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

August 1, 2006

MEMORANDUM

SUBJECT: 2-(Thiocyanomethylthio) benzothiazole (TCMTB) Ecological Hazard and Environmental Risk Assessment Chapter-Revised. D322611.

TO: Kathryn Avivah Jakob, Chemical Review Manager
Diane Isbell, Team Leader
Mark Hartman, Branch Chief
Regulatory Management Branch II
Antimicrobials Division (7510C)

FROM: Kathryn Montague, M.S., Biologist
Srinivas Gowda, Microbiologist
Siroos Mostaghimi, Environmental Engineer/Acting Team Leader
Risk Assessment and Science Support Branch
Antimicrobials Division (7510C)

THRU: Norm Cook, Branch Chief
Risk Assessment and Science Support Branch
Antimicrobials Division (7510C)

Attached are the TCMTB ecological hazard and environmental risk characterization and environmental modeling chapters for incorporation into the RED document.

ECOLOGICAL HAZARD AND ENVIRONMENTAL RISK ASSESSMENT CHAPTER - REVISED

2-(Thiocyanomethylthio)benzothiazole (TCMTB)

D322611

PC Code 035603

CASE No.: 2625

08/01/2006

Kathryn Montague
Srinivas Gowda
Siroos Mostaghimi
Richard Petrie
Antimicrobials Division
Office of Pesticide Programs
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Table of Contents

I. EXECUTIVE SUMMARY

2-(Thiocyanomethylthio)benzothiazole (TCMTB) is a pesticide that is used as a seed treatment to prevent mold and fungus on cotton, wheat, barley, oats, rice, sugar beets, and safflower. Additionally, it is used to control algae, slime, mold, and fungus in industrial processing waters in various applications, such as leather processing, recirculating cooling towers, pulp and paper mills, storage tanks, secondary oil recovery, and waste water systems. It is also used as a materials preservative in various industrial applications. TCMTB is also used as a wood preservative, primarily to control sapstain in cut lumber.

Environmental Fate:
TCMTB shows pH-dependent hydrolytic degradation. While hydrolytically stable at pH 5, the half-life at pH 9 is 1.8-2.1 days. TCMTB breaks down rapidly by photolysis, with a half life of 1.5 hours. Biotic degradation also occurs, with half-lives ranging from 1.4 days in soil under aerobic conditions to 6.9 days in water/sediment systems under anaerobic conditions. TCMTB is mobile-very mobile in various soils; however, because of its tendency to biodegrade in water and soils, TCMTB is not likely to contaminate surface and ground waters.

The Kow of TCMTB is 1995. A Kow > 1000 indicates that a chemical may potentially bioconcentrate; however, the results of a bioconcentration study in fish indicate that bioconcentration of TCMTB will be minimal.

Several major metabolites are formed during the biotic degradation processes of TCMTB, including 2-benzothiazolesulfonic acid (BTSA) and 2-mercaptobenzothiazole (2-MBT). BTSA not of toxicological concern due to being completely excreted (sulfonic acid) and having negligible toxicity. 2-MBT is generally less toxic than parent TCMTB (see tables, below); therefore, mitigation of any risks from TCMTB toxicity endpoints will be protective of any risks from 2-MBT. Therefore, the environmental risk assessment was conducted for TCMTB only.

Ecological Effects:
TCMTB is slightly toxic and 2-MBT is practically non-toxic to birds on an acute oral basis, and both TCMTB and 2-MBT are slightly toxic to birds on a subacute dietary basis.

Based on the results of mammalian studies conducted to meet human toxicity data requirements, TCMTB exhibits low acute oral and dermal toxicity (toxicity category III). However, it is highly irritating to the eyes and skin (toxicity category I and II, respectively) and is also considered to be highly toxic via the inhalation route of exposure (toxicity category I). TCMTB is a dermal sensitizer. The NOAEL determined in a rat 2-generation reproduction study was 400 ppm.

Both TCMTB and 2-MBT are very highly toxic to freshwater fish on an acute basis. Chronic testing indicates that TCMTB causes reproduction and growth effects in fish at very low levels (>0.34 ppb). TCMTB is very highly toxic to estuarine/marine fish on an acute basis.

TCMTB is very highly toxic and 2-MBT is moderately toxic to freshwater aquatic invertebrates on an acute basis, and TCMTB also shows very high acute toxicity to marine/estuarine

invertebrate species

TCMTB impairs growth of aquatic vascular plants at levels greater than 0.15 ppm (150 ppb).

Acute risks to birds and mammals from consuming TCMTB-treated seeds were below Agency Levels of Concern (LOCs). Terrestrial risk from the wood preservative uses of TCMTB were not addressed due to a lack of available models to estimate terrestrial exposure from antisapstain treatments.

Risks to aquatic organisms from the seed treatment use of TCMTB are below LOCs. However, based on the Tier I screening model used for the antisapstain use, there are risks to aquatic organisms. Acute LOCs were exceeded for all taxa except aquatic plants, and chronic LOCs for fish were also exceeded. Chronic risk to invertebrates could not be addressed due to a lack of chronic toxicity data. Precautions to limit leaching and runoff from antisapstain treatment facilities areas (see Label Hazard Statements and Use Recommendations section, below) should prevent exposure to aquatic organisms. The aquatic monitoring study, described below, will provide data on the effectiveness of the mitigation methods.

Endangered Species Concerns:
Using Tier I screening modeling to assess potential exposure from antisapstain wood preservation uses of TCMTB, risks to Listed Species are indicated. Since the model is only intended as a screening-level model, and, as such, has inherent uncertainties and limitations which may result in inaccurate exposure estimations, further refinement of the model is recommended before any regulatory action is taken regarding the antisapstain uses of TCMTB. Potential impacts from the antisapstain use can be mitigated in the interim with precautions to prevent leaching and runoff when wood is stored outdoors. Due to these circumstances, the Agency defers the Endangered Species Decision until additional data are received regarding actual concentrations of TCMTB in waters receiving runoff from antisapstain treatment facilities practicing the mitigation methods described in this document (see Label Hazard Statements and Use Recommendations section, below), as well as the other data described in the data gaps section, below. When the additional data are received, the environmental risk assessment of the antisapstain use of TCMTB will be revised, and the risks to Listed Species will be reconsidered.

Data Gaps:
Ecological Effects**:**
The following data requirements are outstanding for the currently registered uses of TCMTB:
72-4b/850.1400 Aquatic invertebrate life-cycle study (wood preservation)
72-5/850.1500 Fish Life-Cycle Testing
123-1/850.4225 and 850.4250 Tier II seedling emergence and vegetative vigor with rice (wood preservation)
122-1/850.4100 Tier I seedling emergence for 10 species of terrestrial plant (seed treatment)
123-2/850.5400 Algal Toxicity (wood preservation and seed treatment)
[No Guideline] Residues in honey/beeswax and toxicity of treated wood residues to bees - combination of Guidelines 171-4 and 850.3030 (see attached information regarding residue data requirements for uses in beehives. Numbers of bees used in this study and methods for

collection/introduction of bees into hives, feeding, and observations for toxicity and mortality should be consistent with those described in OPPTS Guideline 850.3030, "Honey Bee Toxicity of Residues on Foliage.")**.** The toxicity portion of this study is in lieu of the honeybee contact LD50 test. The residue and toxicity test can be waived provided the label is amended to prohibit the use of treated wood for beehive construction, with a statement such as, "Wood treated with TCMTB shall not be used in the construction of beehives."

The following data requirements are reserved for TCMTB, pending the results of other studies listed above:
Tier II seedling emergence (123-1/850.4100) with 10 species of terrestrial plant (seed treatment)
- may be required if Tier I study shows >25% effect at concentration tested
- may be required if monitoring study shows concentrations at levels known to cause adverse chronic effects in fish (as indicated in early life-stage testing)

Environmental Fate:
The following data requirements are outstanding for the currently registered uses of TCMTB:
161-1 Hydrolysis (wood preservation and seed treatment)
162-1 Aerobic soil metabolism (wood preservation and seed treatment)
162-2 Anaerobic soil metabolism (wood preservation and seed treatment)
162-3 Aerobic aquatic metabolism (wood preservation and seed treatment)

The following data requirements are reserved for TCMTB, pending the results of lower tier testing and exposure modeling:
164-1 Terrestrial field dissipation (seed treatment and wood preservation)
164-2 Aquatic field dissipation (wood preservation)

Label Hazard Statements/Use Recommendations
The following ecological effects/environmental risk statements are required for TCMTB labels: "This product is toxic to fish, aquatic invertebrates, oysters and shrimp."

"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."

Antisapstain labels must state: "Treated lumber must be stored under cover, indoors, or at least 100 feet from any pond, lake, stream, wetland, or river to prevent possible runoff of the product into the waterway. Treated lumber stored within 100 feet of a pond, lake, steam, wetland, or river must be either covered with plastic or surrounded by a berm to prevent surface water runoff into the nearby waterway. If a berm or curb is used around the site, it should consist of impermeable material (clay, asphalt, concrete) and be of sufficient height to prevent runoff during heavy rainfall events."

II. ECOLOGICAL HAZARD ASSESSMENT

A. Toxicity to Terrestrial Animals

1. Birds, Acute and Subacute

An acute oral toxicity study using the technical grade of the active ingredient (TGAI) is required under FIFRA to establish the toxicity of a pesticide to birds. The preferred test species is either mallard duck (a waterfowl) or bobwhite quail (an upland game bird). The results of

Table 1. Acute Oral Toxicity of TCMTB and 2-MBT to Birds

Study type (%a.i.)	Species Tested	Endpoint Parameter	Toxicity Value (95% confidence limits)	NOEL	Other Effects Noted	EPA ID #/Reference	Status
TCMTB							
Avian acute oral, 850.2100/71-1 (80.4% a.i.)	Bobwhite quail (*Colinus virginianus*)	Mortality	LD_{50} = 660.85 (541.09 – 805.08) mg/kg, "slightly toxic"	<292 mg/kg	Signs of toxicity and reduction of body weight and feed consumption at 292 mg/kg	417809-01 (Campbell, 1991)	Acceptable
2-MBT							
Avian acute oral, 850.2100/71-1 (98.22% a.i.)	Bobwhite quail (*Colinus virginianus*)	Mortality	LD50 > 2150 mg/kg "practically non-toxic"	< 1000 mg/kg	Some evidence of dose-related abnormalities upon gross necropsy (friable livers, resorbed eggs, fluid-filled sacs in abdomen)	422671-01 (Pedersen and Helsten, 1992a)	Acceptable

These results indicate that TCMTB is slightly toxic and 2-MBT is practically non-toxic to birds on an acute oral basis. The guideline requirement (71-1/OPPTS 850.2100) is fulfilled.

Two subacute dietary studies using the technical grade of the active ingredient are required to establish the toxicity of a pesticide to birds. The preferred test species are mallard duck (a waterfowl) and Northern bobwhite quail (an upland gamebird). Results of avian subacute dietary tests are tabulated below.

Table 2. Avian Subacute Dietary Toxicity of TCMTB and 2-MBT							
Test Type (Chemical and % a.i.)	Chemical (% a.i.)	Species	Endpoint	Results	Other Effects Noted	Reference	Status
Avian acute dietary, 850.2200/71-2	TCMTB (80-83% a.i.)	Mallard duck (Anas platyrhynchos)	Mortality	8-day LC50 > 10000 ppm "practically non-toxic"	Feed consumption and 10% mortality at 5,000 and 10,000 ppm	Accession #009869 (Booden, 1974)	Acceptable
Avian acute dietary, 850.2200/71-2	TCMTB (75 % a.i.)	Bobwhite quail (Colinus virginianus)	Mortality	LC50 > 10000 ppm "Practically non-toxic"	Huddling and depression at levels > 1000 ppm	Accession #091624 (Knott and Woodard, 1968a)	Supplemental
Avian acute dietary, 850.2200/71-2)	TCMTB (80% a.i.)	Mallard duck (Anas platyrhynchos)	Mortality	8-day LC50 >4496 ppm "Slightly toxic"	NOEC < 450 ppmbased on reduction in body weight gain and food consumption	415956-01 (Long et al., 1990.	Acceptable
Avian acute dietary, 850.2200/71-2	TCMTB (80% a.i.)	Bobwhite quail (Colinus virginianus)	Mortality	8-day LC50 >4496 ppm "Slightly toxic"	NOEC = 450 ppm, based on reduction of average body weight gain at higher levels	415956-02 (Long et al., 1990	Acceptable
Avian acute dietary, 850.2200/71-2)	2-MBT (98.22% a.i.)	Bobwhite quail (Colinus virginianus	Mortality	8-day LC50 >3387 ppm "Slightly toxic"	NOEC = 3387 ppm – no signs of toxicity at any level	424285-01 (Pedersen and Helsten, 1992b)	Acceptable

These results indicate that both TCMTB and 2-MBT are slightly toxic to birds on a subacute dietary basis. The guideline requirement (71-2/OPPTS 850.2200) is fulfilled.

2. Birds, Chronic

Avian reproduction studies using the technical grade of the active ingredient are required for a pesticide when any of the following conditions are met: (1) birds may be subject to repeated or continuous exposure to the pesticide, especially preceding or during the breeding season, (2) the pesticide is stable in the environment to the extent that potentially toxic amounts may persist in animal feed, (3) the pesticide is stored or accumulated in plant or animal tissues, and/or, (4) information derived from mammalian reproduction studies indicates reproduction in terrestrial

vertebrates may be adversely affected by the anticipated use of the product. The currently registered uses of TCMTB do not require avian reproduction testing.

3. Mammals: (Excerpted from Toxicology Chapter)

Wild mammal testing was not required for TCMTB. In most cases, rodent acute toxicity values obtained from studies conducted to support data requirements for human health risk assessment substitute for wild mammal testing. This information is discussed in the Toxicology chapter of this RED document, from which the following is excerpted:

Table 3. Acute Toxicity Data on TCMTB Technical (80% ai)

Guideline No./ Study Type	MRID No.	Results	Toxicity Category
870.1100 Acute oral toxicity	41583801	LD_{50} = 750 mg/kg (M+F); 80% ai	III
870.1200 Acute dermal toxicity	41515401	LD_{50} > 2000 mg/kg (M+F); 80% ai	III
870.1300 Acute inhalation toxicity	41640601	LC_{50}=0.07 mg/L; 80% ai	I
870.2400 Acute eye irritation	Acc No. 111991	Diluted Busan 72 (60 % ai): primary irritation score (PIS)=2/110 (slight conjunctival redness, no corneal opacity); undiluted Busan 72 (60% ai) PIS=34/110 (blanched conjunctivae, chemosis, corneal opacity not reversible by day 7)	I
870.2500 Acute dermal irritation	41583701	primary irritation index=7.42 with severe erythema and edema observed at 72 hours; 80% ai	II
870.2600 Skin sensitization	MRID 42349201 Acc No. 259676	Busan 74 (80% ai) caused delayed contact hypersensitivity in guinea pigs when induced and challenged by a 40% w/v aqueous concentration of active ingredient. Sensitizer.	--

TCMTB exhibits low acute oral and dermal toxicity (toxicity category III). However, it is highly irritating to the eyes and skin (toxicity category I and II, respectively) and is also considered to be highly toxic via the inhalation route of exposure (toxicity category I). TCMTB is a dermal sensitizer.

In a two-generation rat reproduction study, there were no treatment related effects noted at the highest dose tested for parental toxicity or on reproductive parameters examined in this study. Slight, statistically significant effects were noted in mean body weight in the high dose offspring in the second mating (F2B) around lactation day 21. This must be considered as systemic

toxicity as the litters began with relatively equal mean body weights and around lactation day 14, the pups began to consume diet while continuing to nurse.
The parental/systemic NOAEL = 400 ppm (38.4/45.5 mg /kg/day [males/females]) and the parental/systemic LOAEL > 400 ppm (> 38.4/45.5 mg /kg/day [males/females]). The offspring NOAEL is 400 ppm. The Reproductive toxicity NOAEL $\geq$ 400ppm and the Reproductive toxicity LOAEL > 400 ppm.

3. Nontarget Insects - Honeybees

Honeybees could potentially be exposed to pesticide residues if treated wood is used to construct hives or hive components. These residues may be toxic to the bees, or result in residues in honey or other hive products intended for human use/consumption. Therefore, a special honeybee study is required for all wood preservative unless a statement prohibiting the use of treated wood in hive construction is added to the label, such as, "Wood treated with TCMTB shall not be used in the construction of beehives." This study is a combination of Guidelines 171-4 and 850.3030 (see information regarding residue data requirements for uses in beehives in the residue chemistry section of 40 CFR part 158). Numbers of bees used in this study and methods for collection/introduction of bees into hives, feeding, and observations for toxicity and mortality should be consistent with those described in OPPTS Guideline 850.3030, "Honey Bee Toxicity of Residues on Foliage.")**.** The toxicity portion of this study is in lieu of the honeybee contact LD50 test .

B. Toxicity to Aquatic Animals

1. Freshwater

a. Freshwater Fish, Acute

Two fish toxicity studies using the TGAI are required to establish the toxicity of a pesticide to freshwater fish. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). The results of toxicity study are provided in the following table.

Table 4. Acute Toxicity of TCMTB to Freshwater Fish

Study Type/% Active Ingredient (a.i.)	Organism	Endpoints	Results	Other Effects Noted	Reference	Status
TCMTB						
Freshwater fish acute toxicity, 850.1075/72-1 (90 % a.i.)	Rainbow trout (*Oncorhynchus mykiss,*	Mortality	96-hr static LC50 = 55.2 (27 – 75)µg/L (ppb)) "very highly toxic"	None reported	TN 2437 (US EPA, 1980)	Supplemental

Freshwater fish acute toxicity, 850.1075/72-1 (90% a.i.)	Bluegill sunfish (*Lepomis macrochirus*)	Mortality	96-hour static LC50 = 32 (16 – 45) µg/L (ppb)) "very highly toxic"	None reported	TN 2432 (US EPA, 1979)	Supplemental
Freshwater fish acute toxicity, 850.1075/72-1 (80.4 a.i.)	Bluegill sunfish (*Lepomis macrochirus*	Mortality	96-hour flow-through LC50 = 8.7 µg/L (ppb); "very highly toxic"	NOEC = 5.1µg/L (ppb) due to signs of toxicity at higher levels	418042-01 (Machado, 1991a)	Acceptable
Freshwater fish acute toxicity, 850.1075/72-1 (80.4 a.i.)	Rainbow trout (*Oncorhynchus mykiss*	Mortality	96-hour flow-through LC50 = 20.12 (17.77 – 22.91) µg/L (ppb); "very highly toxic"	NOEC = 8.7 µg/L (ppb) due to mortality and lethargy and loss of equilibrium in surviving fish at higher levels	418181-01 (Machado, 1991b)	Acceptable
Freshwater fish acute toxicity, 850.1075/72-1 (75% a.i.)	Rainbow trout (*Oncorhynchus mykiss*, formerly *Salmo gairdineri*)	Mortality	96-hour static LC50 = 29 (21 – 40) µg/L (ppb); "very highly toxic"	Loss of equilibrium and lying on sides observed	ACC#091624 (Knott and Woodard, 1968b)	Supplemental
Freshwater fish acute toxicity, 850.1075/72-1 (75% a.i.)	Bluegill sunfish (*Lepomis macrochirus*	Mortality	96-hour static LC50 = 47 (40 – 55) µg/L (ppb); "very highly toxic	Loss of equilibrium and lying on sides observed	ACC#091624 (Knott and Woodard, 1968b)	Supplemental
2-MBT						
Freshwater fish acute toxicity, 850.1075/72-1 (98.22% a.i.)	Rainbow trout (*Oncorhynchus mykiss*	Mortality	96-hour static LC50 = 730 µg/L (ppb) "very highly toxic"	NOEC = 310 µg/L (ppb) due to mortality at higher treatment levels	422322-01 (Collins, 1992)	Acceptable

These results indicate that both TCMTB and 2-MBT are very highly toxic to freshwater fish on an acute basis. The guideline requirement (72-1/OPPTS 850.1075) is fulfilled.

b. Freshwater Fish, Chronic

i. Early Life-Stage Testing

A freshwater fish early life-stage test using the technical grade of the active ingredient is required for a pesticide when it may be applied directly to water or if the end-use product is expected to be transported to water from the intended use site, and any of the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to

be continuous or recurrent regardless of toxicity, (2) any aquatic acute LC50 or EC50 is less than 1 mg/l, (3) the EEC in water is equal to or greater than 0.01 of any acute LC50 or EC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any acute LC50 or EC50 value and any one of the following conditions exist: studies of other organisms indicate the reproductive physiology of fish may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g., half-life greater than 4 days). The preferred test species is rainbow trout, but other species may be used.

Table 5: Chronic Toxicity Values for Freshwater Fish Exposed to TCMTB

Study Type	Species	Endpoint	NOEC µg a.i./l	LOEC µg a.i./l	MRID# (reference)	Status
Freshwater fish Early life-stage toxicity (72-4a/850.1300) (83.78% a.i.)	Rainbow trout (*Oncorhynchus mykiss*)	Reproduction, post-hatch survival, growth	0.34 ppb based on growth and egg hatchability	0.56 ppb based on growth	425959-01 (Rhodes, 1992)	Acceptable

The results indicate that TCMTB causes reproduction and growth effects in fish at very low levels (>0.34 ppb). The guideline requirement (72-4a/OPPTS 850.1300) is fulfilled.

Some reports in the published literature indicate that TCMTB may cause sublethal effects in fish, which could result in an increase in predation and a decreased ability to survive. This information was submitted to the Agency under FIFRA §6(a)2 (MRID #424053-01). These studies demonstrate that exposure to TCMTB at levels of 8-10 ppb caused gill damage and behavioral changes, which could severely reduce the ability of fish to survive in the wild. From Proceedings of the Seventeenth Annual Aquatic Toxicity Workshop, Nov. 5-7, 1990, Vancouver, BC, Vol. 1. (edited by P. Chapman, F. Bishay, E. Power, K. Hall, L. Harding, D. Mcleay, M. Nassichuk and W. Knapp). Canadian Technical report of Fisheries and Aquatic Sciences, No. 1774 (vol 1). Individual paper citations: (Kruzynski and Birtwell, 1990; Kruzynski et al., 1990; Chew et al., 1990). The LC50 used in this risk assessment (8.7 µg/L) is comparable to the levels at which these sublethal effects occurred, however, so the risk assessment should be protective of those effects.

ii. Fish Life-Cycle Testing

Fish life-cycle testing is required for a wood preservative if treated wood will be used in the aquatic environment (including estuarine/marine environments) or use of treated wood in aquatic environments is not prohibited by product labeling, and any of the following conditions apply:(i) the estimated environmental concentration (EEC) in water is $\geq$ 0.1 of the no-observed-effect-concentration/level (NOEC/NOEL) determined in fish early life-stage studies; or
(ii) If studies with other organisms indicate the reproductive physiology of fish may be affected; or, (iii) If the pesticide is intended for use such that its presence in the aquatic environment is

likely to be continuous or recurrent, regardless of toxicity. Testing should be conducted using the more sensitive of freshwater or marine/estuarine species. The preferred freshwater test species is fathead minnow (*Pimephales promelas*), and the preferred estuarine/marine species is sheepshead minnow (*Cyprinodon variegatus*), but other species may be used as per the Guidelines document (72-4/850.1400). All of the above apply to TCMTB, so a fish life-cycle test is indicated; however, since an aquatic monitoring study is required to address the effectiveness of mitigation methods proposed in this RED, fish life-cycle testing is **reserved**, pending the results of the monitoring study.

c. Freshwater Invertebrates, Acute

A freshwater aquatic invertebrate toxicity test using the TGAI is required to establish the toxicity of a pesticide to freshwater aquatic invertebrates. The preferred test species is *Daphnia magna.*

Table 6. Acute Toxicity of TCMTB and 2-MBT to Freshwater Invertebrates

Substance/% Active Ingredient (AI)	Organism	Endpoints	Results	Toxicity	Reference	Status
TCMTB (90% a.i.)	*Daphnia magna*	Immobilization	48-hr static EC50 = 23 µg/L (ppb)	Very highly toxic	TN 2427 (US EPA, 1979)	Supplemental
TCMTB (80.4% a.i.)	*Daphnia magna*	Immobilization	48-hour flow-through EC50 = 22 µg/L (ppb); NOEC = 8.7 µg/L (ppb)	Very highly toxic	418382-01 (McNamara, 1991)	Acceptable
2-MBT						
2-MBT (100% a.i.)	*Daphnia magna*	Immobilization	48-hour static EC50 = 2.9 mg/L (ppm)	Moderately toxic	422260-01 (Collins, 1992b)	Acceptable

These studies indicates that TCMTB is very highly toxic and 2-MBT is moderately toxic to aquatic invertebrates on an acute basis. The guideline requirement (72-2/OPPTS 850.1010) is fulfilled.

d. Freshwater Invertebrates, Chronic

A freshwater aquatic invertebrate life-cycle test using the technical grade of the active ingredient is required for a pesticide if the end-use product may be applied directly to water or expected to be transported to water from the intended use site, and any of the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) any aquatic acute LC50 or EC50 is less than 1 mg/l, or, (3)

the EEC in water is equal to or greater than 0.01 of any acute EC50 or LC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any aquatic acute EC50 or LC50 value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g., half-life greater than 4 days). The preferred test species is *Daphnia magna*.

One daphnid life-cycle study was submitted (MRID#425591-01), but was invalidated due to high variablility in the test concentrations to which the daphnids were exposed. **A new daphnid life-cycle study (72-4b/850.1400) is required to support the currently registered uses of TCMTB.**

e. Freshwater Field Studies

An aquatic monitoring study is required, which will determine concentrations of TCMTB in water and sediments exposed to runoff from TCMTB antisapstain treatment facilities. A protocol for this study must be approved by AD/RASSB prior to study initiation.

6. Toxicity to Estuarine and Marine Organisms

a. Estuarine and Marine Fish, Acute

Acute toxicity testing with estuarine/marine fish using the technical grade of the active ingredient is required for a chemical when the end-use product is intended for direct application to the marine/estuarine environment or the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species is sheepshead minnow.

Table 7. Acute Toxicity of TCMTB to Estuarine/Marine Fish

Substance/% a.i.	Species	Endpoint	Results	Toxicity	Reference	Status
TCMTB (80% a.i.)	Sheepshead minnow (*Cyprinodon variegatus*)	Mortality	96-hour static LC50 = 60 (36 – 100) µg/L (ppb)	Very highly toxic	403636-01 (Surprenant, 1986a)	Accep table

The results indicate that TCMTB is very highly toxic to estuarine/marine fish on an acute basis. The guideline requirement (72-3a/OPPTS 850.1025) is fulfilled.

b. Estuarine and Marine Fish, Chronic

Estuarine/marine fish early life-stage testing is not required for the currently registered uses of

TCMTB. The freshwater fish early life-stage test, which is required, should provide an adequate endpoint for use in future risk assessments, since acute data indicate the freshwater fish species tested are comparably sensitive or more sensitive to TCMTB than the marine/estuarine species tested. Risks assessed using the freshwater endpoint should therefore be protective of marine/estuarine species.

c. Estuarine and Marine Invertebrates, Acute

Acute toxicity testing with estuarine/marine invertebrates using the technical grade of the active ingredient is required for a pesticide when the end-use product is intended for direct application to the marine/estuarine environment or the active ingredient is expected to reach this environment because of its use in coastal counties. The preferred test species are mysid shrimp and eastern oyster.

Table 8: Acute Toxicity of TCMTB to Estuarine/Marine Invertebrates

Test	% ai.	Species	Endpoint	Results	Toxicity	Reference	Status
Marine/estuarine bivalve acute embryo-larvae toxicity, 72-3b/850.1055	80%	Quahog clam, *Mercenaria mercenaria*	Normal embryo-larvae development	48-hour static EC50 = 13.9 (9.8 – 16.1) µg/L (ppb) ; NOEC < 13 20.3 µg/L (ppb)	Very highly toxic	403636-03 (Surprenant, 1986)	Acceptable
Marine/estuarine invertebrate acute toxicity, 72-3c/850.1035	80%	Mysid (*Americamysis bahia*, formerly *Mysidopsis bahia*)	Mortality	96-hour static LC50 = 20.3 µg/L (ppb); NOEC < 7.8 µg/L (ppb)	Very highly toxic	403636-02 (Surprenent, 1987)	Acceptable

The results indicate that TCMTB is very highly toxic to marine/estuarine invertebrate species. The guideline requirements (72-3b and 72-3c/OPPTS 850.1035 and 850.1045) are fulfilled.

d. Estuarine and Marine Invertebrate, Chronic

An estuarine/marine invertebrate life-cycle toxicity test is required for a pesticide if the end-use product may be applied directly to water or expected to be transported to water from the intended use site, and any of the following conditions are met: (1) the pesticide is intended for use such that its presence in water is likely to be continuous or recurrent regardless of toxicity, (2) any

aquatic acute LC50 or EC50 is less than 1 mg/l, or, (3) the EEC in water is equal to or greater than 0.01 of any acute EC50 or LC50 value, or, (4) the actual or estimated environmental concentration in water resulting from use is less than 0.01 of any aquatic acute EC50 or LC50 value and any of the following conditions exist: studies of other organisms indicate the reproductive physiology of invertebrates may be affected, physicochemical properties indicate cumulative effects, or the pesticide is persistent in water (e.g., half-life greater than 4 days). A freshwater invertebrate life cycle study (72-4b/850.1400) is required for TCMTB. Since the acute invertebrate data indicate that daphnids are more sensitive to TCMTB than clams and mysids, data from the freshwater invertebrate life cycle test will be adequate to assess risk for marine/estuarine invertebrate species.

e. Estuarine and Marine Field Studies

This testing is currently reserved for TCMTB.

7. Bioaccumulation in Aquatic Organisms

a. Fish (MRID #424185-01, 424932-01, and 467052-01): (see Environmental Fate chapter of this RED document for additional details regarding this study)

The log octanol-water coefficient (log Kow) of TCMTB is 3.30. Bioconcentration testing is required for chemicals having a log Kow $\geq$ 3.00 if they are likely to result in exposure to aquatic organisms, so this testing was required for TCMTB.

Radiolabeled residues accumulated in bluegill sunfish that were exposed to uniformly phenyl-ring labeled [^{14}C]TCMTB, at a nominal concentration of 0.40 µg/L, under flow-through aquarium conditions. Maximum bioconcentration factors (BCF), based on total radioactivity were 302X for viscera, 64X for fillet, and 184X for whole fish tissues. Seventy-five to 77%, 84-87%, and 84-86% of the mean accumulated [^{14}C] residues (exposure days 14-28) were eliminated from the fillet, viscera and whole fish tissues, respectively, by days 21-35.

The results indicate that the bioaccumulation potential of TCMTB is minimal.

This study was scientifically sound, and fulfills the requirements for Guideline 165-1.

8. Toxicity to Plants

Phytotoxicity testing is required for pesticides other than herbicides on a case-by-case basis (e.g., labeling bears phytotoxicity warnings, incidents of plant damage have been reported, or literature indicating phytotoxicity is available). Since many of the TCMTB product labels state that the product controls algae, semi-aquatic (seed germination in rice, 123-1/850.4225, and vegetative vigor in rice, 123-1/850.4250) and aquatic plant testing (123-2/850.4400 and 850.5400) is required for TCMTB. Additionally, since TCMTB is used as a seed treatment, terrestrial plant testing (seed germination, 123-1/850.4225 and vegetative vigor, 123-1/850.4250) is required for TCMTB.

No terrestrial or semi-aquatic plant toxicity data have been submitted for TCMTB. These data are required to support the currently registered uses of TCMTB. **Guidelines 123-1/850.4225 and 850.4250 (Tier II seedling emergence and vegetative vigor) for rice are required to support wood preservative uses. Guideline 122-1/850.4100 (Tier I seedling emergence) for 10 species of terrestrial plants (to support seed treatment uses) is also required. Guideline 123-1/850.4100 (Tier II seedling emergence) is reserved for seed treatment uses, pending the results of the Tier I test.**

A single aquatic plant study was submitted for TCMTB, the results of which are summarized below. Additional aquatic phytotoxicity testing with four species of algae are required to support the currently registered uses of TCMTB.

Table 9: Toxicity of TCMTB to Aquatic Plants

Test	Species/% a.i.	Endpoint	Toxicity	NOEC/other effects noted	MRID (reference)	Status
Aquatic Vascular Plant Acute Toxicity, Tier II (dose-response), 123-2/850.4400	Duckweed *(Lemna gibba)*/83.5% a.i.	Frond growth	14-day static renewal EC50 = 0.43 (0.29 – 0.65) mg/L (ppm)	0.15 mg/L (ppm)	442009-01 (Thompson and Swigert, 1996)	Acceptable

The results indicate that TCMTB is impairs growth of aquatic vascular plants at levels greater than 0.15 ppm (150 ppb). Guideline 850.4400 is fulfilled; however, **Guideline 123-2/850.5400 is NOT fulfilled, as additional testing with four algae species is required to support wood preservative and seed treatment uses of TCMTB.**

III. ENVIRONMENTAL FATE AND EXPOSURE ASSESSMENT SUMMARY

A. Environmental Fate Assessment Summary (excerpted from the TCMTB Environmental Fate Chapter of this RED document):

As an antimicrobial pesticide, 2-(thiocyanomethylthio)benzothiazole (TCMTB) is used largely as a wood preservative. It is also used as a microbiocide/microbiostat and bacteriocide/bacteriostat in industrial processes and water system, as well as in industrial materials, as a preservative. As an agricultural pesticide, TCMB is used for seed treatment of crops; bulb and corm treatment of flowers; and seed and soil treatment of trees. Buckman Laboratories has submitted several guideline studies for an environmental fate assessment; however, not all of these studies fulfill Guidelines requirements. Additionally, a special leaching study is required to support the antisapstain uses of TCMTB. For additional information, please refer to the Environmental Fate Chapter of this RED.

An assessment of the various studies indicates the hydrolysis of TCMTB is pH dependent. It is hydrolytically stable under abiotic and buffered conditions at pH 5 and slowly

degrades at pH 7. Under more alkaline conditions, hydrolysis proceeds more rapidly with a calculated half-life ranging from 1.8 to 2.1 days. Photolytically, TCMTB degrades in a pH 5 buffered aqueous solution with a calculated half-life of 1.5 hours. Based on its degradation, TCMTB may not pose a concern for surface water run-off.

Aquatic metabolism under aerobic and anaerobic conditions, as well as aerobic soil metabolism, are major routes of dissipation for TCMTB. TCMTB's calculated degradation half-life in flooded lake sediment is 6.9 days; however, the apparent half-life occurs between 2 and 4 days. Similarly, TCMTB shows a tendency of degrading anaerobically in flooded sediment within 2.7 days. Under aerobic conditions in sandy loam soil, a representative agricultural soil, TCMTB degrades with a calculated half-life of 1.4 days. Because of the biodegradation in water and soils, TCMTB is not likely to contaminate surface and ground waters.

TCMTB's tendency to bind with agricultural soils varies according to soil type. TCMTB is mobile-very mobile in various soils; however, because of its tendency to biodegrade in water and soils, TCMTB is not likely to contaminate surface and ground waters. TCMTB is very mobile in clay loam, sand, and sandy loam soil, and mobile in clay and silt loam soil. K_ds are 3.5 for clay loam soil, 0.99 for sand soil, 9.9 for sandy loam soil, 22.1 for clay soil, and 62.7 for silt loam soil. There may be a water/sediment partitioning issue and an acute adverse impact on benthic organisms. However, TCMTB degrades fairly rapidly in freshwater and soils and the impacts may be short-lived.

Additional information on the aqueous availability of TCMTB from wood, indicates that the use of TCMTB as a wood preservative may result in minimal releases to the environment

B. Environmental Exposure Assessment

1. Terrestrial:

a. Seed Treatment

The Terrestrial Residue Exposure Model (TREX) was used to calculate risk quotients for birds and mammals consuming TCMTB-treated seeds. This is discussed in the risk assessment section, below.

b. Antisapstain

No model is available to estimate the exposure to terrestrial wildlife from the use of TCMTB-treated wood. It is assumed that risk to aquatic organisms from runoff of TCMTB from antisapstain treating facilities is the greater concern from this use of TCMTB; therefore, the risk assessment for the antisapstain uses of TCMTB focuses on aquatic organisms.

2. Aquatic:

a. Seed-Treatment

Aquatic exposure from seed treatment uses of TCMTB was modeled by the Environmental Fate and Effects Division (EFED) (USEPA, 2005). The following section is a summary of that exposure assessment.

This aquatic exposure assessment provides the estimated environmental concentrations (EEC) for the use of 2-(Thiocyanomethylthio)benzothiazole (TCMTB) as a seed treatment on cotton, wheat, barley, oats, rice, sugar beets, and safflower. For this action, EFED considered risk *only* from parent compound of TCMTB and not any degradates associated with TCMTB.

TABLE 10: Application Rates for Seed Treatment Uses of TCMTB (revised 02/16/06)

Crop	Application Rate (fl oz/100 lbs)	Max. Seeding Rate (lbs/ac)	Rate (lbs ai/ac)
Cotton	5	18	0.018
Safflower	2	100	0.041
Sugar beets	2	8	0.003
Rice	1.25	150	0.039
Wheat	1.25	150	0.039
Oats	1.25	128	0.033
Barley	1.25	100	0.026

The maximum seeding rate information is based on EFED's Terrestrial Residue Exposure model (TREX) (http://www.epa.gov/oppefed1/models/terrestrial/). The application rate ranges from 0.0018 lb ai/ac to 0.041 lb ai/ac.

Modeling Approach

For this aquatic exposure assessment, the highest rate of 0.0128 lb ai/ac is used for the screening purpose. We used the tier 1 models: GENEEC (version 2.0; Aug. 1, 2001) and SCI-GROW (version 2.3; Nov. 4, 2003) screening models to assess estimated concentrations of TCMTB in surface water and ground water, respectively. These models and their descriptions are available at the EPA internet site:

http://www.epa.gov/oppefed1/models/water/ .

Conclusions: *For surface water exposures, results from GENEEC indicate that the TCMTB concentrations of 0.28 ppb (ug/L), 0.26 ppb, 0.20 ppb, 0.12 ppb, and 0.08 ppb, respectively, for peak, 4-day average, 21-day average, 60-day average, and 90-day average exposure. For ground water, SCI-GROW indicates that TCMTB concentrations are not likely to exceed 0.00014 µg/L. Full model inputs and outputs are in provided in USEPA, 2006.*

Since these models are not specifically designed to estimate concentrations for pesticides used for seed treatment, there are uncertainties in their predictive potential. However, these uncertainties are not expected to substantially decrease the conservativeness of the Tier 1 modeling results.

Uncertainties in the Seed Treatment Modeling

Several factors suggests low environmental exposure from seed treatment, including (1) seed treatment pesticides are applied at low rates; (2) adjuvants are used to encourage pesticide binding to the seed coat; (3) physicochemical properties of seed treatment pesticides generally exhibit low mobility to retain the pesticide near the seed coat and root zone; (4) seeds are normally incorporated, which is expected to limit environmental exposure; and (5) seed treatments may have indoor use patterns (e.g., seed storage). In additional to these factors, the main uncertainty in our assessment for the use of TCMTB as a seed treatment is that we have not accounted for the potential for sorption to, or reaction on, the seed coat. Because of model limitations and because we have no data to the contrary, we assumed that TCMTB does not sorb to the seed coat, but only to soil. In effect, this assumption provides conservative runoff and leaching scenarios.

SCI-GROW was developed using Koc values ranging from 32 – 180 ml/g and half-lives from 13 – 1000 days. The input values for TCMTB are outside these ranges, therefore, the extrapolation increases the uncertainty of the ground water estimated concentrations.

b. Antisapstain

This section is a summary of the environmental exposure modeling conducted to address the antisapstain uses of TCMTB. For additional details, please refer to the Antisapstain Environmental Modeling Chapter of this RED document.

Runoff concentrations of TCMTB were estimated for facilities that treat wood with antisapstain chemicals. The concentrations were estimated using an approach developed to determine runoff concentrations of pesticides from antisapstain facilities in British Columbia, Canada (Krahn and Strub, 1990).

Krahn and Strub (1990), in their protocol for a leaching study, suggest that treated wood be stored outdoors, stacked into lumber packages 24" x 48" x 16', and placed over leachate collection trays (1.52 m x 5.2 m). A total of 16 leaching cycles should be applied at a rate of 15 mm/day every other day, with each rain duration lasting 5 hours and a target intensity of 3 mm/hr. These values are based on the average precipitation that occurs in British Columbia in the worst-case month of the year.

No leaching studies were available for TCMTB. For lack of better data, predictions of leaching behavior (as would be observed in a study following the Krahn and Strub (1990) protocol) were

made based on the chemical properties of TCMTB and a number of assumptions (see Antisapstain Environmental Modeling Chapter for details).

Aschacher and Gruendlinger (2000) have measured uptake of antisapstain dipping solution by pine boards. Freshly sawn pine boards (2.3 x 10 x 50 cm, code R2 and R2 Ab) were dipped into a 1.5% Busan 30 L solution (a.i.: 2-thiocyanomethylthio-benzthiazole, TCMTB). One set of samples was treated in April 1997, and another set was treated in April 1998. For each type of board treated each year, the uptake was measured based on the average of 7 boards. The average uptake, based on the measurement of 28 boards, was 163 g solution/m^2.

Krahn and Strub (1990) assume that leachate entering the storm drain is diluted with extra runoff water at a 1:15 ratio. This is based on measurements of runoff in storm drains at facilities using antisapstain chemicals in British Columbia. Use of the ratios 1:6 and 1:23 were also suggested by Krahn and Strub (1990) to determine a "general industry wide" predicted runoff concentration. These values were used in this assessment. The estimated leachate concentration (0.196 ppm) was used in conjunction with these dilution factors to estimate runoff concentrations

Table 11. Estimated Runoff Concentrations

Parameter	Dilution Factor	Estimated Runoff Concentration (ppm)[a]
High-end dilution	23.0	0.00852
Typical dilution	15.0	0.0131
Low-end dilution	6.00	0.0327

[a]Estimated Runoff Concentration = Estimated Leachate Concentration (0.196 ppm) / Dilution Factor

Uncertainties and Limitations

- Krahn and Strub (1990) note that the concentrations of antisapstain chemical in runoff will be affected by numerous variables, including: chemical formulation, chemical retention in wood, rough vs. planed lumber cut, lumber packaging and stacking, drying time prior to exposure to precipitation, precipitation duration, precipitation intensity, precipitation frequency, precipitation pH, quantity of treated lumber on the storage site, species of lumber treated, general house keeping practices, whether the lumber is 1^{st}, 2^{nd}, or 3^{rd} growth, solubility of the chemical in water, diffusion of the chemical into the wood, additives in the formulations, exposure and degradation due to ultraviolet light, microbial action, ambient temperatures, and affinity of the chemical to soils and to yard surfaces.
- Information regarding the leaching behavior of TCMTB-treated wood is limited. It is unclear how well the method used above predicts the results of a study conducted using the protocol described by Krahn and Strub (1990).
- It was assumed, for this assessment, that rain events are of equal intensity and duration. Variations in the intensities and durations of rain events would affect the results.
- Krahn and Strub (1990) obtained a dilution factor of 15 based on a study of antisapstain facilities in British Columbia. The dilution factor is dependent on the intensity of rainfall events. There is no reason to expect that the average rainfall intensity in British

Columbia would be representative of the average rainfall intensity of the United States; however, for lack of better data, the value was used.

- Krahn and Strub (1990) assume that any batch of treated wood remains in the yard for 16 rain cycles. The frequency of rainfall events in British Columbia may not be representative of the frequency of rainfall events in the United States; therefore, the use of 16 rain cycles may not be an accurate description of treatment facilities in the United States.
- The model is sensitive to the selection of the thickness of the leachable region, and the depth to which the antisapstain is assumed to penetrate. Although the value of 0.01 m is based on the value used in the Wood Leaching Model (WLM) (Lee, 2004), it is unclear how this value was derived and if use of the value is reasonable for a dipping treatment. The WLM is still under development, and has not yet been validated.

IV. Risk Assessment and Characterization

Risk assessment integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. One method of integrating the results of exposure and ecotoxicity data is called the quotient method. For this method, risk quotients (RQs) are calculated by dividing exposure estimates by ecotoxicity values, both acute and chronic:

RQ = EXPOSURE/TOXICITY

RQs are then compared to levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) **acute high** - potential for acute risk is high regulatory action may be warranted in addition to restricted use classification; (2) **acute restricted use** - the potential for acute risk is high, but this may be mitigated through restricted use classification; (3) **acute endangered species** - the potential for acute risk to endangered species is high, and regulatory action may be warranted, and (4) **chronic risk** - the potential for chronic risk is high, and regulatory action may be warranted. Currently, AD does not perform assessments for chronic risk to plants, acute or chronic risks to nontarget insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients are derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds) (2) LD50 (birds and mammals (3) EC50 (aquatic plants and aquatic invertebrates) and (4) EC25 (terrestrial plants). The NOEC value is used as the ecotoxicity test value in assessing chronic effects.

Risk presumptions, along with the corresponding RQs and LOCs are tabulated below.

Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Birds and Wild Mammals		
Acute High Risk	EEC[1]/LC50 or LD50/sqft[2] or LD50/day[3]	0.5
Acute Restricted Use	EEC/LC50 or LD50/sqft or LD50/day (or LD50 < 50 mg/kg)	0.2
Acute Endangered Species	EEC/LC50 or LD50/sqft or LD50/day	0.1
Chronic Risk	EEC/NOEC	1

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items

[2] $\frac{\text{mg/ft}^2}{\text{LD50 * wt. of bird}}$ [3] $\frac{\text{mg of toxicant consumed/day}}{\text{LD50 * wt. of bird}}$

Risk Presumptions for Aquatic Animals

Risk Presumption	RQ	LOC
Acute High Risk	EEC[1]/LC50 or EC50	0.5
Acute Restricted Use	EEC/LC50 or EC50	0.1
Acute Endangered Species	EEC/LC50 or EC50	0.05
Chronic Risk	EEC/MATC or NOEC	1

[1] EEC = (ppm or ppb) in water

Risk Presumptions for Plants

Risk Presumption	RQ	LOC
Terrestrial and Semi-Aquatic Plants		
Acute High Risk	EEC[1]/EC25	1
Acute Endangered Species	EEC/EC05 or NOEC	1
Aquatic Plants		
Acute High Risk	EEC[2]/EC50	1
Acute Endangered Species	EEC/EC05 or NOEC	1

[1] EEC = lbs ai/A

[2] EEC = (ppb/ppm) in water

A. Environmental Risk Assessment for Terrestrial Organisms:

Modeling was performed to address the exposure and risk to birds and mammals consuming seeds treated with TCMTB. Using the Terrestrial Residue Exposure Model (TREX) (http://www.epa.gov/oppefed1/models/terrestrial/) for the seed treatment on safflower, which has the highest application rate of 0.041 lb ai/A, the following RQs for seed treatment were calculated:

Avian: : 0.02 as (mg ai/kg/day)/LD50

The avian RQ was calculated with no toxicity scaling factor. Scaling factors are used when it is likely that a pesticide will be proportionally more toxic to smaller organisms than larger ones (e.g., the toxicity will not be directly correlated with body weight). TREX recommends a default scaling factor of 1.15, based on Mineau et al. (1996); however, that scaling factor was developed based on 37 conventional pesticides, most of which are cholinesterase inhibitors. There is no information available indicating that such an adjustment is necessary or appropriate for TCMTB.

Mammalian Acute: 0.05 as (mg ai/kg/day)/LD50,
0.02 as (mg ai/ft2)/(LD50*BW)
Chronic: 0.53 as (mg/kg seed)/reproduction NOAEC

All of these are below any LOCs for avian or mammalian acute risk and mammalian chronic risk. Avian chronic data are not available nor required for the currently registered uses of TCMTB, therefore chronic avian risk was not assessed.

B. Environmental Risk Assessment for Aquatic Organisms:

To develop RQs, the EECs determined by modeling were compared to the most-sensitive endpoint for each taxa. For seed treatment, the peak EEC was used for acute and endangered species risks, the 21-day average was used for invertebrate chronic risk, and the 60 day average was used for the fish chronic risk. For antisapstain uses, the worst-case scenario (low dilution) and the "best-case" (high dilution) EECs were used for acute and endangered species risks, and the typical dilution was used for fish and invertebrate chronic risks. RQs exceeding one or more LOCs (listed in the risk presumptions section, above) are in **bold** text.

Table 12: Aquatic Organism Risk Quotients for Seed Treatment and Antisapstain Uses of TCMTB

Taxa/Endpoint	Seed treatment EEC	Seed Treatment RQ	Antisapstain EEC Low dilution High dilution	Antisapstain RQ
Freshwater fish Acute 8.7 µg/L	0.28 ppb	0.03	32.7 ppb 8.5 ppb	**3.76** **0.98**
Freshwater Invertebrates Acute 22 µg/L	0.28 ppb	0.01	32.7 ppb 8.5 ppb	**1.49** **0.39**
Marine/Estuarine Fish Acute 60µg/L	0.28 ppb	0.00	32.7 ppb 8.5 ppb	**0.54** **0.14**
Marine/Estuarine Bivalve Acute 13.9µg/L	0.28 ppb	0.02	32.7 ppb 8.5 ppb	**2.35** **0.61**
Marine/Estuarine Invertebrate Acute 20.3 µg/L	0.28 ppb	0.01	32.7 ppb 8.5 ppb	**1.61** **0.42**
Green Algae Acute EC50 430 µg/L	0.28 ppb	0.00	32.7 ppb 8.5 ppb	0.08 0.02
Green Algae NOEC 150µg/L	0.28 ppb	0.00	32.7 ppb 8.5 ppb	0.22 0.06
Fish Chronic 0.34µg/L	0.12 ppb	0.35	13.1 ppb 8.5 ppb	**38.53** **25.00**
Invertebrate Chronic – DATA GAP	0.20 ppb	-----	13.1 ppb	-----

For seed treatment, no LOCs are exceeded, indicating that the use poses minimal risk to aquatic organisms.

For the antisapstain use, the low dilution (worst-case) EECs exceed acute high risk LOCs for all taxa, and chronic risk to fish. Even using the high dilution ("best-case") EECs still results in exceedance of acute high risk LOCs for freshwater fish and marine bivalves, and restricted use LOCs for freshwater invertebrates, marine fish and marine invertebrates, and chronic risk to fish.

Chronic risk to invertebrates cannot be assessed at this time due to the lack of chronic invertebrate toxicity data.

The model used to estimate exposure from antisapstain uses is intended as a Tier I screening model, and, as such, has inherent assumptions and uncertainties that may result in over- or under-estimation of exposure levels. Additional information, including, but not limited to, specific leaching data for TCMTB used as an antisapstain wood preservative, and aquatic monitoring data from waters receiving runoff from TCMTB antisapstain treatment facilities, would remove some of the uncertainties, and may result in more accurate exposure estimation.

Methods to reduce the amount of TCMTB potentially released from antisapstain-treated wood would mitigate the risks. Possible mitigation methods might include lowering the application rate or requiring specific storage conditions to prevent exposure of recently treated wood to weather (e.g., full covering) and/or prevent the release of any associated runoff into aquatic habitats (e.g., drip pads). TCMTB is very mobile in soils, so any TCMTB leached outdoors will

likely reach aquatic habitats.

C. Endangered Species Considerations

Section 7 of the Endangered Species Act, 16 U.S.C. Section 1536(a)(2), requires all federal agencies to consult with the National Marine Fisheries Service (NMFS) for marine and anadromous listed species, or the United States Fish and Wildlife Services (FWS) for listed wildlife and freshwater organisms, if they are proposing an "action" that may affect listed species or their designated habitat. Each federal agency is required under the Act to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To jeopardize the continued existence of a listed species means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species." 50 C.F.R. § 402.02.

To facilitate compliance with the requirements of the Endangered Species Act subsection (a)(2) the Environmental Protection Agency, Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (U.S. EPA 2004). After the Agency's screening-level risk assessment is performed, if any of the Agency's Listed Species LOC Criteria are exceeded for either direct or indirect effects, a determination is made to identify if any listed or candidate species may co-occur in the area of the proposed pesticide use. If determined that listed or candidate species may be present in the proposed use areas, further biological assessment is undertaken. The extent to which listed species may be at risk then determines the need for the development of a more comprehensive consultation package as required by the Endangered Species Act.

Using Tier I screening modeling to assess potential exposure from antisapstain wood preservation uses of TCMTB, risks to Listed Species are indicated. Since the model is only intended as a screening-level model, and, as such, has inherent uncertainties and limitations which may result in inaccurate exposure estimations, further refinement of the model is recommended before any regulatory action is taken regarding the antisapstain uses of TCMTB. Potential impacts from the antisapstain use can be mitigated in the interim with precautions to prevent leaching and runoff when wood is stored outdoors. Due to these circumstances, the Agency defers the Endangered Species Decision until additional data are received regarding actual concentrations of TCMTB in waters receiving runoff from antisapstain treatment facilities practicing the mitigation methods described in this document (see Label Hazard Statements and Use Recommendations section, below), as well as the other data described in the data gaps

section, below. When the additional data are received, the environmental risk assessment of the antisapstain use of TCMTB will be revised, and the risks to Listed Species will be reconsidered.

D. Label Hazard Statements for and Use Recommendations:

TCMTB labels must state:

“This product is toxic to fish, aquatic invertebrates, oysters and shrimp.”

"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."

Antisapstain labels must state~~:~~
"Treated lumber must be stored under cover, indoors, or at least 100 feet from any pond, lake, stream, wetland, or river to prevent possible runoff of the product into the waterway. Treated lumber stored within 100 feet of a pond, lake, steam, wetland, or river must be either covered with plastic or surrounded by a berm to prevent surface water runoff into the nearby waterway. If a berm or curb is used around the site, it should consist of impermeable material (clay, asphalt, concrete) and be of sufficient height to prevent runoff during heavy rainfall events."

REFERENCES

Submitted Studies:

Accession #009869. Booden, R.M. 1974. Avian Dietary LC50, Mallard Duck, Report #4043620. Unpublished data, conducted by Warf Institute for Buckman Laboratories, Memphis, TN.

Accession #091624. Knott, W.B., and G. Woodard. 1968a. Busan 72 – Safety Evaluation on Bobwhite Quail. Unpublished data, conducted by Woodard Research Corp., for Buckman Laboratories, Inc., Memphis, TN.

Accession #091624. Knott, W.B., and G. Woodard. 1968b. Busan 72 – Safety Evaluation on Bluegill Sunfish and Rainbow Trout. Unpublished data, conducted by Woodard Research Corp., for Buckman Laboratories, Inc., Memphis, TN

MRID #403636-01. Surprenant, D.C. 1986a. Acute Toxicity of TCMTB to the Sheepshead Minnow, *Cyprinodon variegatus*. Unpublished data, conducted by Springborn Bionomics, Inc., for Buckman Laboratories, Inc., Memphis, TN

MRID #403363-02. Surprenant, D.C. 1987. Acute Toxicity of TCMTB to Mysid Shrimp (*Mysidopsis bahia*). Unpublished data, conducted by Springborn Bionomics, Inc., for Buckman Laboratories, Inc., Memphis, TN.

MRID #403636-03. Surprenant, D.C. 1986b. Acute Toxicity of TCMTB to Embryo-Larvae of the Quahog Clam (*Mercenaria mercenaria*). Unpublished data, conducted by Springborn Bionomics, Inc., for Buckman Laboratories, Inc., Memphis, TN.

MRID #415956-01. Long, R.D., C.P. Driscoll, K.A. Hoxter, and G.J. Smith. 1990. TCMTB: A Dietary LC50 Study with the Mallard. Unpublished data, conducted by Wildlife International, Ltd., for Buckman Laboratories, Inc., Memphis, TN.

MRID # 415956-02. Long, R.D., C.P. Driscoll, K.A. Hoxter, and G.J. Smith. 1990. TCMTB: A Dietary LC50 Study with the Northern Bobwhite. Unpublished data, conducted by Wildlife International, Ltd., for Buckman Laboratories, Inc., Memphis, TN.

MRID #417809-01. Campbell, S. 1991. TCMTB: An Acute Oral Toxicity Study with the Northern Bobwhite." Unpublished data, conducted by Wildlife International, Ltd., for Buckman Laboratories, Memphis, TN

MRID #418042-01. Machado, M. W. 1991a. TCMTB – Acute Toxicity to Bluegill Sunfish (*Lepomis macrochirus*) under Flow-through Conditions. Unpublished data, conducted by Springborn Laboratories, Inc., for Buckman Laboratories, Inc., Memphis, TN.

MRID #418181-01. Machado, M. W. 1991b. TCMTB – Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) under Flow-through Conditions. Unpublished data, conducted by Springborn Laboratories, Inc., for Buckman Laboratories, Inc., Memphis, TN

MRID #418382-01. McNamara, P.C. 1991. TCMTB – Acute Toxicity to Daphnids (*Daphnia magna*) Under Flow-Through Conditions. Unpublished data, conducted by Springborn Laboratories, Inc, for Buckman Laboratories, Inc., Memphis, TN.

MRID #422260-01. Collins, M.K. 1992b. 2-Mercaptobenzothiazole (ROKON) – Acute Toxicity to Daphnids (*Daphnia magna*) Under Static Conditions. Unpublished data, conducted by Springborn Laboratories, Inc., for R.T. Vanderbilt Ct., Inc., Norwalk, CT.

MRID #422322-01. Collins, M.K. 1992a. 2-Mercaptobenzothiazole (ROKON) – Acute Toxicity to Rainbow Trout (*Oncorhynchus mykiss*) Under Static Conditions. Unpublished data, conducted by Springborn Laboratories, Inc., for R.T. Vanderbilt Ct., Inc., Norwalk, CT

MRID #422671-01. Pedersen, C.A., and B.R. Helsten. 1992a. 2-Mercaptobensothiazole (ROKON): 14-day Acute Oral LD50 Study in Bobwhite Quail. Unpublished data, conducted by Bio-Life Associates, Ltd., for R.T. Vanderbilt Co., Inc., Norwalk, CT.

MRID #424285-01. Pedersen, C.A., and B.R. Helsten. 1992b. 2-Mercaptobenziothiazol (ROKON): 8-Day Acute Dietary LC50 Study in Bobwhite Quail. Unpublished data, conducted by Bio-Life Associates, Ltd., for R.T. Vanderbilt Co., Norwalk, CT.

MRID #425929-01. Rhodes, J.E. 1992. Early Life-Stage Toxicity of 2-(Thiocyanomethylthio)benzothiazole (TCMTB) to the Rainbow Trout Under Flow-Through Conditions. Unpublished data, conducted b ABC Laboratories, Inc., for Buckman Laboratories International, Inc., Memphis, TN.

MRID #442009-01. Thompson, S.G., and J.P. Swigert. 1996. TCMTB: A 14-Day Static-Renewal Toxicity Test with Duckweed (*Lemna gibba*). Unpublished data, conducted by Wildlife International, Ltd., for Buckman Laboratories International, Inc., Memphis, TN.

Additional References:

Aschacher G and Gruendlinger R, 2000. Methods to evaluate the ecotoxicological risks of anti-sapstain preservatives. Holzforschung, Austria Research and Development. www.holzforschung.at/english/img_eng/ascha200.pdf.

Addinsoft, 2004. XLSTAT v7.5. http://www.xlstat.com.

.

Chew, G.L., G.M. Kruzynski, and I.K. Birtwell. Behavioural assessment of exposure of juvenile Chinook salmon (*Oncorhynchus tshawtscha*) to sublethal doses of a toxicant. In Proceedings of the Seventeenth Annual Aquatic Toxicity Workshop, Nov. 5-7, 1990, Vancouver, BC, Vol. 1. (edited by P. Chapman, F. Bishay, E. Power, K. Hall, L. Harding, D. Mcleay, M. Nassichuk and W. Knapp). Canadian Technical report of Fisheries and Aquatic Sciences, No. 1774 (vol 1).

Karickhoff SW, DS Brown, TA Scott, 1979. Sorption of Hydrophobic Pollutants on Natural Sediments. Water Resources. 13:241-248.

Krahn P and Strub R, 1990. Standard Leaching Test for Antisapstain Chemicals: Regional Program Report 90-10. Environment Canada, Conservation and Protection, Pacific and Yukon Region North Vancouver, BC.

Kruzynski, G.M., and I.K. Birtwell. 1990. Some Respiratory Responses of Juvenile Pacific Salmon to the Antisapstain Chemical TCMTB. In Proceedings of the Seventeenth Annual Aquatic Toxicity Workshop, Nov. 5-7, 1990, Vancouver, BC, Vol. 1**.** (edited by P. Chapman, F. Bishay, E. Power, K. Hall, L. Harding, D. Mcleay, M. Nassichuk and W. Knapp). Canadian Technical report of Fisheries and Aquatic Sciences, No. 1774 (vol 1).

Kruzynski, G.M., I.K. Birtwell, G.L. Chew, G.E. Piercey,and S. Spohn. 1990. An approach to testing for ecological relevance using behavioral toxicology. . In Proceedings of the Seventeenth Annual Aquatic Toxicity Workshop, Nov. 5-7, 1990, Vancouver, BC, Vol. 1. (edited by P. Chapman, F. Bishay, E. Power, K. Hall, L. Harding, D. Mcleay, M. Nassichuk and W. Knapp). Canadian Technical report of Fisheries and Aquatic Sciences, No. 1774 (vol 1).

Lee R, 2004. WLM recommendation regarding chemical generalization. Memorandum to Siroos Mostaghimi, USEPA. December 15, 2004.

Mineau, P., B.T. Collins, and A. Baril. 1996. On the Use of Scaling Factors to Improve Interspecies Extrapolation of Acute Toxicity in Birds. Regul Toxicol Pharmacol 24; 24-29.

USEPA. 2006. Office of Pesticide Programs internal memorandum, "Aquatic Exposure Assessment for the Use of the Fungicide of 2-Thiocyanomethylthio)benzothiazole (TCMTB) as a Seed Treatment on Cotton, Wheat, Barley, Oats, Rice, Sugar Beets, and Safflower," February 16, 2006.

USEPA. 2004. Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs U.S. Environmental Protection Agency - Endangered and Threatened Species Effects Determinations, 1/23/04.

US EPA. 1979. TN 2432. Biological Report of Analysis, 90+ TCMTB, sample MB618. Unpublished data, performed by US EPA Terrestrial and Aquatic Biology Laboratory.

US EPA. 1979. TN 2427. Biological Report of Analysis, 90+ TCMTB, sample MB618. Unpublished data, performed by US EPA Terrestrial and Aquatic Biology Laboratory.

US EPA. 1980. TN 2437. Biological Report of Analysis, 90+ TCMTB, sample MB618. Unpublished data, performed by US EPA Terrestrial and Aquatic Biology Laboratory.

USEPA, 2004. Wood Leaching Model: Chemical Concentration Screening Tool, v1.0. USEPA/OPPT/AD, developed by Versar, Inc.