granules is no longer appropriate since the individual granules will no longer be present in the turf.

c. Aggregate Risk Mitigation

The Agency's aggregate risk assessment for atrazine is based on exposure estimates for drinking water based on monitoring data and residential exposure estimates based on chemical-specific exposure data.

1) Acute Exposure

Acute aggregate exposure estimates for atrazine are the same as those presented for acute drinking water risks because the Agency does not believe that high-end exposures through food, drinking water, and residential uses will all occur on the same day. Since acute drinking water risks do not exceed the Agency's level of concern, acute aggregate risk is also acceptable, and no mitigation measures are necessary.

2) Intermediate-Term and Chronic Exposure

The aggregate risk assessment for intermediate-term and chronic exposures to atrazine and the chlorinated metabolites combines estimates of high-end seasonal or long-term average exposures to atrazine in drinking water with long-term average exposures in food. Neither intermediate-term nor long-term exposures are expected to occur in or around the home from residential uses of atrazine. Therefore, the intermediate-term and chronic aggregate risk for atrazine is the same as the intermediate-term and chronic drinking water risk. As such, mitigation measures presented above to address intermediate-term and chronic drinking water risk also mitigates the intermediate-term and chronic aggregate risk. No additional mitigation measures are needed to specifically address aggregate risk.

3) Short-Term Aggregate Exposure

The short-term (1-30 days) aggregate risk assessment combines short-term residential exposures with short-term drinking water exposures. If the short-term DWLOC is less than the measured average concentrations in surface water and groundwater, there is a risk of concern. Short-term aggregate risk estimates that include residential exposures to atrazine are only applicable for those regions of the United States where atrazine is used on turf, the Southeast (including Florida).

For adult handlers applying granular formulations of atrazine via bellygrinder, both residential exposures alone and aggregate exposures are of concern. To address the residential concern, the Agency has concluded that the application of granular lawn products using hand-held devices should be limited to spot applications only.

For adults exposed to atrazine after it has been applied to turf or home lawns, neither residential exposure alone nor aggregate exposures are of concern. Therefore, no mitigation is needed.

For children exposure to atrazine after it has been applied in liquid formulations to home lawns, aggregate exposure is of concern. Combined dermal and incidental oral exposures for toddlers result in a MOE of 180 for toddlers' aggregate dermal and oral exposures, based on the 1 lb ai/A rate necessary to address residential concerns alone. Since this is above the Agency's level of concern, the short-term DWLOC is zero for aggregated exposures from liquid formulations across multiple exposure routes for toddlers. However, since the lawn use of atrazine is limited to the Southwest and Florida and the CWS of concern, with the exception of Iberville, LA, are in the Midwest, it is highly unlikely that home lawn exposure will occur at the same time as high-end drinking water exposures.

For children exposed to atrazine after it has been applied as a granular formulation to home lawns, and watered-in, aggregate exposure is not of concern. Toddlers' risk estimates from combined pathways for incidental oral exposures based on granular formulations result in an MOE of 730 and thus do not exceed the Agency's level of concern. Toddlers' risk estimates from dermal exposures based on granular formulations also do not exceed HED's levels of concern (MOE = 690 if <u>not</u> watered-in and 2000 if granules are watered-in immediately after application). For most CWS, short-term DWLOCs for toddlers' post application aggregate

exposures do not exceed the Agency's level of concern for granular formulations watered-in after application to turf. Thus, mitigation measures required for residential concerns alone (i.e, requiring that granular formulations be watered-in) mitigate any aggregate post-application concerns. In addition, the few CWS that have 30-day average concentrations above the DWLOC are primarily located in the Midwest (outside of atrazine turf use areas), with the exception of Iberville, Louisiana.

Further, all of the CWS with 30-day average concentrations above the DWLOC have also been identified under the intermediate-term drinking water risk assessment as of concern, including Iberville, Lousiana. As such, levels of atrazine in all of these CWS are being mitigated through the Agency's localized atrazine drinking water mitigation plan described above.

d. Occupational Risk Mitigation

It is the Agency's policy to mitigation occupational risks to the greatest extent necessary and feasible with personal protective equipment and engineering controls. In managing these risks, EPA must take into account the economic, social, and environmental costs and benefits of the pesticide's use. A wide range of factors is considered in making risk management decisions for worker risks. These factors include, in addition to the calculated MOEs, incident data, the nature and severity of adverse effect, uncertainties in the risk assessment, the cost, availability and relative risk of alternatives, importance of the chemical in integrated pest management (IPM) programs, and other similar factors.

Agricultural Handlers

Several occupational handler scenarios are not of concern at baseline levels of PPE (long-sleeved shirt and long pants, shoes and socks); therefore, no risk mitigation is necessary at this time in order for these uses to remain eligible for reregistration. These scenarios are described in Section III.A.4. of this document.

For the remaining agricultural handlers scenarios, occupational risks are of concern when considering the use of PPE or engineering controls (the maximum feasible mitigation). To reduce mixer/loader and applicator risk so that atrazine products are eligible for reregistration, risk mitigation measures are necessary. These mitigation measures are explained in more detail below.

The use of the maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; and a dust/mist respirator) is needed to adequately mitigate risks from the following agricultural use scenarios:

- Mixing and loading liquid formulations for aerial application at a rate less than 3 lb ai/A
- Mixing and loading liquid formulations for groundboom application
- Mixing and loading liquid formulations for rights-of-way sprayers
- Mixing and loading dry flowable formulations for groundboom application
- Applying via groundboom
- Applying via rights-of-way sprayers

Several occupational handler scenarios require the use of engineering controls to adequately mitigate agricultural handler risks. The following mitigation is being required:

- Closed mixing and loading systems are being required for the following scenarios:
  - Mixing and loading liquid formulations for aerial application at a rate greater than 3 lb ai/A
  - Mixing and loading dry flowable formulations for aerial application
- Packaging in water soluble bags is being required for wettable powders for both aerial and groundboom application.
- Closed application equipment is being required for aerial applications

Several occupational handler scenarios remain of concern when engineering controls are considered, so the following additional mitigation is necessary to address occupational risks:

- For handlers incorporating liquid formulations onto liquid or dry bulk fertilizer, the Agency is requiring the following mitigation measures:
  - restrict the impregnation of bulk fertilizer to commercial facilities (prohibit on-farm impregnation); and
  - restrict impregnation of dry bulk fertilizer to 500 tons per day for no more than 30 days per year.
- For handlers applying liquids with rights-of-way sprayers, the Agency is requiring a maximum application rate of 1.0 lb ai/A.

In addition, closed cabs are being required for flaggers in accordance with current agricultural practices.

Lawn Care Operators

For turf and LCO uses of atrazine, handler risks are of concern, but can be mitigated through the use of PPE. To reduce this risk so that atrazine turf products are eligible for reregistration, risk mitigation measures are necessary. These mitigation measures are explained in more detail below.

The use of baseline PPE (long-sleeved shirt and long pants, shoes and socks) is needed to mitigate risks from the following LCO scenarios:

- Mixing and loading dry flowable for groundboom application
- Loading granular formulations for applications
- Mixing, loading, and applying granular via push-type spreaders
- Mixing, loading, and applying granular via belly-grinder
- Applying liquids via groundboom
- Applying granular formulations with a tractor-drawn spreader

The use of baseline PPE plus gloves is needed to mitigate risk from the following LCO scenarios:

- Mixing and loading, or mixing, loading, and applying liquid formulations via lawn handgun and compressed air sprayer
- Mixing, loading, and applying water dispersable granules via lawn handgun
- Mixing, loading, and applying water soluble powder via lawn handgun
- Applying liquids with a handgun

The use of the maximum PPE (long-sleeved shirt and long pants, shoes socks, and coveralls; gloves; and a dust/mist respirator) is needed to adequately mitigate risks from the following LCO scenarios:

- Mixing and loading liquid formulations for groundboom application
- Mixing, loading, and applying liquid formulations via backpack sprayer
- Mixing, loading, and applying liquid formulations via low-pressure handwand

Post-Application Occupational Risk

The Agency has not identified any post-application occupational risks from atrazine. Therefore, no mitigation measures are needed at this time.

2. Environmental Risk Mitigation

The Agency has ecological risk concerns from the use of atrazine. The Agency has identified the potential for community-level and population-level risk to aquatic ecosystems at concentrations of atrazine from 10 to 20 ppb.

To mitigate these ecological risks to aquatic communities, the Agency is requiring that atrazine registrants, in consultation with EPA, develop a program under which the registrants monitor for atrazine concentrations and mitigate environmental exposures if EPA determines that mitigation is necessary. The program will focus on watershed impacts of atrazine use.

The program will include an appropriate ecological level of concern (LOC), including for endangered species, identified by EPA; development of a protocol for a monitoring program that specifies the frequency, location, and timing of sampling, as well as an appropriate coordination with TMDL programs; triggers for mitigation measures; and description of mitigation measures that will be taken if triggers are exceeded. This monitoring and mitigation program would be designed, conducted and implemented on a tiered watershed level and must be consistent with existing state and federal water quality programs.

The requirement that this process be established is presented in the January 31, 2003, Memorandum of Agreement between the Agency and the atrazine technical registrants. Per the Memorandum of Agreement, the Agency and the registrants must reach an agreement on the ecological monitoring program by April 30, 2003. If an agreement has not been reached, the Agency will identify any requirements the Agency deems necessary in the October 31, 2003, revision to the Atrazine IRED. The establishment of a process to address ecological risks on a watershed basis allows the Agency to conclude that atrazine products are eligible for reregistration.

3. Other Labeling

Other use and safety information need to be placed on the labeling of all end-use products containing atrazine, in addition to the mitigation measures listed above and other existing label requirements. For the specific labeling statements, refer to Section V of this document.

The Agency reserves the right to require additional label amendment to mitigate risks from triazine residues. Any further amendments will be discussed in the triazine cumulative decision.

a. Endangered Species Statement

The Agency has developed the Endangered Species Protection Program to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to implement mitigation measures that address these impacts. The Endangered Species Act requires federal agencies to ensure that their actions are not likely to jeopardize listed species or adversely modify designated critical habitat. To analyze the potential of registered pesticide uses to affect any particular species, EPA puts basic toxicity and exposure data developed for IREDs into context for individual listed species and their locations by evaluating important ecological parameters, pesticide use information, the geographic relationship between specific pesticide uses and species locations, and biological requirements and behavioral aspects of the particular species. This analysis will take into consideration any regulatory changes recommended in this IRED that are being implemented at this time. A determination that there is a likelihood of potential impact to a listed species may result in limitations on use of the pesticide, other measures to mitigate any potential impact, or consultations with the Fish and Wildlife Service and/or the National Marine Fisheries Service as necessary.

The Endangered Species Protection Program as described in a *Federal Register* notice (54 *FR* 27984) is currently being implemented on an interim basis. As part of the interim program, the Agency has developed County Specific Pamphlets that articulate many of the specific measures outlined in the Biological Opinions issued to date. The Pamphlets are available for voluntary use by pesticide applicators on EPA's website at www.epa.gov/espp. A final Endangered Species Protection Program, which may be altered from the interim program, is scheduled to be proposed for public comment in the *Federal Register* before the end of 2001.

b. Spray Drift Management

The Agency is currently working with stakeholders to develop appropriate generic label statements to address spray drift risk. Once this process has been completed, atrazine product labels will need to be revised to include this additional language.

V. What Registrants Need to Do

In order to be eligible for reregistration, registrants need to implement the risk mitigation measures outlined in Section IV and V, which include, among other things, submission of the following:

For products containing atrazine, registrants need to submit the following items for each product within eight months of the date of the PDCI:

(1) an application for reregistration (EPA Form 8570-1, filled in, with a description on the application, such as, "Responding to Interim Reregistration Eligibility Decision" document);
(2) five copies of the draft label incorporating all label amendments outlined in Table 17 of this document;
(3) responses to the generic and/or product specific Data Call-Ins (DCIs) as instructed in the enclosed DCIs;
(4) two copies of the Confidential Statement of Formula (CSF); and
(5) a certification with respect to data compensation requirements.

Note that the first set of required responses for the product-specific DCI is due 90 days from the receipt of the DCI. The second set of required responses is due eight months from the date of the DCI. For questions about product reregistration and/or the product-specific DCI, please contact Bonnie Adler at (703) 308-8523.

For the generic DCI, the following items are due:

(1) DCI response form, due 90 days from the receipt of the DCI;
(2) Registrant response form, due 90 days from the receipt of the DCI; and
(3) the actual generic data in response to the DCI.

A. Manufacturing Use Products

1. Additional Generic Data Requirements

The generic data base supporting the reregistration of atrazine for the above eligible uses has been reviewed and determined to be substantially complete. The following data gaps remain:

Product Chemistry Data

Product-Specific Product Chemistry data requirements have not been fulfilled (Series 830). Please see Product-Specific Data Call-Ins.

Toxicology Data

Non-Guideline Study	28-day inhalation toxicity study measuring LH surge and estrus cycle parameters

Non-Guideline Study	Assessment of CNS alterations after atrazine exposure (recommended)

Occupational Data

None

Environmental Fate and Ecological Effects Data

OPPTS 850.2100 (71-1(a))	Acute Avian Oral - Northern Quail (3 major degradates)
OPPTS 850.1075 (72-1(a))	Acute Fish Toxicity Bluegill (major degradate)
OPPTS 850.1075 (72-1(c))	Acute Fish Toxicity Rainbow Trout (major degradate)
OPPTS 850.1010 (72-2(a))	Acute Aquatic Invertebrate Toxicity (major degradate)
OPPTS 850.1025 (72-3(a))	Acute Estuarine/Marine Fish Toxicity (major degradate)
OPPTS 850.1025 (72-3(b))	Acute Estuarine/Marine Mollusk Toxicity (TGAI and major degradate)
OPPTS 850.1025 (72-3(c))	Acute Estuarine/Marine Shrimp Toxicity (major degradate)
OPPTS 850.1400 (72-4(a))	Early Life-Stage Fish (Marine) (TGAI)
OPPTS 850.1350 (72-4(b))	Life-Cycle Marine Invertebrate (TGAI)
OPPTS 835.4300 (162-4)	Aerobic Aquatic Metabolism - Lab
OPPTS 835.1410 (163-2)	Volatility (Lab)
OPPTS 835.1200 (164-2)	Aquatic Sediment
OPPTS 850.1950 (165-5)	Accumulation in Aquatic Non-Target Organisms
OPPTS 840.1100 (201-1)	Spray Drift - Droplet Size Spectrum
OPPTS 835.4200 (202-1)	Spray Drift - Drift Field Evaluation

Residue Chemistry Data

OPPTS 860.1380 (171-4e)	Storage Stability
OPPTS 860.1900 (165-2)	Field Rotational Crop Study (in review)
OPPTS 860.1500 (171-4k)	Crop Field Trials - Crop Group 17
OPPTS 860.1360 (171-4)	Multi-Residue Method

Other Data Requirements

Non-Guideline Study	Rural Well Monitoring Program (see MOA & DCI for details)
Non-Guideline Study	Surface Water CWS Monitoring Program (see MOA & DCI for details)
Non-Guideline Study	Ecological Monitoring and Mitigation Program (see MOA & DCI for details - specifics to be negotiated)

2. Labeling for Manufacturing Use Products

To remain in compliance with FIFRA, manufacturing use product (MUP) labeling should be revised to comply with all current EPA regulations, PR Notices and applicable policies. The MP labeling should bear the labeling contained in Table 17 at the end of this section.

B. End-Use Products

1. Additional Product-Specific Data Requirements

Section 4(g)(2)(B) of FIFRA calls for the Agency to obtain any needed product-specific data regarding the pesticide after a determination of eligibility has been made. Registrants must review previous data submissions to ensure that they meet current EPA acceptance criteria and if not, commit to conduct new studies. If a registrant believes that previously submitted data meet current testing standards, then the study MRID numbers should be cited according to the instructions in the Requirement Status and Registrants Response Form provided for each product.

A product-specific data call-in, outlining specific data requirements, accompanies this interim RED.

2. Labeling for End-Use Products

Labeling changes are necessary to implement the mitigation measures outlined in Section IV above. Specific language to incorporate these changes is specified in the Table 28 at the end of this section.

C. Existing Stocks

Registrants may generally distribute and sell products bearing old labels/labeling for 26 months from the date of the issuance of this Interim Reregistration Eligibility Decision document. Persons other than the registrant may generally distribute or sell such products for 50 months from the date of the issuance of this interim RED. However, existing stocks time frames will be established case-by-case, depending on the number of products involved, the number of label changes, and other factors. Refer to "Existing Stocks of Pesticide Products; Statement of Policy"; Federal Register, Volume 56, No. 123, June 26, 1991.

The Agency has determined that registrants may not distribute or sell atrazine products bearing old labels/labeling after the date of cancellation or amendment unless it is for the purpose of relabeling in accordance with the terms of this interim RED. Persons other than the registrants may distribute or sell such products until October 1, 2003. Registrants and persons other than the registrants remain obligated to meet pre-existing label requirements and existing stocks requirements applicable to products they sell or distribute. In addition, EPA has agreed to allow the atrazine technical registrants to re-label cancelled products with new provisions or to create supplemental labeling that will allow distributors to provide new label language to purchasers of atrazine products with labels that do not comply with this interim RED.

D. Labeling Changes Summary Table

In order to be eligible for reregistration, amend all product labels to incorporate the risk mitigation measures outlined in Section IV. Table 29 below describes how language on the labels should be amended.