UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

MEMORANDUM

Date: **August 19, 2004**

Subj: ***REVISED*** Metam Sodium: Occupational and Residential Exposure Assessment for the Reregistration Eligibility Decision Document

PC Code: 039003 (Metam Sodium) and 068103 (MITC)

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The attached assessment is the revised occupational and residential exposure and risk estimates for metam sodium and its major degradate MITC to support HED's reregistration eligibility decision (RED) document.

The data analysis included in this assessment was prepared by Versar, Inc under the supervision of HED. The assessment was reviewed by HED's Science Council for Exposure (ExpoSAC) to ensure compliance with current HED policy as well as ExpoSAC standard operating procedures (SOPs) for conducting occupational and residential exposure (ORE) assessments.

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Executive Summary

Metam sodium is an agricultural fumigant used to control weeds, nematodes, and fungi on a variety of crops. It is also registered as a root control agent for use in sewers and drains, as a vegetation control agent for shorelines and drained bodies of water (California special local needs label), and as a wood preservative. Methyl isothiocyanate (MITC) is the primary degradate of metam sodium and accounts for the fumigant activity. Human exposure and risk from wood treatment as well as other antimicrobial uses (i.e., metam potassium) that may result in MITC exposure will be assessed by OPP's Antimicrobial Division. This assessment estimates the risk for exposure to metam sodium and its primary degradate MITC from its use as an agricultural fumigant, as a vegetation control agent in California, and as a root control agent. The toxicological endpoints that were used to complete the occupational and residential risk assessments for metam sodium and MITC are from the 8/19/04 HED memo "Toxicity endpoint selection and inhalation dosimetry calculations for metam sodium, dazomet, and MITC."

The short-term (non-cancer) dermal risk assessment for metam sodium is based on an oral NOAEL of 4.22 mg/kg/day from a oral developmental toxicity study in rats. The LOAEL of 16.88 mg/kg/day was based on reduced body weight gain and decreased food efficiency in maternal rats and increased incidence of skeletal observations and the increase in total resorption. The intermediate-term (non-cancer) dermal risk assessment for metam sodium is based on an oral NOAEL of 0.1 mg/kg/day from an oral chronic toxicity study in dogs. The study showed increased ALT and microscopic changes in the liver observed in female dogs. A dermal absorption rate of 2.5% was assumed.

The short- and intermediate-term (non-cancer) inhalation risk assessment for metam sodium is based on an NOAEL of 6.5 mg/m^3, which was defined in a 90-day inhalation study in rats. The LOAEL in females was 45 mg/m^3, based on histopathological changes in the nasal passages and changes in clinical chemistry. Long-term exposures to metam sodium are not expected for current registered uses. Since the adverse effects for all studies utilized in the metam sodium dermal and inhalation risk assessments are female-specific, the average weight of adult females was used to estimate dose in the exposure assessments for adults.

A short-term dermal endpoint was not selected for MITC. No dermal hazard via typical dermal contact with MITC is expected. Unprotected skin could be exposed to MITC vapor, however this exposure can not, at this time, be quantified.

An eye irritation study in human subjects was used to select MITC endpoints for acute inhalation risk assessments. This irritation study evaluated both the impact of duration of exposure and dose on human eye irritation using a specially designed goggle system. Therefore, duration-specific risk evaluations can be performed using endpoints from this study. Specifically, for acute inhalation exposures to MITC of up to 15 minutes, a NOAEL of 0.6 ppm (1799 ug/m3) was selected based on eye irritation observed at the LOAEL of 1.9 ppm. For acute exposures of 1 to 8 hours in duration, a NOAEL of 0.22 ppm (660 ug/m3) was selected from the human eye irritation study based on effects observed at the LOAEL of 0.8 ppm.

For short-term (ST), intermediate-term (IT), and long-term (LT) exposures to MITC, a NOAEL of 6.8 ppm (20 mg/m3) was selected from a 28-day inhalation rat study. In the rat study, a LOAEL of 34 ppm (100 mg/m3) was based on metaplasia of the respiratory epithelium observed when the animals were sacrificed and necropsied at the end of the study. The EPA's reference concentration approach

(RfC) was used to estimate a human equivalent concentration (HEC) of 0.163 ppm (487 ug/m3) for use in MOE calculations for residential bystander exposures. An HEC of 0.683 ppm (2.04 mg/m3) was estimated to calculate margins of exposure (MOEs) for occupational handlers and occupational bystanders. It is important to note that the same endpoint (NOAEL of 6.8 ppm based on metaplasia of the respiratory epithelium) was used in the RfC calculations for residential bystanders, and occupational handlers and occupational bystanders. However, the final HECs differ because the residential HEC is based on 24-hour exposures occurring 7 days per week, whereas the occupational HEC is based on 8-hour exposures occurring 5 days per week..

Metam sodium is classified as a probable (B2) carcinogen with a Q_1* of 1.98 x 10^{-1}.

The level of concern (LOC) for non-dietary non-cancer exposure to metam sodium and MITC are:

<u>Metam Sodium</u>

- MOEs less than 100 for ST and IT dermal exposure
- MOEs less than 100 for ST and IT inhalation exposure

<u>MITC</u>

- MOEs less than 10 for acute inhalation exposure
- MOEs less than 30 for ST and IT inhalation exposure
- MOEs less than 300 for LT inhalation exposure

The Agency has defined a range of acceptable cancer risks based on a policy memorandum issued in 1996 by then Office of Pesticide Programs director, Mr. Dan Barolo. This memo refers to a predetermined quantified "level of concern" for occupational carcinogenic risk. In summary, this policy memo indicates occupational carcinogenic risks that are 1 x 10^{-6} or lower require no risk management action. For those chemicals subject to reregistration, the Agency is to carefully examine uses with estimated risks in the 10^{-6} to 10^{-4} range to seek ways of cost-effectively reducing risks. If carcinogenic risks are in this range for occupational handlers, increased levels of personal protection would be warranted as is commonly applied with non-cancer risk estimates (e.g., additional PPE or engineering controls). Carcinogenic risks that remain above 1.0 x 10^{-4} at the highest level of mitigation appropriate for that scenario remain a concern.

For metam sodium, handler exposure estimates were based on surrogate data from: (1) the Pesticide Handlers Exposure Database (PHED); (2) Outdoor Residential Exposure Task Force (ORETF); and (3) California DPR's review of a sodium tetrathiocarbonate handler study. For MITC, handler exposure estimates were based on four chemical-specific handler studies that examined MITC exposures to handlers involved in metam sodium applications. **ST and IT MOEs estimated for both metam sodium and MITC exceed the LOC using the maximum feasible mitigation controls** (e.g. personal protective equipment, closed mixing systems, and enclosed cabs) **for several scenarios. Handler cancer risks estimated for metam sodium also exceed the LOC using the maximum feasible mitigation controls for several scenarios.**

Acute and ST bystander MOEs for MITC inhalation exposure were based on off-site monitoring data from application site-specific studies**. Acute and ST MOEs exceeded the LOC for some of off-site sample stations monitoring at distances up to 1,000 meters from the field edge (0.6 miles).**

Acute, ST, IT, and LT MOEs were also estimated based on 3 ambient monitoring studies in peak metam sodium use areas of California. None of the estimated MOEs for those studies exceeded the LOC.

EPA's Industrial Source Complex (ISC) dispersion model was also used to estimate MITC air concentrations near treated fields. HED believes that the exposures calculated in this risk assessment are high-end estimates and do not underestimate the risk. Although the Agency has used ISC in the past for regulatory purposes, HED has not previously used the model to estimate air concentrations for pesticides used in agricultural applications. California Department of Pesticide Regulation has been using the ISC model since the early 1990's to estimate bystander exposure to fumigants including methyl bromide. ISC is also an integral part of the Fumigant Exposure Modeling System (FEMS). FEMS is based on a probabilistic approach for estimating bystander risk that is currently being developed by the Metam Sodium Alliance.

The ISC model was used to estimated MITC concentrations for a range of meteorological conditions based on the best available MITC emission rate data from metam sodium field volatility studies. Estimated concentrations for 1, 8, and 24 hour are provided for a range of fields of sizes (i.e. 1, 5 ,10, 20, and 40 acres) at a range of distances (25, 100, and 500 meters). The approach mirrors that used by CDPR. However, the Agency considered additional meteorological conditions for characterization purposes. The concentrations estimated for MITC from metam sodium applications at 500 meters for treating 40 acres **result in acute MOEs less than 10 and ST MOEs less than 30 for most of the meteorological conditions that were assessed.**

MITC concentrations were also estimated using ISC for the edge of the field at 48 hours after application (minimum time on current labels for re-entry). The estimated concentrations for some of the of meteorological conditions assessed exceed the LOC for acute exposure.

In some instances, the risk based on ISC modeling for a given distance, application type, and sealing method may be orders of magnitude higher than the risk estimated directly from the air concentration measured in a off-site monitoring study. The point estimate risks were calculated using actual off-site measured air concentrations from field volatility studies. The duration of each sample was approximately 4 hours. During the time that these concentrations were measured, the meteorological conditions (e.g., wind speed, wind direction, atmospheric stability, and mixing height) and flux rate varied with time. With the current modeling approach, the off-site air concentrations were estimated using a constant flux rate (derived or reported from off-site monitoring studies) and constant meteorological conditions for the duration of exposure. While this approach may overestimate concentrations for extended periods of time (e.g. 24 hours), it does provide estimates of air concentrations at locations not sampled in the off-site monitoring studies.

Measured values taken during real-life conditions are preferable to modeled values. Additional application specific studies with samples stations taken at the appropriate time durations, directions (i.e. N, S, E, W, NE, SE, SW, etc), and distances would reduce the need for reliance on air dispersion modeling. Registrants are strongly encouraged to submit study protocols to the Agency prior to conducting such studies for consultation regarding the OPPTS Harmonized Test Guidelines (i.e. Series 875 Occupational and Residential Exposure Test Guidelines. According to the Metam Sodium Alliance there have been at least six studies conducted since 2001 that have not yet been submitted to the Agency (new studies: USDA-2002 Bakersfield, CA with shank injection; USDA-2002 Bakersfield, CA with chemigation; Sullivan-2002 Pacific NW with shank injection; USDA-2003 Citra, FL with incorporation;

USDA-2003 Citra, FL with shank injection; USDA-2004 Salinas, CA with shank injection; USDA-2004 Salinas, CA with drip.)

HED is in the process of working with the Office of Air, CDPR, EPA's Science Advisory Panel (SAP), registrants, and other stakeholders to further refine modeling approaches used for metam sodium and other fumigants (including the potential use of a probabilistic and/or distributional approaches).

Table B. Summary of Toxicological Endpoints for Risk Assessment, Exposure Durations, and Data Sources for Each Exposure Scenario Assessed in this Document.

Toxicological Endpoint		Population	Exposure Data and Approach for Estimating Risk	Rpt Section
Metam Sodium	ST Dermal NOAEL = 4.22 mg/kg/day Absorption Rate = 2.5% LOC = MOE <100	Occupational Handlers	Surrogate data from PHED, ORETF, and Sodium Tetrathiocarbonate Study	2.1.3.2
	IT Dermal NOAEL = 0.1 mg/kg/day Absorption Rate = 2.5% LOC = MOE <100	Occupational Handlers	Surrogate data from PHED, ORETF, and Sodium Tetrathiocarbonate Study	2.1.3.2
	ST and IT Inhalation NOAEL = 1.11 mg/kg/day LOC = MOE <100	Occupational Handlers	Surrogate data from PHED	2.1.3.2
	Cancer Q* = 1.98 $(mg/kg/day)^{-1}$	Occupational Handlers	Surrogate data from PHED	2.1.4.2

Table B. Summary of Toxicological Endpoints for Risk Assessment, Exposure Durations, and Data Sources for Each Exposure Scenario Assessed in this Document.

	Toxicological Endpoint	Population	Exposure Data and Approach for Estimating Risk	Rpt Section
MITC	Acute Inhalation NOAEL = 1799 ug/m3 for < 15 mins of exposure NOAEL = 660 ug/m3 for 1 to 8 hrs of exposure LOC = MOE <10	Residential Bystanders	4 hour concentrations from each sample station in each of the off-site studies were compared to the NOAEL	2.2.5.2
			1-hr average concentrations were estimated using air dispersion modeling (ISCST) and compared to the NOAEL	3.3
		Occupational Handlers	Maximum MITC concentration for handler tasks were estimated from 4 MITC handler studies and then compared to the NOAEL.	2.1.5.2
		Postapplication Workers	ISCST was used to estimate concentration at field edge 48-hrs after application and then compared to NOAEL	3.5
	ST Inhalation HEC = 487 ug/m3 for 1 to 30 days of exposure LOC = MOE <30	Residential Bystanders	24-hr average concentrations for each of the sample stations in off-site monitoring studies were estimated and compared to the human equivalent concentration (HEC).	2.2.5.2
			24-hr average concentrations were estimated using air dispersion modeling (ISCST) and compared to the HEC.	3.2
	ST Inhalation HEC = 2042 ug/m3 for 1 to 30 days of exposure LOC = MOE <30	Occupational Handlers	Geometric mean MITC concentration for handler tasks estimated from 4 MITC handler studies and then compared to the HEC.	2.1.5.2
		Occupational Bystanders	8-hr average concentrations were estimated using air dispersion modeling (ISCST) and compared to the HEC.	3.4
	IT Inhalation HEC = 487 ug/m3 for < 180 days of exposure LOC = MOE <30	Residential Bystanders	Average of 24-hour TWA concentrations were estimated from ambient sampling studies and compared to the HEC.	2.2.5.2
	LT Inhalation HEC = 487 ug/m3 for > 180 days of exposure LOC = MOE <300	Residential Bystanders	Average of 24-hour TWA concentrations were estimated from ambient sampling studies amortized for 188 days/year and compared to the HEC.	2.2.5.2

1.0 Occupational and Residential Exposure/Risk Assessment

1.1 Purpose

This document is the occupational and residential non-dietary exposure and risk assessment for the fumigant metam sodium and its primary degradate, methyl isothiocyanate (MITC) from its use as an agricultural fumigant, as a vegetation control agent in California, and as a root control agent.

1.2 Criteria for Conducting Exposure Assessments

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is a potential for exposure to handlers (mixers, loaders, applicators) during use or to persons entering treated sites or exposed to vapors after application is complete. Toxicological endpoints were selected for ST and IT dermal and inhalation exposures to metam sodium. Toxicological endpoints were also selected for acute, short-, intermediate-, and long-term inhalation exposures to MITC, which is a metam sodium degradate of toxicological concern. No dermal endpoint of concern was selected for MITC, even though dermal exposure to the vapor may occur. There is a potential for exposure in a variety of occupational agricultural and commercial settings as well as in residential bystander scenarios. Therefore, risk assessments are required for occupational handlers and for occupational and residential bystander exposures that can occur as a result of metam sodium use.

1.3 Summary of Hazard Concerns

The toxicological endpoints that were used to complete the occupational and residential risk assessments are summarized below are from the 8/19/04 HED memo "Toxicity endpoint selection and inhalation dosimetry calculations for metam sodium, dazomet, and MITC."

HED selected toxicological endpoints of concern for metam sodium and its degradates. Methylisothiocyanate (MITC), the principle breakdown product, accounts for the fumigant activity of metam sodium. MITC is the primary soil degradate and mammalian metabolite of metam sodium. There are several toxicologically notable metabolites/degradates. Specifically, methyl isocyanate (MIC) is a photolysis degradate of the MITC which has been measured in ambient air in agricultural areas of California. Following soil application of metam sodium, both carbon disulfide (CS_2) and hydrogen sulfide (H_2S) can be formed – the relative amounts depend on the pH of the soil. Following oral exposure to metam sodium, rats metabolize approximately 20-25% of the dose (on a molar basis) to carbon disulfide. This assessment addresses the exposure and risk to metam sodium and MITC only.

1.3.1 Metam Sodium

Metam sodium is a soil fumigant where the use patterns can vary widely ranging from shorter-term through intermediate-term exposure durations. As such, when the HED recently evaluated the metam sodium hazard database, endpoints were selected to address each duration of exposure. Metam Sodium exposures are expected to occur primarily to occupational handlers.

Dermal Route (non-cancer)

The ST dermal risk assessment (1 to 30 days of exposure) for metam sodium is based on an NOAEL of 4.22 mg/kg/day from a oral developmental toxicity study in rats. The LOAEL of 16.88 mg/kg/day was based on reduced body weight gain and decreased food efficiency in maternal rats and increased incidence of skeletal observations and the increase in total resorption.

The IT dermal risk assessment for metam sodium is based on an NOAEL of 0.1 mg/kg/day from an oral chronic toxicity study in dogs. The study showed increased ALT and microscopic changes in the liver observed in female dogs. The NOAEL of 0.1 mg/kg/day was also selected for assessing long-term dermal exposures. However, based on metam sodium's current use pattern, LT exposures (greater than 6 months) are not expected.

A dermal absorption factor of 2.5 percent was selected based on dermal absorption data from a metam sodium absorption study performed on rats. HED's level of concern (LOC) for dermal risk is 100.

Inhalation Route (non-cancer)

The ST and IT (non-cancer) inhalation risk assessment for metam sodium is based on an NOAEL of 6.5 mg/m^3 (1.11 mg/kg/day) which was defined in a 90-day inhalation study in rats. The LOAEL in females was 45 mg/m^3 (7.71 mg/kg/day) of metam sodium based on histopathological changes in the nasal passages (i.e., mucigenic hyperplasia) and changes in clinical chemistry. LT exposure to metam sodium (i.e. greater than 6 months) are not expected for current registered uses.

Non-cancer Level of Concern (LOC)

The LOC for metam sodium exposure are MOEs of less than 100 (based on 10x to account for interspecies extrapolation to humans from the animal test species and another 10x to account for intraspecies sensitivity).

Cancer

The Health Effects Division Carcinogenicity Peer Review committee (CPRC) evaluated the weight-of-the-evidence on metam sodium with particular reference to its carcinogenic potential. The CPRC concluded that metam sodium should be classified as a Group B_2 - probable human carcinogen, based on statistically significant increases in malignant angiosarcomas in both sexes of the CD-1 mouse. The CPRC recommended that for the purpose of risk characterization, a linear low dose extrapolation model be applied to the animal data for the quantification of human risk (Q_1*), based on the total incidence of angiosarcomas in male mice, at all sites combined. The most potent unit risk (Q_1*) is 1.98×10^{-1} in human equivalents converted from animals to humans by use of the 3/4's scaling factor.

Cancer Level of Concern (LOC)

The Agency has defined a range of acceptable cancer risks based on a policy memorandum issued in 1996 by then Office of Pesticide Programs director, Mr. Dan Barolo. This memo refers to a predetermined quantified "level of concern" for occupational carcinogenic risk. In summary, this policy memo indicates occupational carcinogenic risks that are 1×10^{-6} or lower require no risk management action. For those chemicals subject to reregistration, the Agency is to carefully examine uses with estimated risks in the 10^{-6} to 10^{-4} range to seek ways of cost-effectively reducing risks. If carcinogenic risks are in this range for occupational handlers, increased levels of personal protection would be warranted as is commonly applied with non-cancer risk estimates (e.g., additional PPE or engineering controls). Carcinogenic risks that remain above 1.0×10^{-4} at the highest level of mitigation appropriate for that scenario remain a concern.

Acute Toxicity Classification

Metam sodium is classified as category III for acute oral, dermal, and inhalation toxicity. It is classified as category III for eye irritation potential and category IV for skin irritation potential. Results were positive for dermal sensitization in guinea pigs.

Body Weight

Since the adverse effects for all studies utilized in the metam sodium dermal and inhalation risk assessments are female-specific, the average weight of adult females (i.e., 60 kg) was used to estimate exposure.

1.3.2 Methyl Isothiocyanate (MITC)

Metam sodium forms MITC (methyl isothiocyanate) as its primary mammalian metabolite and primary soil degradate. As such, when the HED recently evaluated the MITC hazard database, endpoints were selected to address the same durations of exposure as metam sodium. Exposures can occur to occupational users and residential populations, so both were considered in this assessment.

Dermal Route (non-cancer)

A ST dermal endpoint were selected for MITC since no dermal hazard via typical dermal contact with MITC is expected. Unprotected skin could be exposed to MITC vapor, however this exposure can not, at this time, be quantified.

Inhalation Route (non-cancer)

An eye irritation study in human subjects was used to select MITC endpoints for acute inhalation risk assessments. This irritation study evaluated both the impact of duration of exposure and dose on human eye irritation using a specially designed goggle system. Therefore, duration-specific risk evaluations can be performed using endpoints from this study. Specifically, for acute inhalation exposures to MITC of up to 15 minutes, a NOAEL of 0.6 ppm (1799 ug/m3) was selected based on eye irritation observed at the LOAEL of 1.9 ppm. For acute exposures of 1 to 8 hours in duration, a NOAEL of 0.22 ppm (660 ug/m3) was selected from the human eye irritation study based on effects observed at the LOAEL of 0.8 ppm.

For ST, IT, and LT exposures to MITC, a NOAEL of 6.8 ppm (20 mg/m3) was selected from a 28-day inhalation rat study. In the rat study, a LOAEL of 34 ppm (100 mg/m3) was based on metaplasia of the respiratory epithelium observed when the animals were sacrificed and necropsied at the end of the study. The EPA's reference concentration approach (RfC) was used to estimate a human equivalent concentration (HEC) of 0.163 ppm (487 ug/m3) for use in MOE calculations for residential bystander exposures. An HEC of 0.683 ppm (2.04 mg/m3) was estimated to calculate MOEs for occupational handlers and occupational bystanders. It is important to note that the same endpoint (NOAEL of 6.8 ppm based on metaplasia of the respiratory epithelium) was used in the RfC calculations for residential bystanders, and occupational handlers and occupational bystanders. However, the final HECs differ because the residential HEC is based on 24-hour exposures occurring 7 days per week, whereas the occupational HEC is based on 8-hour exposures occurring 5 days per week..

Non-cancer Level of Concern (LOC)

The LOC for MITC acute inhalation exposure are MOEs of less than 10. The LOC is based on a 10x uncertainty factor (UF) to account for intraspecies sensitivity.

For MITC ST inhalation exposure, the LOC are MOEs of less than 30 (based on a 3x UF to account for interspecies extrapolation to humans from the animal test species and 10x UF to account for intraspecies sensitivity) The LOC for LT exposure are MOEs of less than 300 (based on ST UFs with an additional 10x UF).

Acute Toxicity Classification

MITC is classified as category I for acute dermal toxicity and as category II for acute oral and inhalation toxicity. It is also classified as category I for eye irritation potential and skin irritation potential. MITC is a sensitizer.

1.3.3 MITC Exposure from Dazomet Uses

Dazomet is a another soil fumigant product that produces MITC as its primary breakdown degradate. Annual use of dazomet in the US is reportedly significantly less than that of metam sodium. No data were submitted to HED for MITC exposure from dazomet uses, therefore, quantitative exposure and risk estimates from dazomet uses can not be completed at this time. Until further data is provided, HED assumes the exposure and risk to MITC from dazomet uses is similar to that estimated in this assessment for MITC from metam sodium uses.

Dazomet granular products such as Basamid are registered for use on lawns and ornamental plants in residential settings. HED has no data to characterize the frequency of residential dazomet use. Since dazomet rapidly converts to MITC upon contact with soil, children's exposure to dazomet is not expected (i.e. via oral, dermal, inhalation routes). However, bystander inhalation exposure to MITC by children and adults living near or at a treated residential site could occur.

Dazomet granular products are not "restricted use" and therefore permit application by a homeowner. Current labels list Basamid formulations as being sold in 50-lb bags as well as 15- or 7.5-lb jugs. According to BASF, the 15- and 7.5-lb jugs were for a canceled tobacco use and now the only formulation available are 50-lb bags which would suggest that application by a homeowner is unlikely. Until the Registration Division can verify whether homeowners do NOT apply dazomet products, HED must assume that homeowners can be "handlers" and therefore may be exposed to dazomet (via dermal and inhalation) and MITC (predominately via inhalation).

1.3.4 MITC Exposure from Metam Potassium Uses

Metam potassium is a another soil fumigant product that produces MITC as its primary breakdown degradate. No data were submitted to HED for MITC exposure from metam potassium uses. Therefore, quantitative exposure and risk estimates from metam potassium uses can not be completed at this time.

Use patterns and exposure scenarios for metam sodium and metam potassium were compared and found to be substantially similar. Therefore, HED assumes the exposure and risk to MITC from metam potassium uses is similar to that estimated in this assessment for MITC from metam sodium uses.

1.3.5 Metam Sodium's Other Breakdown Products

This assessment is based only on the risk associated with metam sodium and it's major breakdown product MITC. However, it should be noted that application of metam sodium may also result in exposure to other breakdown products that are volatile compounds with known toxicity.

Methyl Isocyanate (MIC)	The OSHA PEL and ACGIH TLV is 0.05 mg/m3 (0.02 ppm) for an 8-hour TWA. California DPR established a "conditional 1-hour REL value of 0.99 ppb". The production of MIC from MITC in laboratory is reportedly about 7%. California's Air Resource Board reported that preliminary measurements of MIC following application of metam sodium revealed levels between 0.09 and 2.5 ppb, 4% of the MITC levels.
Hydrogen Sulfide (H_2S)	The OSHA PEL and ACGIH TLV is 14 mg/m^3 (10 ppm) for an 8-hour TWA. The 15-minute STEL is 21 mg/m^3 (15 ppm).

	California's Ambient Air Quality Standard is 30 ppb for a 1-hour average. California DPR reports measurements of H_2S after applications of metam sodium at levels reaching 76 ppb at 1 to 4 hours postapplication, becoming non-detectable at 5 to 7 hours and then rising again to 21 to 24 hours .
Carbon Disulfide (CS_2)	The current OSHA PEL for carbon disulfide is 20 ppm as an 8-hour TWA, 30 ppm as an acceptable peak concentration for 30-minutes, and 100 ppm as a maximum peak. ACGIH has assigned carbon disulfide a TLV of 10 ppm (31 mg/m3) for an 8-hour TWA (with a "Skin" notation). NIOSH has established REL of 1 ppm (3 mg/m3) as an 8-hour TWA (with a "Skin" notation). California DPR reports measurements of CS_2 after applications of metam sodium at or below the LOD of 4 ppb.

1.3.6 Special FQPA Safety Factor(s)

Since metam sodium and MITC do not have published or proposed tolerances, the special FQPA safety factor is not applicable to risk assessments for these chemicals.

1.4 Incident Reports

An analysis of incident reports will be included in a separate memo by Jerry Blondell.

1.5 Summary of Physical and Chemical Properties of Metam Sodium and MITC

1.5.1 Metam Sodium

Metam sodium (CAS registry number 137-42-8) is an aqueous solution of the salt, having a molecular formula of $C_2H_4NS_2$ and a molecular weight of 129.18 g/mole. The vapor pressure of the solution is 21 mm Hg.

1.5.2 MITC

Methyl isothiocyanate (CAS registry number 556-61-6) is yellowish in color and has a pungent odor likened to horseradish. The molecular formula of MITC is C_2H_3NS and the molecular weight is 73.11 g/mole. It is highly volatile with a vapor pressure of 16.0 mm Hg at 25°C. It is poorly soluble in water and readily soluble in most organic solvents.

1.6 Summary of Use Patterns and Formulations

Metam sodium products are described in this section.

1.6.1 End-Use Products

Based on pounds of active ingredient used, metam sodium is the third most widely used agricultural pesticide in the United States. Metam sodium has four major uses:

- an agricultural fumigant,
- a root control compound for use in drains and sewers,
- a vegetation control compound for use along drained ponds and lakes (California special local need registration), and
- a wood preservative

This assessment is concerned with its use as an agricultural fumigant, as a vegetation control agent in California, and as a root control agent. The wood preservative exposure and risk assessment is being completed separately.

For agricultural fumigation and vegetation control, metam sodium is formulated as a water-soluble concentrate or in aqueous solution. Once metam sodium is applied to soil or mixed with water, it rapidly and completely breaks down to MITC and other degradates. In soil, metam sodium usually converts to MITC within one day following application with the decomposition rate depending on soil temperature, soil composition, and soil moisture. Warm soil temperature, increased clay or organic matter, small soil particle size, and low soil moisture facilitate rapid conversion of metam sodium to MITC. MITC accounts for the fumigant activity of metam sodium.

Metam sodium also is formulated as a water-soluble, surface-active formulation in combination with dichlobenil for use as a non-systemic foaming herbicide to rid sewer lines and drain systems of roots and other organic material.

1.6.2 Registered Use Categories and Sites

Metam sodium is an agricultural fumigant used to control weeds, nematodes, and fungi on a wide variety of crops. It is also registered as a root control agent for use in sewers and drains, and as a vegetation control agent for shorelines and drained bodies of water in California. MITC is the primary degradate of metam sodium and accounts for the fumigant activity. Both metam sodium and MITC are also registered as sterilization agents for treated wood, however, this use was not examined in this assessment. Human exposure and risk from wood treatment as well as other antimicrobial uses (i.e., metam potassium) that may result in MITC exposure will be assessed by OPP's Antimicrobial Division.

An analysis of the current labeling and available use information was completed by Special Review and Reregistration Division. Metam sodium is registered for use in a variety of occupational scenarios and thus occupational populations could be potentially exposed while making metam sodium applications. It is possible for occupational and residential populations to be exposed to MITC, the primary degradate of metam sodium, during postaplication time periods, but less likely for such populations to be exposed to metam sodium itself due to its rapid degradation when in contact with water or soil.

Table 1. Summary of Maximum Application Rates for Registered Metam Sodium Uses			
Crop/Site	Application Method	Maximum Label Rate[1]	
		Most Labels	Outlier Label
Ornamentals, turf, food, and fiber crops – large area applications	Tractor-drawn or Sprinkler Irrigation	320 lb ai/acre	338 lb ai/acre
	Drip Irrigation	239 lb ai/acre	320 lb ai/acre
Cotton, soybeans, and sugar beets	Tractor-drawn or Drip Irrigation	38 lb ai/acre	not applicable
Orchards (replant or transplant)	Tractor-drawn or Sprinkler Irrigation	320 lb ai/acre	not applicable
Peanuts CBR resistant cultivars	Tractor-drawn or Sprinkler Irrigation	32 lb ai/acre	not applicable
Peanuts – CBR-susceptible cultivars	Tractor-drawn or Sprinkler Irrigation	63.3 lb ai/acre	not applicable
Wheat and barley	Tractor-drawn or Sprinkler Irrigation	32 lb ai/acre	not applicable
Tobacco plant beds	Tractor-drawn or Sprinkler Irrigation	387 lb ai/acre	412 lb ai/acre
Small areas of ornamentals, food, fiber crops, seed beds, plant beds, and lawns	Tractor-drawn or Sprinkling Can	12 lb ai/1000 ft^2	not applicable
	Hose proportioner	8 lb ai/1000 ft^2	not applicable
Potting soil	Sprinkling Can[2]	4 lb ai/1000 ft^2	not applicable
	Cement Mixer and Shredder	0.012 lb ai/1 ft^3	not applicable
Tree replanting	Open Pour	16 lb ai/1000 ft^2	not applicable
Sewer roots	Foam Spray	0.212 lb ai/gallon	not applicable
Drained water bodies and shorelines (SLN 5481-466)	Power Sprayer (Handgun Sprayer)	8 lb ai/1000 ft^2	not applicable

[1] When more than one maximum rate is listed for a given crop/method, the lower rate was found on the majority of product labels. The higher rate represents the absolute highest rate found on any metam product label.
[2] Amvac label lists a rate of 1.5 pts of AMVAC per 50 sq ft of soil (4 lb ai/100 ft^2). HED assumed that this was a typo and the rate is 0.4 lb ai/100 ft^2.

Some product labels for ornamentals, turf, food, and fiber crops (large and small areas) and potting soil do not explicitly prohibit use in greenhouses and/or "confined areas." The metam sodium registrants Amvac, Tessenderlo-Kerley Inc., Taminco, and Buckman have stated that they do not support use of metam sodium in enclosed greenhouses and are not aware of such a use in practice. Additionally, Amvac has stated that metam sodium may be used in non-enclosed greenhouses, that is, greenhouses with the structural supports in place but not the enclosing plastic, or in open structures with a roof but no sides. However, since not all metam product labels explicitly prohibit use in greenhouses and "confined areas", these uses could potentially occur.

1.6.3 Application Methods

Metam sodium is applied with several types of application equipment – the major methods are chemigation, tractor-drawn, or drip applications. Applications to smaller areas may be made with handheld equipment, including sprinkling cans, hose proportioners (hose-end sprayers), power sprayers (handgun sprayers), or foam injectors. Applications to potting soil may be made by adding it to soil in a cement mixer or by spraying it onto a soil stream as the soil is ejected from a shredder.

Chemigation

- *Sprinkler irrigation* is a system in which water is applied by means of perforated pipes or nozzles operated under pressure so as to form a spray pattern;
- *Flood irrigation* is a system where the entire surface of the soil is covered by water;
- *Furrow irrigation* is a system where water is applied in furrows or rows resulting in partial surface flooding of the soil – this method of irrigation is normally used with clean-tilled crops;

Drip

- *Drip or trickle irrigation* is a system where water is applied at low pressure directly to the root zone of plants by means of applicators, such as orifices, emitters, porous tubing, or perforated pipe, that are placed either on or below the surface of the ground.

Tractor-drawn applications

- *Shank soil injection* is a system where the fumigant is applied with knife-like blades called shanks. A tube carrying the product runs down the back of each shank to the opening. Since metam sodium only moves a few inches in the soil, sometimes the shanks have multiple openings to improve distribution. The metam sodium is injected below the surface of the soil and applied in a narrow band as the fumigation equipment moves across the field. Then usually the surface of the soil is sealed or compacted by pulling a ring roller, drag, or other device behind the fumigation equipment or by applying a thin layer of water over the soil surface.
- *Rotary tiller injection* is a system where the fumigant is sprayed on the surface of the soil, then incorporated into the soil with rotary tiller. The soil may be sealed by pulling a ring roller, drag, or other device behind the rotary tiller equipment or by applying a thin layer of water over the soil surface.

- *Spray blade injection* is system where the fumigant is injected into the soil behind a spray blade, which is immediately capped by a mound of soil and rolled.

The **foam applications** are applied in isolated sections of the sewer system for approximately an hour. At the end of the treatment period, the solution is released into the main sewer system and the treated area is flushed with water. MITC is likely formed during the treatment process and may enter air spaces in the treatment area and in nearby sewer systems.

Metam sodium is applied to soil with **handheld equipment** such as sprinkling cans, hose-proportioners (i.e., hose-end sprayers), power sprayers (handgun sprayers), cement mixers, and shredders.

1.6.4 Soil Sealing Methods

Soil sealing methods recommended on product labels include applying irrigation water and/or plastic tarps or packing soil with a roller or drag. Although not specified on EPA registered labels, the are two types water sealing methods currently used. The Metam Sodium Alliance provided the following definition of two methods.

"Standard" and "intermittent" in the context of water sealing are terms developed from research trials where different watering schemes were used to determine efficacy of water in managing MITC release from metam-sodium applications. Based on work to date, the following are considered preliminary operational definitions of a "standard water seal" and an "intermittent water seal".

Standard Water Seal*: A single application of water directly after the pesticide has been applied, to seal the surface.*

Intermittent Water Seal*: An application of water directly after the pesticide has been applied, to seal the surface, followed by application of additional water (in one or two sessions) before late evening on the day of application.* (This definition differs somewhat from off-site studies that have submitted where water was applied after application and then again the **following day**.*)*

The application and sealing methods mentioned in the last two sections are the major methods identified from data provided to the Agency may not reflect every method currently used to apply metam sodium in the US. Additional information on methods not listed will used to revise this assessment. Available data for estimating handler and bystander exposures is identified in **Sections 2.1.1 and 2.2.1**. Data gaps are identified also identified in individual report sections and also summarized in **Appendix H**.

1.6.5 Current Metam Sodium Labels

Current metam sodium labels require applicators and other handlers involved in direct contact activities to wear the following personal protective equipment (PPE):

- coveralls over long-sleeved shirt and long pants;

- chemical-resistant gloves;
- chemical-resistant footwear plus socks;
- chemical-resistant headgear for overhead exposure;
- chemical-resistant apron during equipment cleaning or mixing/loading procedures (unless dry disconnect devices are used);
- face-sealing goggles, unless a full-face respirator is worn;
- a respirator with either an organic vapor removing cartridge with a prefilter approved for pesticides (MSHA//NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G).

PPE requirements for handlers using enclosed cabs for applications include:

- coveralls;
- shoes and socks;

If a pungent, rotten-egg odor can be detected inside the enclosed cab, the handlers must also wear the following:

- face sealing goggles, unless a full-face respirator is worn;
- a respirator with either an organic vapor removing cartridge with a prefilter approved for pesticides (MSHA//NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G).

Also, the PPE specified for use during direct contact activities must be available inside the enclosed cab during application and must be worn if the handler leaves the enclosed cab to perform any direct contact activity.

Metam sodium currently has a 48-hour entry prohibition period during which time only a few specific ***handling*** tasks are allowed to be performed (according to the current labels). They include assessing/adjusting the soil seal; assessing pest control, application technique, or application efficacy; and sampling air or soil. All other tasks are prohibited until the entry restriction is over. Handlers performing any of these tasks must wear the following PPE:

- coveralls over long-sleeved shirt and long pants;
- chemical resistant gloves;
- chemical resistant footwear plus socks;

If a pungent, rotten-egg odor can be detected outdoors, the handlers must also wear the following:

- face sealing goggles, unless a full-face respirator is worn;
- a respirator with either an organic vapor removing cartridge with a prefilter approved for pesticides (MSHA//NIOSH approval number prefix TC-23C), or a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G).

Fumigant warning signs must be posted at entrances to treated areas and workers must also be orally warned about the application.

2.0 Occupational and Residential Exposures and Risks

It has been determined there is a potential for exposure to metam sodium and MITC in occupational scenarios from handling metam sodium products during the application process (i.e., mixer/loaders, applicators, and mixer/loader/applicators) and a potential for postapplication worker exposure to MITC from entering into or being near areas previously treated with metam sodium. As a result, risk assessments have been completed for occupational handler scenarios as well as postapplication worker scenarios.

2.1 Occupational Handler Exposures and Risks

HED uses the term "handlers" to describe those individuals who are involved in the pesticide application process. HED believes that there are distinct job functions or tasks related to applications and that exposures can vary depending on the specifics of each task. Job requirements (e.g., amount of chemical to be used in an application), the kinds of equipment used, the target being treated, and the level of protection used by a handler can cause exposure levels to differ in a manner specific to each application event.

Exposure scenarios can be thought of as ways of categorizing the kinds of exposures that occur related to the use of a chemical. The use of scenarios as a basis for exposure assessment is very common as described in the *U.S. EPA Guidelines For Exposure Assessment* (U.S. EPA; Federal Register Volume 57, Number 104; May 29, 1992). Information from the current labels; use and usage information; toxicology data; and exposure data were all key components in developing the exposure scenarios.

The first step in the handler risk assessment process is to identify the kinds of individuals that are likely to be exposed to metam sodium and MITC during the metam sodium application process. In order to do this in a consistent manner, HED has developed a series of general descriptions for tasks that are associated with pesticide applications. Tasks associated with occupational pesticide use (i.e., for "handlers") can generally be categorized using one of the following terms:

- **Mixers and/or Loaders:** these individuals perform tasks in preparation for an application. For example, prior to application, loaders would transfer metam sodium from the tank delivery truck into on-site field tanks for use in shank injection, rotary tiller, or sprinkler, and drip application equipment.

- **Applicators:** these individuals operate application equipment during the release of a pesticide product into the environment. These individuals can make applications using equipment such as shank injectors or rotary tillers.

- **Chemigation/Sprinkler and Drip Application Monitors:** these individuals monitor sprinkler and drip applications and ensure that any clogged nozzles or errant spray patterns are fixed so that the pesticide is applied in the correct pattern.

- **Irrigators:** these individuals perform the application of a water seal after the metam sodium application occurs.

- **Mixer/Loader/Applicators and or Loader/Applicators:** these individuals are involved in the entire pesticide application process (i.e., they do all job functions related to a pesticide application event). These individuals would transfer metam sodium solution into application equipment and then also apply it. Industry sources indicate that approximately 90% of handlers who apply metam sodium with a tractor also did the mixing and loading.

Next, assessors must understand how exposures to metam sodium and MITC occur (i.e., frequency and duration) and how the patterns of these occurrences can cause the effects of the chemical to differ (referred to as dose response). Wherever possible, use and usage data determine the appropriateness of certain types of risk assessments (e.g., a chronic risk assessment is not warranted for a vast majority of metam sodium uses because chronic duration exposure patterns are not expected to occur). Other parameters are also defined from use and usage data such as application rates and application frequency. HED always completes non-cancer risk assessments using maximum application rates for each scenario because what is possible under the label (the legal means of controlling pesticide use) must be evaluated, for complete stewardship, in order to ensure there are no concerns for each specific use.

A chemical can produce different effects based on how long a person is exposed, how frequently exposures occur, and the level of exposure. It is likely that metam sodium and thus, MITC exposures can occur in a variety of patterns. HED believes that occupational metam sodium and MITC handler exposures can occur from 1 day up to several months. HED completes both ST and IT assessments for occupational scenarios in essentially all cases because these kinds of exposures are likely and acceptable use and usage data are not available to justify deleting intermediate-term scenarios. Based on available data, LT handler exposures are not expected to occur for metam sodium and MITC. (See ** Note** in **Section 2.1.1.1** regarding USDA usage survey)

The same endpoint was selected for both ST and IT metam sodium inhalation exposure (NOAEL = 6.5 mg/kg/day). Separate toxicological endpoints of concern have been selected for ST and IT metam sodium dermal exposures (4.22 mg/kg/day for ST and 0.1 mg/kg/day for IT). Dermal absorption was assumed to be 2.5%.

No dermal endpoint of concern was selected for MITC, however, dermal exposure to the vapor may occur. Toxicological endpoints of concern were selected for acute, ST, IT, and LT inhalation exposures to MITC. (acute NOAEL for < 15 minutes exposure = 1799 ug/m3, acute NOAEL for 1 to 8 hours exposure = 660 ug/m3, ST, IT, and LT HEC = 2042 ug/m3).

Occupational handler exposure assessments are completed by HED using different levels of personal protection. HED typically evaluates all exposures with a tiered approach. The lowest tier is represented by the baseline exposure scenario (i.e., long-sleeve shirt, long pants, shoes, and socks) followed by increasing the levels of personal protective equipment or PPE (e.g., gloves, double-layer body protection, and respirators) and engineering controls (e.g., enclosed cabs and closed mixing/loading systems). This approach is always used by HED in order to be able to define label language using a risk-based approach. In addition, the minimal level of adequate protection for a chemical is generally considered by HED to be the most practical option for risk reduction (i.e., over-burdensome risk mitigation measures are not considered a practical alternative).

2.1.1 Data and Assumptions For Handler Exposure Scenarios

2.1.1.1 Assumptions for Handler Exposure Scenarios

A series of assumptions and exposure factors served as the basis for completing the occupational handler risk assessments. Each assumption and factor is detailed below on an individual basis. The assumptions and factors used in the risk calculations include:

- No handler studies were provided that directly measure exposure to metam sodium.

- For metam sodium, occupational handler exposure estimates were based on surrogate data from: (1) the Pesticide Handlers Exposure Database (PHED); (2) Outdoor Residential Exposure Task Force (ORETF); and (3) a sodium tetrathiocarbonate handler study (6/26/02 Draft Metam Sodium Risk Characterization Document).

- The studies in PHED are based on application rates significantly lower than what is used for many of the field applications of metam sodium. A linear extrapolation from the rates in PHED to the anticipated rates for metam sodium may overestimate the exposure to handlers.

- For MITC exposure assessments, exposure values were taken from four chemical-specific handler studies that examined MITC exposures to handlers involved in metam sodium applications.

- For assessing non-cancer risks from metam sodium exposures, the average body weight of an adult female handler (60 kilograms) is used, since the toxicological endpoint of concern is female-specific.

- For assessing cancer risks from metam sodium exposures, the average body weight of an adult handler (70 kilograms) is used, since the cancer endpoint is not sex-specific.

- Commercial handlers (i.e. for hire applicators, large-scale private growers, cooperatives, etc.) who support metam sodium applications for ornamentals, food, and fiber crops and sewer treatment applications are assumed to be short- to intermediate-term exposure durations. Greater than 30 exposure days/year (intermediate term exposures) for commercial handler non-cancer exposures is based on high end values. All other handlers are assumed to be exposed for less than 30 days per year (i.e. short-term durations). **[SEE ** NOTE ** BELOW]**

- For cancer assessments, it was assumed that commercial handlers (i.e., for hire applicators, large-scale private growers, cooperatives, etc.) who support metam sodium applications for ornamentals, food and fiber crops, and sewer treatment applications may be exposed to metam sodium for 20 days per year (based on average values). All other handlers were assumed to be exposed for 5 days per year (based on average values). All handlers were assumed to have a 35 year career and a 70 year lifespan. **[SEE ** NOTE ** BELOW]**

- Generic protection factors (PFs) were used to calculate exposures when data were not available. For example, a 90 percent protection factor was assumed for the use of a respirator equipped with an organic-vapor-removing cartridge.

- Exposure factors used to calculate daily exposures to handlers are based on applicable data if available. For lack of appropriate data, values from a scenario deemed similar enough by the assessor might be used. As a example, for metam sodium handler exposures, PHED data for groundboom equipment were used to assess shank injection and rotary tiller applications. The nature of these application methods are believed to be similar enough to bridge the data.

- For non-cancer assessments, HED assumes the maximum application rates allowed by labels in its risk assessments (see **Table 1**). For cancer assessments, average/typical application rates provided by BEAD were used, if available. The following average application rates were provided by BEAD:

Crop/Use Site Treated	Avg/Typical Rate
Large areas of turfgrass	252 lbs ai/A
Large areas of ornamentals or food crops	108 lbs ai/A
Cotton, soybeans, and sugar beets	44.4 lbs ai/A
Peanuts	27.5 lbs ai/A
Wheat and barley	162 lbs ai/A *

* The average rates reported by USDA in 2001 for wheat and barley (162 lb ai/A) is significantly higher than the maximum label rate (31.7 lb ai/A) for control of "certain root diseases caused by early season fungi." However, HED notes that wheat and barley also can be treated at the application rate on the label for ornamentals, food, and fiber crops (338 or 320 lb ai/A). Therefore, HED estimated cancer rates with the 162 lb ai/A label rate since that is the rate reported by USDA as the average rate for wheat and barley.

- Occupational handler exposure is assumed to occur for 8 hours per day.

- For the non-cancer and cancer metam sodium handler exposure assessments, the daily areas treated were defined for each handler scenario (in appropriate units) by determining the amount that can be reasonably treated in a single day (e.g. acres, square feet, cubic feet, or gallons per day). When possible, the assumptions for daily areas treated is taken from the Health Effects Division Science Advisory Committee on Exposure SOP #9: Standard Values for Daily Acres Treated in Agriculture which was completed on July 5, 2000. However, no standard values are available for numerous scenarios. Assumptions for these scenarios are based on HED estimates and could be further refined from input from affected sectors.

**** NOTE **** *During the error-only process (Phase 1), EPA received comments from the registrants that the assumptions used in the preliminary assessment to calculate handler risk overestimated the area treated per day and application rates for most application [scenarios]. Representatives from OPP, registrants, growers, and the USDA held a series of conference calls and prepared a survey to collect usage information (survey form included in* ***Appendix D****). The survey was sent to US growers, commercial applicators, and crop advisors by USDA on July 14, 2004. A number of survey responses have been received by EPA during the recent comment period (Phase 3), but more are expected. HED will update this assessment as appropriate when EPA has received all the surveys and completed an analysis of the information provided.*

It should also be noted that the postapplication MITC exposure estimates based on air dispersion modeling in this assessment (S**ection 3.0**) were performed for the application of metam sodium to 1, 5, 10, 20 and 40 acre fields. Even using these relatively small field sizes, acute and short-term risks exceeded the level of concern for most of the application methods assessed.

Table 2: Handler Assumptions for "Area Treated Per Day"			
Application Method	Crop/Use Site	Area Treated per day	Source
Sprinkler irrigation	Ag Uses	350 acres	ExpoSac SOP #9 .
Drip	Ag Uses	100 acres	Estimate from CDPR 7/17/03.
Tractor - Shank Injection or Rotary Tiller	Ag Uses	80 to 128 acres	In MITC studies 80A treated in 5 hrs. (128 acres = 80 acres /5hrs x 8 hrs)
	Sod Farms	80 to 128 acres	In MITC studies 80A treated in 5 hrs. (128 acres = 80acress /5hrs x 8 hrs)
	Tobacco Beds	20 to 40 acres	MSTF Usage Report in US - average of 18 acres per day for soil injection (Also see note below *)
	Golf Courses	20 to 40 acres	Value for groundboom application to golf courses is 40 acres per day in ExpoSac SOP #9. In telone field volatility study (MRID 451207), 9 holes irregular shaped fairways (20.4 acres) were treated in 11 hours using tractor-drawn shank injection (5.12 gallons per acre) .
	Seed Beds, Plant Beds, Lawns, other small areas	0.5 to 5 acres	No data, HED estimate. Average lawn size in SOP #12 is 0.5 acre
Hose proportioner	Seed Beds, Plant Beds, Lawns	0.5 to 5 acres	No data, HED estimate. Average lawn size in SOP #12 is 0.5 acre. Value for handgun application on lawns and golf courses is 5 acres per day in ExpoSac SOP #9.
	Golf Courses	5 acres	Value for handgun application on lawns and golf courses is 5 acres per day in ExpoSac SOP #9 .
Open pour	Tree Re-planting	1,000 ft2	No data, HED estimate.
Sprinkler Can	Seed Beds, Plant Beds, Lawns, Potting Soil	1,000 ft2	No data, HED estimate.
Cement Mixer and Shredder	Potting Soil	54 ft3	Isofenphos RED.
Foam Spray	Sewers Roots	675 to 1,350 gallons	Dichlobenil ORE Assessments (D270052, D269093)
Power sprayer (Handgun sprayer)	Drained Water Bodies and Shorelines	5 acres	Value for handgun application on lawns and golf courses is 5 acres per day in ExpoSac SOP #9.

* In 1995, the NC Cooperative Extension Service stated that typical tobacco bed sizes of

100 square yards are used for each acre of tobacco (from http://www.epa.gov/spdpublc/mbr/casestudies/volume1/tobacco.html). All major tobacco producing states are abandoning the traditional, labor-intensive outdoor seedbed production in favor of greenhouse systems (Miner 1995, Nesmith 1995). North Carolina, with roughly 284,000 acres in production, is the nation's number one tobacco-producing state; in 1994, 54 percent of the state's seedlings were produced in greenhouses, with the majority of greenhouses using the float production method (Peedin 1994). This production method also prevails in Kentucky, the second largest tobacco-producing state. Approximately 70 percent of Kentucky's tobacco seedlings are produced in a greenhouse floatation system using hydroponics and soil-less mixtures (Nesmith 1995).

2.1.1.2 Exposure Data for Handler Exposure Scenarios

Data pertaining to Metam Sodium Handler Exposure

No handler studies were provided that directly measure exposure to metam sodium. For metam sodium handler exposure assessments, all analyses were completed using the best available surrogate exposure data for the scenario in question. Any new data will be used to revise the handler assessment.

HED uses a concept known as *unit exposure* as the basis for the scenarios used to assess handler exposures to pesticides. *Unit exposures* numerically represent the exposures one would receive related to an application. They are generally presented as (mg active ingredient exposure/pounds of active ingredient handled). HED has developed a series of unit exposures that are unique for each scenario typically considered in our assessments (i.e., there are different unit exposures for different types of application equipment; job functions; and levels of protection). The *unit exposure* concept has been established in the scientific literature and also through various exposure monitoring guidelines published by the U.S. EPA and international organizations such as Health Canada and OECD (Organization For Economic Cooperation and Development). The concept of unit exposures can be illustrated by the following example. If an individual makes an application using a low-pressure sprayer with either 10 pounds of chemical A or 10 pounds of chemical B using the same clothing and personal protective equipment, the exposures to chemicals A and B would be similar.

Pesticide Handler Exposure Database (PHED) Version 1.1 (August 1998): PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide regulation, and member companies of the American Crop Protection Association. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates)

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading, applying), formulation type (e.g., wettable powders, granulars), application method (e.g., aerial, groundboom), and clothing scenarios (e.g., gloves, double layer clothing).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Appendix A, Table A1. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many occupational scenarios that can be utilized to ensure consistency in exposure assessments. Unit exposures are used which represent different levels of personal protection as described above. Protection factors were used to calculate unit exposure values for varying levels of personal protection if data were not available.

ORETF Handler Studies (MRID 449722-01): A report was submitted by the ORETF (Outdoor Residential Exposure Task Force) that presented data in which the application of various products used on turf by homeowners and lawncare operators (LCOs) was monitored. All of the data submitted in this report were completed in a series of studies. The study that monitored LCO exposure scenarios using a low pressure, high volume turf handgun (ORETF Study OMA002) is summarized below as is the study that monitored homeowner exposures while using a hose-end sprayer (ORETF Study OMA004).

OMA002: A mixer/loader/applicator study was performed by the Outdoor Residential Exposure Task Force (ORETF) using Dacthal as a surrogate compound to determine "generic" exposures to individuals applying a pesticide to turf with a low-pressure "nozzle gun" or "handgun" sprayer. Dermal and inhalation exposures were estimated using whole-body passive dosimeters and breathing-zone air samples on OVS tubes. Inhalation exposure was calculated using an assumed respiratory rate of 17 liters per minute for light work (NAFTA,1999), the actual sampling time for each individual, and the pump flow rate. All results were normalized for pounds active ingredient handled. A total of 90 replicates were monitored using 17 different subjects. Four different formulations of dacthal [75% wettable powder (packaged in 4 and 24 pound bags), 75% wettable powder in water soluble bags (3 pound bag), 75% water dispersable granules (2 pound bag) and 55% liquid flowable (2.5 gallon container)] were applied by five different LCOs to actual residential lawns at each site in three different locations (Ohio, Maryland, and Georgia) for a total of fifteen replicates per formulation. An additional ten replicates at each site were monitored while they performed spray application only using the 75 percent wettable powder formulation. A target application rate of 2 pounds active ingredient was used for all replicates (actual rate achieved was about 2.2 pounds active ingredient per acre). Each replicate treated a varying number of actual client lawns to attain a representative target of 2.5 acres (1 hectare) of turf. The exposure periods averaged five hours twenty-one minutes, five hours thirty-nine minutes, and six hours twenty-four minutes, in Ohio, Maryland and Georgia, respectively. Average time spent spraying at all sites was about two hours. All mixing, loading, application, adjusting, calibrating, and spill clean up procedures were monitored, except for typical end-of-day clean-up activities, e.g. rinsing of spray tank, etc. Dermal exposure was measured using inner and outer whole body dosimeters, hand washes, face/neck washes, and personal air monitoring devices. All test subjects wore one-piece, 100 percent cotton inner dosimeters beneath 100 percent cotton long-sleeved shirt and long pants, rubber boots and nitrile gloves. Gloves are typically worn by most LCOs, and required by many pesticide labels for mixing and loading. Overall, residues were highest on the upper and lower leg portions of the dosimeters In general, concurrent lab spikes produced mean recoveries in the range of 78-120 percent, with the exception of OVS sorbent tube sections which produced mean recoveries as low as 65.8 percent. Adjustment for recoveries from field fortifications were performed on each dosimeter section or sample matrix for each study participant, using the mean recovery for the closest field spike level for each matrix and correcting the value to 100 percent. The unit exposure values are presented below. [Note the data were found to be lognormally distributed. As a result, all exposure values are geometric means.]

Table 3: Unit Exposure Values Obtained From ORETF LCO Handgun Studies (MRID 449722-01)

Type	(mg exp./lb ai handled)			
	Dermal			Inhalation
	Single Layer, No Gloves	Single Layer, Gloves	Double Layer, Gloves	
LCO Turfgun (EC Formulation)	0.69	0.48	0.25	0.0015

All unit exposure values are geometric means. Double layer value calculated using a 50% protection factor. Turfgun, no glove data were not back calculated using a 90 percent protection factor as it is deemed unreliable.

OMA004: A mixer/loader/applicator study was performed by the Outdoor Residential Exposure Task Force (ORETF) using diazinon (25% EC) as a surrogate compound to determine "generic" exposures to individuals applying a pesticide to turf with a garden hose-end sprayer. Surrogate chemicals were chosen by the Task Force for their representativeness based on physical chemical properties and other factors. The study was designed to simulate a typical application event for a homeowner applying pesticides to home lawns via a hose-end sprayer. Each replicate monitored the test subject treating 5,000 square feet of turf at a nominal application rate of 4 pounds active ingredient per acre and handling a total of 0.5 pounds active ingredient per replicate. The average time per replicate was 75 minutes. A total of 60 replicates were monitored using 30 test subjects (two replicates each). Thirty applicator replicates were monitored using a ready-to-use (RTU) product (Bug-B-Gon) packaged in a 32 fl. oz. screw-on container. These containers were attached to garden hose-ends. An additional 30 mixer/loader/applicator replicates were monitored using Diazinon Plus also packaged in 32 fl. oz. plastic bottles. This product required the test subjects to pour the product into dial-type sprayers (DTS) that were attached to garden hose-ends. Dermal and inhalation exposures were monitored using passive dosimetry (inner and outer whole body dosimeters, hand washes, face/neck wipes, and personal inhalation monitors with OVS tubes). The inner samples represent a single layer of clothing. Inhalation exposure was calculated using an assumed respiratory rate of 17 liters per minute for light work (NAFTA,1999), the actual sampling time for each individual, and the pump flow rate. No gloves were worn in any replicate. All results were normalized for the amount of active ingredient handled. The QA/QC data are within an acceptable range and the study results are corrected for field recoveries. The unit exposure values are presented below. [Note: All values are geometric means as the data were lognormally distributed.]

Table 4. Unit Exposure Values Obtained From ORETF Hose-End Sprayer Studies (MRID 449722-01)

Type	Dermal: Short Pants, Short Sleeved Shirt (mg exp./lb ai handled)	Inhalation (mg exp./lb ai handled)
Hose-end Sprayer	0.35	0.0071
All unit exposure values are geometric means.		

The metam sodium exposure for the occupational loading/applying of metam sodium using an hose-end proportioner was assessed using only the ORTEF data LCO turf gun data. This data were determined to be a better surrogate than the hose-end sprayer data because study participants in the turf gun study were trained LCOs wearing single or double layer clothes with gloves. The hose-end sprayer study was based clothing worn by homeowners (i.e. short-sleeve shirt, short pants, and no gloves).

Other Metam Sodium Handler Surrogate Data: California DPR used surrogate data for sodium tetrathiocarbonate to estimate metam sodium handler exposure. Sodium tetrathiocarbonate is a soil fumigant applied by shank injection and chemigation. The sodium tetrathiocarbonate study (Pilling, Richard L., *Worker Exposure to Sodium Tetrathiocarbonate and to Carbon disulfide During Normal Application of GY-81*, 12/7/93) focused solely on dermal exposures pertaining to chemigation applications.

In this study GY-81 (active ingredient: sodium tetrathiocarbonate), containing cesium as a marker, was applied via irrigation at three separate locations utilizing three chemigation methods. One application was applied to grapes via furrow irrigation, one to grapes via drip irrigation, and one to oranges via mini-sprinklers. Each application was applied at the maximum allowable label application rate. Three volunteers were utilized in the study for each application: a mixer/loader and two applicators. The study used biomonitoring to measure the uptake of sodium tetrathiocarbonate in the body. Urine samples were collected from each volunteer and analyzed for 2-thiothiazolidine-4-carboxylic acid (TTCA)/creatinine ratio to monitor for possible dermal absorption of GY-81. External dosimetry was also utilized to monitor for surface exposure to sodium tetrathiocarbonate as well as hand and glove washings. All of these were analyzed for levels of cesium.

The study concluded that exposure to sodium tetrathiocarbonate during commercial applications of GY-81 was close to the limits of the method utilized in this study. The average dermal exposure value for sodium tetrathiocarbonate across all three trials of the study was found to be 2.27 mg/person/day from an average application rate of 136 lb ai/acre (6/14/02 CADPR Report). In order to utilize this data we had to convert the results to a dermal exposure value for metam sodium. It was assumed dermal exposure is directly proportional to application rate and using this assumption EPA was able to acquire dermal exposure values for the metam sodium scenarios. It was also necessary to convert this dermal exposure value via acres treated. The average acres treated in the study across the three trials was found to be 10.53 acres and this value was utilized to convert the dermal exposure a second time. This final dermal exposure was then utilized in the risk calculations.

HED notes the following issues with the sodium tetrathiocarbonate studies:

- The studies did not measure exposures to tetrathiocarbonate directly. Instead, cesium ions were added to the formulation. Estimation of dermal exposure per day was based on a proportionality between the initial tetrathiocarbonate concentration and the measured level of cesium ions.

- Cesium ions were either not detected or were below the level of quantitation in the occupational tasks examined in the surrogate exposure study. Consequently, values which reflect the limits of detection or quantitation were substituted for actual exposure values.

- The sodium tetrathiocarbonate was applied by chemigation (furrow, drip, and low-volume sprinklers) at a much lower application rate (range between 103 and 207 lb ai/A) than the maximum application rate for metam sodium for most crops (320 lb ai/A)

- The loaders in the sodium tetrathiocarbonate studies transferred the liquid pesticide from a mobile nurse tank into nurse tanks connected to the irrigation system using a mechanical transfer system. Therefore, these data are only applicable to loading metam sodium with engineering controls.

- The applicators in the sodium tetrathiocarbonate studies connected the nurse tanks to the irrigation system using a mechanical transfer system and they did not enter the treated area at any time during the chemigation application. Therefore, these data are only applicable to loading metam sodium with engineering controls.

- Only dermal exposures to sodium tetrathiocarbonate were measured.

Data pertaining to MITC Handler Exposure

For **MITC**, all handler exposure analyses were completed using MITC-specific inhalation exposure data taken from four metam sodium handler studies. The following provides a brief summary of the studies. A more detailed analysis of the studies is included in HED study review memos (listed by DP Barcode).

1.

Study Title/Date:	Worker Mixer/Loader and Applicator Exposure from Field Applications of Metam-Sodium/ August 24, 1993
Study Location:	Yuma County, Arizona
HED Review:	D285487
MRID No.	429684-02
M/L Equipment:	Transfer from tank delivery truck to spray tanks
Application Equipment:	Shank Injection - Two tractors, a John Deere 4455 equipped with a closed-cab and air-conditioning and an open-cab John Deere 4430, were used to pull the shank injection rig. Solid Set Sprinkler - 30 sprinkler lines (3 per replicate) were used during the sprinkler trial. Each sprinkler line had 42 sprinkler heads and measured 1,260 feet.
Sealing Method(s):	No seal reported for shank, water applied for 1.5 hours after sprinkler application
Soil type:	Indio Silt Loam
Areas treated:	20 acres (shank) and 30 acres (sprinkler)
Application Rate:	320 lb ai/acre (shank and sprinkler sites)
Issues of concern:	* No discussion on the trapping efficiency of the charcoal tubes * Only 10 replicates per activity for each application method * No discussion on the trapping efficiency of the charcoal tubes * High field fortification recoveries (>110%) for five samples collected at sprinkler injection site * Field blank samples collected for were contaminated. * No description of storage conditions and sample handling * A single set of QA/QC samples was used to evaluate field recovery, storage stability, and transportation losses

2.

Study Title/Date:	Worker Loader and Applicator Exposure from Field Applications of Metam-Sodium/May 26, 1993.
Study Location:	Grant County, Washington
HED Review:	D285486
MRID No.	429584-01
Application Equipment:	Rotary Tiller and Center Pivot Sprinkler
Sealing Method(s):	soil sealed with roller for shank injection, no seal reported for sprinkler
Soil Type:	Quincy Loamy Fine Sand
Areas treated:	10 acres (shank) and 65 acres (sprinkler)
Application Rate:	320 lb ai/acre for shank and 290 lb ai/acre for sprinkler

Issues of concern:	* No discussion on the trapping efficiency of the charcoal tubes * High Field fortification recoveries were for four samples collected on the second application day * No description of storage conditions and sample handling * A single set of QA/QC samples was used to evaluate field recovery, storage stability, and transportation losses

3.

Study Title/Date:	Determination of Methyl Isothiocyanate Inhalation Exposure to Workers as They Apply Metam-Sodium Through Shank Injection and Sprinkler Irrigation/ December 14, 1999
Study Location:	Kern County, California
HED Review:	D273316
MRID No.	451239-02
Application Equipment:	Sprinkler and shank injection
Sealing Method(s):	10 inch soil cap for shank. ½ inch water cap immediately after each application (sprinkler irrigation and shank injection) and an additional ½ inch water cap was applied 24 hours after the sprinkler irrigation application.
Soil Type:	not specified
Areas treated:	Sprinkler - Four 20 acre plots treated over 4 days with sprinklers (heads were located every 9.1 m along all irrigation pipes throughout the application plots). Shank Injection -
Application Rate:	160 lb ai/acre for shank (320 lb ai/ treated acre) and 320 lb ai/acre for sprinkler sites
Issues of concern:	* Amount of ai handled per replicate was not reported * Details within the study report were vague concerning the clothing each worker wore, the actual procedures followed during the application process, and the clean-up procedures, etc * There were only three field fortification replicates per fortification level per site and only one field blank per site * The overall average laboratory fortified recovery was 108.5% + 18%. However, the high level fortification recoveries (100 μg) were between 117.9 and 136.1 percent.

4.

Study Title/Date:	Determination of Methyl Isothiocyanate Inhalation Exposure to Workers During Application of Metam-Sodium Through Shank Injection/ March 1, 2001
Study Location:	Kern county, California
HED Review:	D290873
MRID No.	457037-03
Application Equipment:	Shank injection
Sealing Method(s):	10 inch soil cap and ½ inch water cap was applied
Soil Type:	not specified
Areas treated:	40 acres (Three 13 acre plots). Plots were pre-irrigated.
Application Rate:	160 lb ai/acre for shank (320 lb ai/ treated acre)

Issues of concern: * Amount of ai handled per replicate was not reported
* Only three to five replicates were conducted per work function
* the levels of MITC detected in the actual field samples did not correspond to the field fortification levels.
* The highest MITC level detected in an actual field sample was 10X the highest field fortification level

Typically HED normalizes handler inhalation exposure data to a unit exposure (expressed as ug ai per lb ai handled). The unit exposure would then be combined with the application rate (lb ai/acre) and area treated per day (acres/day) to estimate an average daily exposure. Since all of the handler studies did not provide adequate information to estimate unit exposures, MOEs were calculated directly from the exposure values in the 4 studies. It was assumed that the MITC concentration measured for tasks would remain constant if the task was performed for the entire 8-hr work shift. In other words if an applicator exposure during a 4-hour period was 50 ug/m^3, it was assumed that his exposure would also be 50 ug/m^3 if the task was performed for 6 or 8 hours.

As previously mentioned, there are many QA/QC and other inconsistencies with available metam sodium handler studies. For handler MITC exposure, no task has the minimum 15 replicates as recommended by OPPTS 875 Series Guidelines

The Metam Sodium Alliance commented that MRID 429684-02 does not reflect current cultural practices used in the US for the following reasons:

i. A typical applicator practice was employed on the chemigation study, including the use of extremely small, 3.5 acre applications, which were applied on a slug application basis (applied in 2 hours rather than the more standard 6 hour application), and sequential 3.5 acre applications occurred throughout the nocturnal periods. (*HED comment - study report for MRID 429684-02 indicates that 30 acres were treated with sprinkler application at the Yuma County Site)*

ii. The worker positioned himself to be downwind of the off-gassing field even though only spot checks of the pump needed to be made on a brief periodic basis. It clearly would not be standard practice, or reasonable, for an individual to stay purposefully downwind of a field producing MITC.

iii. Nocturnal applications produced high emissions coupled with inversion conditions, which led to elevated worker exposures. At the least, these impacts should be clearly categorized with nocturnal applications, and evaluated separately from applications representative of daytime operations.

iv. In summary, the emissions for this chemigation study were particularly high because of the slug application, the application was done during an inversion condition that minimized dilution, and, for an unknown reason, the applicator did not stand upwind of the off-gassing field for approximately 50 minutes of each 60-minute period when he was not monitoring the status of the application at the pump. The combination of these three factors produced anomalously high exposures.

v. Similarly, including this study in assessing risks associated with shank injection of metam-sodium is inappropriate and in error. Exposures were generally higher than the studies over the past ten years because it was a nocturnal application during inversion conditions.

Based on the reasons stated by the Metam Sodium Alliance, the replicates from this study have been removed from the other pooled replicates for handler tasks that were assessed. In **Table 9** of **Section 2.1.5.2** (Non-cancer MITC Risk Summary), MOEs have been estimated for replicates from MRID 429684-02 but flagged with a caveat stating that the study may not reflect current cultural practices.

The registrants have suggested that the EPA's identification of an enclosed charcoal filtration systems for MRID 451239-02 and 457037-03 are incorrect. Information regarding the filtration system was taken directly form the study report submitted.

2.1.2 Handler Exposure Scenarios

It has been determined that exposure to pesticide handlers is likely during the occupational use of metam sodium in a variety of occupational environments. The anticipated use patterns and current labeling indicate several occupational exposure scenarios based on the types of equipment and techniques that can potentially be used to make metam sodium applications. The quantitative exposure/risk assessment developed for occupational handlers is based on the following scenarios.

[Note: The scenario numbers correspond to the tables of risk calculations included in the occupational risk calculation aspects of the appendices. Metam sodium dermal and inhalation exposure was estimated using PHED or ORETF data. MITC inhalation exposure was estimating using MITC-specific data taken from four metam sodium handler studies]

Loader:

(1a) Loading Liquids to support Shank Injection Applications
(1b) Loading Liquids to support Rotary Tiller Applications
(1c) Loading Liquids to support Sprinkler Irrigation Applications
(1d) Loading Liquids to support Drip Irrigation Applications
(1e) Loading Liquids to support Sprinkler Irrigation Applications (based data from Sodium Tetrathiocarbonate study)
(1f) Loading Liquids to support Drip Irrigation Applications (based data from Sodium Tetrathiocarbonate study)

Applicator:

(2) Applying Liquids with Shank Injection Equipment
(2a) Applying Liquids with Shank Injection Equipment (Personal Pump Samplers) - enclosed cab with charcoal filter
(2b) Applying Liquids with Shank Injection Equipment (Personal Pump Samplers) - enclosed cab with cellulose filter
(2c) Applying Liquids with Shank Injection Equipment (Personal Pump Samplers) - open cab equipment
(2d) Applying Liquids with Shank Injection Equipment (In-cab Samplers) - enclosed cab with charcoal filter
(3) Applying Liquids with Rotary Tiller Equipment
(3a) Applying Liquids with Rotary Tiller Equipment (Personal Pump Samplers) - enclosed cab with charcoal filter
(3b) Applying Liquids with Rotary Tiller Equipment (Personal Pump Samplers) - enclosed cab with cellulose filter

Loader/Applicator:

(4a) Loading/Applying Liquids with open cab equipment
(4b) Loading/Applying Liquids with enclosed cab equipment
(4c) Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment - enclosed cab with charcoal filter

(5a) Loading/Applying Liquids with open cab equipment
(5b) Loading/Applying Liquids with enclosed cab equipment

Chemigation Monitor:

(6) Monitoring Liquid Chemigation Applications

Soil-Seal Irrigator:

(7) Sealing Soil with Irrigation Water Following Shank Injection Applications Using Liquid Formulations

Mixer/Loader/Applicator:

(8) Loading/Applying Liquids with Sprinkling Can Equipment
(9) Loading/Applying Liquids with Hose Proportioner Equipment
(10) Loading/Applying Liquids with Power Sprayer Equipment
(11) Loading/Applying Liquids with Cement Mixer Equipment
(12) Loading/Applying Liquids with Shredder Equipment
(13) Loading/Applying Liquids with Foaming Equipment
(14) Loading/Applying Liquids to Tree Replant Sites

2.1.3 Non-Cancer Metam Sodium Handler Exposure and Risk Assessment

The occupational handler exposure and cancer and non-cancer risk calculations are presented in this section.

2.1.3.1 Non-cancer Metam Sodium Exposure and Risk Calculations

Non-cancer risks were calculated using the Margin of Exposure (MOE) which is a ratio of the daily dose to the toxicological endpoint of concern. Daily dose values are calculated by first calculating exposures by considering application parameters (i.e., rate and area treated) along with unit exposure values. Exposures were then normalized by body weight and adjusted for absorption factors as appropriate to calculate dose levels. Then MOEs were calculated.

Daily Exposure: The daily exposure and daily dose to handlers were calculated as described below. The first step was to calculate daily exposure (dermal or inhalation) using the following formula:

$$Daily\ Exposure\left(\frac{mg\ ai}{day}\right) = Unit\ Exposure\left(\frac{mg\ ai}{lb\ ai\ handled}\right)\ x\ Application\ Rate\left(\frac{lbs\ ai}{area}\right)\ x\ Daily\ Area\ Treated\left(\frac{area}{day}\right)$$

Where:

Daily Exposure	=	Amount (mg ai/day) deposited on the surface of the skin that is available for dermal absorption or amount inhaled that is available for inhalation absorption;
Unit Exposure	=	Unit exposure value (mg ai/lb ai) derived from August 1998 PHED Surrogate Exposure Table, from ORETF data, or other suitable data
Application Rate	=	Normalized application rate based on a logical unit treatment, such as acres, square feet, gallons, or cubic feet. Maximum values are generally used (lb ai/A, lb ai/sq ft, lb ai/gal, lb ai/cu ft); and
Daily Area Treated	=	Normalized application area based on a logical unit treatment such as acres (A/day), square feet (sq ft/day), gallons per day (gal/day), or cubic feet (cu ft/day).

Daily Dose: Daily dose (inhalation or dermal) was calculated using the following formula:

$$Average\ Daily\ Dose\ (mg/kg/day) = Daily\ Exposure\left(\frac{mg\ ai}{day}\right)\ x\left(\frac{AbsorptionFactor(\%/100)}{Body\ Weight\ (kg)}\right)$$

Where:

Average Daily Dose	=	Absorbed dose received from exposure to a pesticide in a given scenario (mg pesticide active ingredient/kg body weight/day);
Daily Exposure	=	Amount (mg ai/day) deposited on the surface of the skin that is available for dermal absorption or amount inhaled that is available for inhalation absorption;
Absorption Factor	=	A measure of the amount of chemical that crosses a biological boundary such as the skin or lungs (% of the total available absorbed); and
Body Weight	=	Body weight determined to represent the population of interest in a risk assessment (kg).

Margins of Exposure: Finally, the calculations of daily dermal dose and daily inhalation dose received by handlers were then compared to the appropriate endpoint (i.e., NOAEL) to assess the total risk to handlers for each exposure route within the scenarios. All MOE values were calculated separately for dermal and inhalation exposure levels using the formula below:

$$MOE = \frac{NOAEL\ (mg/kg/day)}{Average\ Daily\ Dose\ (mg/kg/day)}$$

Where:

MOE	=	Margin of exposure, value used by HED to represent risk or how close a chemical exposure is to being a concern (unitless);
ADD	=	(Average Daily Dose) or the amount as absorbed dose received from exposure to a pesticide in a given scenario (mg pesticide active ingredient/kg body weight/day); and
NOAEL	=	Dose level in a toxicity study, where no observed adverse effects occurred (NOAEL) in the study

It is important to present risk values for each route of exposure (i.e., dermal or inhalation) in each scenario because it makes determining appropriate risk mitigation measures easier. For example, if overall risks are driven by dermal exposures and not inhalation, it is inadvisable to require respirators even though they may marginally reduce overall risks. A total MOE was not calculated because common toxicity endpoints were not used to calculate dermal and inhalation risks for each exposure duration.

2.1.3.2 Metam Sodium Non-cancer Risk Summary (using PHED, ORETF, and sodium tetrathiocarbonate data)

All of the non-cancer risk calculations for occupational metam sodium handlers completed in this assessment are included in **Appendices A, B and C**. A summary of the short- and intermediate-term risks for each exposure scenario are presented below in **Tables 5** and **6**, respectively.

<u>Occupational Metam Sodium Risk Summary:</u>

Short-term Dermal Risks

For the agricultural crop scenarios using PHED data, the short-term dermal MOEs for handlers **are less than 100** for the following scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre) and at 40 acres treated per day (387 lb ai/acre)
- ornamentals, food, and fiber crops, and turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system)

- tobacco plant beds at 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 350 acres treated per day (63.3 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (320 lb ai/acre and 239 lb ai/acre)

Scenario 1e: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 128 acres treated per day (31.7 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA closed cab data)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)
- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using

PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

For the mixer/loader/applicator scenarios in commercial and small scale agricultural settings, the short-term dermal MOEs are **less than 100** for the following scenarios:

Scenario 9: Mixing/Loading/Applying Liquids via hose proportioner (using ORETF LCO hand-gun data-occupational)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 5 acres treated per day (350 lb ai/acre)

Scenario 10: Mixing/Loading/Applying Liquids via power sprayer (using ORETF LCO handgun data-occupational)

- drained water bodies and shorelines at 5 acres treated per day (350 lb ai/acre)

Short-term Inhalation Risks

For the agricultural crop scenarios using PHED data, the short-term inhalation MOEs for handlers **are less than 100** for the following scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre) and at 40 acres treated per day (387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day ()
- peanuts-CBR susceptible cultivators at 128 acres treated per day (63.3 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre) and at 40 acres treated per day (387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 350 acres treated per day (63.3 lb ai/acre)
- peanuts-CBR resistant cultivators at 350 acres treated per day (32 lb ai/acre)
- wheat, barley at 350 acres treated per day (31.7 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops, turf (sod farms) at 100 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- tobacco plant beds at 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 128 acres treated per day (63.3 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA closed cab data)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)

- tobacco plant beds at 20 and 40 acres treated per day (412 lb ai/acre and 387 lb ai/acre)
- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)

- ornamentals, food, and fiber crops, turf (sod farms) at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- turf (golf courses) at 20 and 40 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

For the mixer/loader/applicator scenarios in commercial and small scale agricultural settings, the short-term inhalation MOEs are **greater than 100** at some level of personal protection.

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary										
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Loader										
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) (1a)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	5 acres	1.3	**170**	230	450	21	**210**	310
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	0.5 acres	13	**1,700**	2,300	4,500	**210**	2,100	3100
	tobacco plant beds	412 lb ai/acre	40 acres	0.2	27	36	71	3	34	49
	tobacco plant beds	412 lb ai/acre	20 acres	0.4	53	72	**140**	7	67	97
	tobacco plant beds	387 lb ai/acre	40 acres	0.2	28	38	76	4	36	52
	tobacco plant beds	387 lb ai/acre	20 acres	0.5	57	77	**150**	7	72	**100**
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	0.1	10	14	27	1	13	19
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	0.1	16	22	44	2	21	30
	turf (golf course)	338 lb ai/acre	40 acres	0.3	33	44	87	4	41	59
	turf (golf course)	338 lb ai/acre	20 acres	0.5	65	88	**170**	8	82	**120**
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	128 acres	0.1	11	15	29	1	14	20
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	80 acres	0.1	17	23	46	2	22	31
	turf (golf course)	320 lb ai/acre	40 acres	0.3	34	47	92	4	43	63
	turf (golf course)	320 lb ai/acre	20 acres	0.6	69	93	**180**	9	87	**130**
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	0.4	54	74	**150**	7	68	99
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	0.7	87	**120**	230	11	**110**	160
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	0.7	91	**120**	240	11	**110**	160
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	1.1	**140**	200	390	18	**180**	260
	peanuts (CBR resistant cultivators)	32 lb ai/acre	128 acres	0.9	**110**	150	290	14	**140**	200
	peanuts (CBR resistant cultivators)	32 lb ai/acre	80 acres	1.4	**170**	230	460	22	**220**	310
	wheat, barley	31.7 lb ai/acre	128 acres	0.9	**110**	150	290	14	**140**	200
	wheat, barley	31.7 lb ai/acre	80 acres	1.4	**170**	230	460	22	**220**	320
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) (1b)	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	0.1	10	14	27	1	13	19
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	0.1	16	22	44	2	21	30
	turf (golf course)	338 lb ai/acre	40 acres	0.3	33	44	87	4	41	59
	turf (golf course)	338 lb ai/acre	20 acres	0.5	65	88	**170**	8	82	**120**
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	128 acres	0.1	11	15	29	1	14	20
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	80 acres	0.1	17	23	46	2	22	31
	turf (golf course)	320 lb ai/acre	40 acres	0.3	34	47	92	4	43	63
	turf (golf course)	320 lb ai/acre	20 acres	0.6	69	93	**180**	9	87	**130**

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary

Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) (1c)	tobacco plant beds	412 lb ai/acre	40 acres	0.2	27	36	71	3	34	49
	tobacco plant beds	412 lb ai/acre	20 acres	0.4	53	72	**140**	7	67	97
	tobacco plant beds	387 lb ai/acre	40 acres	0.2	28	38	76	4	36	52
	tobacco plant beds	387 lb ai/acre	20 acres	0.5	57	77	**150**	7	72	**100**
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	350 acres	<1	4	5	10	<1	5	7
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	350 acres	<1	4	5	11	1	5	7
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	350 acres	0.2	20	27	53	3	25	36
	wheat, barley	31.7 lb ai/acre	350 acres	0.3	40	54	**110**	5	50	72
	peanuts (CBR resistant cultivators)	32 lb ai/acre	350 acres	0.3	39	53	**110**	5	50	72
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Drip Irrigation Nurse Tank (mechanical transfer system) (1d)	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	100 acres	0.1	14	19	37	2	17	25
	ornamentals, food and fiber crops, turf (sod farm)	239 lb ai/acre	100 acres	0.2	18	25	49	2	23	34
	cotton, soybeans, sugar beets	38 lb ai/acre	100 acres	0.9	**120**	160	310	15	**150**	210
Loading Liquids to support Sprinkler Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1e)	tobacco plant beds	412 lb ai/acre	40 acres	ND	ND	ND	**390**	ND	ND	ND
	tobacco plant beds	412 lb ai/acre	20 acres	ND	ND	ND	**780**	ND	ND	ND
	tobacco plant beds	387 lb ai/acre	40 acres	ND	ND	ND	**410**	ND	ND	ND
	tobacco plant beds	387 lb ai/acre	20 acres	ND	ND	ND	**830**	ND	ND	ND
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	350 acres	ND	ND	ND	54	ND	ND	ND
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	350 acres	ND	ND	ND	57	ND	ND	ND
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	350 acres	ND	ND	ND	**290**	ND	ND	ND
	wheat, barley	31.7 lb ai/acre	350 acres	ND	ND	ND	**570**	ND	ND	ND
	peanuts (CBR resistant cultivators)	32 lb ai/acre	350 acres	ND	ND	ND	**580**	ND	ND	ND
Loading Liquids to support Drip Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1f)	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	100 acres	ND	ND	ND	**200**	ND	ND	ND
	ornamentals, food and fiber crops, turf (sod farm)	239 lb ai/acre	100 acres	ND	ND	ND	**270**	ND	ND	ND
	cotton, soybeans, sugar beets	38 lb ai/acre	100 acres	ND	ND	ND	**1700**	ND	ND	ND

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary										
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Applicator										
Applying Liquids via Shank Injection Equipment (using PHED groundboom data) (2)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	5 acres	**280**	280	350	770	34	**340**	590
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	0.5 acres	**2800**	2,800	3,500	7,700	340	**3,400**	5,900
	tobacco plant beds	412 lb ai/acre	40 acres	44	44	56	**120**	6	55	94
	tobacco plant beds	412 lb ai/acre	20 acres	88	88	**110**	250	11	**110**	190
	tobacco plant beds	387 lb ai/acre	40 acres	47	47	59	**130**	6	58	**100**
	tobacco plant beds	387 lb ai/acre	20 acres	93	93	**120**	260	12	**120**	200
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	17	17	21	47	2	21	36
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	27	27	34	75	3	33	57
	turf (golf course)	338 lb ai/acre	40 acres	54	54	68	**150**	7	67	**110**
	turf (golf course)	338 lb ai/acre	20 acres	**110**	110	140	300	13	**130**	230
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	128 acres	18	18	22	49	2	22	38
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	80 acres	28	28	36	79	4	35	61
	turf (golf course)	320 lb ai/acre	40 acres	57	57	72	**160**	7	70	**120**
	turf (golf course)	320 lb ai/acre	20 acres	**110**	110	140	320	14	**140**	240
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	89	89	**110**	250	11	**110**	190
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	**140**	140	180	400	18	**180**	310
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	**150**	150	190	420	19	**190**	320
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	**240**	240	300	670	30	**300**	510
	peanuts (CBR resistant cultivators)	32 lb ai/acre	128 acres	**180**	180	220	490	22	**220**	380
	peanuts (CBR resistant cultivators)	32 lb ai/acre	80 acres	**280**	280	360	790	35	**350**	610
	wheat, barley	31.7 lb ai/acre	128 acres	**180**	180	230	500	22	**220**	380
	wheat, barley	31.7 lb ai/acre	80 acres	**290**	290	360	800	35	**350**	610
Applying Water Soluble Liquids via Rotary Tiller Equipment (using PHED groundboom data) (3)	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	17	17	21	47	2	21	36
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	27	27	34	75	3	33	57
	turf (golf course)	338 lb ai/acre	40 acres	54	54	68	**150**	7	67	**110**
	turf (golf course)	338 lb ai/acre	20 acres	**110**	110	140	300	13	**130**	230
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	128 acres	18	18	22	49	2	22	38
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	80 acres	28	28	36	79	4	35	61
	turf (golf course)	320 lb ai/acre	40 acres	57	57	72	**160**	7	70	**120**
	turf (golf course)	320 lb ai/acre	20 acres	**110**	110	140	320	14	**140**	240

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary										
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Loader/Applicator										
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data) (4a) [d]	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	5 acres	4.4	68	**110**	NA	20	**200**	NA
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	0.5 acres	44	**680**	1,100	NA	**200**	2,000	NA
	tobacco plant beds	412 lb ai/acre	40 acres	0.7	11	17	NA	3	31	NA
	tobacco plant beds	412 lb ai/acre	20 acres	1.4	22	34	NA	6	62	NA
	tobacco plant beds	387 lb ai/acre	40 acres	0.7	11	18	NA	3	33	NA
	tobacco plant beds	387 lb ai/acre	20 acres	1.5	23	36	NA	7	66	NA
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	0.3	4	7	NA	1	12	NA
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	0.4	7	10	NA	2	19	NA
	turf (golf course)	338 lb ai/acre	40 acres	0.9	13	21	NA	4	38	NA
	turf (golf course)	338 lb ai/acre	20 acres	1.7	26	42	NA	8	76	NA
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	128 acres	0.3	4	7	NA	1	13	NA
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	80 acres	0.5	7	11	NA	2	20	NA
	turf (golf course)	320 lb ai/acre	40 acres	0.9	14	22	NA	4	40	NA
	turf (golf course)	320 lb ai/acre	20 acres	1.8	28	44	NA	8	80	NA
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	1.4	22	35	NA	6	63	NA
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	2.3	35	56	NA	10	**100**	NA
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	2.4	37	58	NA	11	**110**	NA
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	3.8	58	93	NA	17	**170**	NA
	peanuts (CBR resistant cultivators)	32 lb ai/acre	128 acres	2.8	43	69	NA	13	**130**	NA
	peanuts (CBR resistant cultivators)	32 lb ai/acre	80 acres	4.5	69	**110**	NA	20	**200**	NA
	wheat, barley	31.7 lb ai/acre	128 acres	2.8	44	69	NA	13	**130**	NA
	wheat, barley	31.7 lb ai/acre	80 acres	4.5	70	**110**	NA	20	**200**	NA

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary										
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA with closed cab) (4b) [d]	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	5 acres	NA	NA	NA	44	NA	NA	73
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns	523 lb ai/acre	0.5 acres	NA	NA	NA	**440**	NA	NA	**730**
	tobacco plant beds	412 lb ai/acre	40 acres	NA	NA	NA	7	NA	NA	12
	tobacco plant beds	412 lb ai/acre	20 acres	NA	NA	NA	14	NA	NA	23
	tobacco plant beds	387 lb ai/acre	40 acres	NA	NA	NA	7	NA	NA	12
	tobacco plant beds	387 lb ai/acre	20 acres	NA	NA	NA	15	NA	NA	25
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	NA	NA	NA	3	NA	NA	4
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	NA	NA	NA	4	NA	NA	7
	turf (golf course)	338 lb ai/acre	40 acres	NA	NA	NA	8	NA	NA	14
	turf (golf course)	338 lb ai/acre	20 acres	NA	NA	NA	17	NA	NA	28
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	128 acres	NA	NA	NA	3	NA	NA	5
	ornamentals, food and fiber crops, orchard (replant/transplant), turf (sod farm)	320 lb ai/acre	80 acres	NA	NA	NA	4	NA	NA	7
	turf (golf course)	320 lb ai/acre	40 acres	NA	NA	NA	9	NA	NA	15
	turf (golf course)	320 lb ai/acre	20 acres	NA	NA	NA	18	NA	NA	30
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	NA	NA	NA	14	NA	NA	23
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	NA	NA	NA	22	NA	NA	38
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	NA	NA	NA	23	NA	NA	39
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	NA	NA	NA	37	NA	NA	63
	peanuts (CBR resistant cultivators)	32 lb ai/acre	128 acres	NA	NA	NA	28	NA	NA	46
	peanuts (CBR resistant cultivators)	32 lb ai/acre	80 acres	NA	NA	NA	44	NA	NA	74
	wheat, barley	31.7 lb ai/acre	128 acres	NA	NA	NA	28	NA	NA	47
	wheat, barley	31.7 lb ai/acre	80 acres	NA	NA	NA	45	NA	NA	75
Transferring Water Soluble Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with open cab) (5a) [d]	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	0.3	4	7	NA	1	12	NA
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	0.4	7	10	NA	2	19	NA
	turf (golf course)	338 lb ai/acre	40 acres	0.9	13	21	NA	4	38	NA
	turf (golf course)	338 lb ai/acre	20 acres	1.7	26	42	NA	8	76	NA
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	128 acres	0.3	4	7	NA	1	13	NA
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	80 acres	0.5	7	11	NA	2	20	NA
	turf (golf course)	320 lb ai/acre	40 acres	0.9	14	22	NA	4	40	NA
	turf (golf course)	320 lb ai/acre	20 acres	1.8	28	44	NA	8	80	NA

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary										
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with closed cab) (5b) [d]	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	128 acres	NA	NA	NA	3	NA	NA	4
	ornamentals, food and fiber crops, turf (sod farm)	338 lb ai/acre	80 acres	NA	NA	NA	4	NA	NA	7
	turf (golf course)	338 lb ai/acre	40 acres	NA	NA	NA	8	NA	NA	14
	turf (golf course)	338 lb ai/acre	20 acres	NA	NA	NA	17	NA	NA	28
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	128 acres	NA	NA	NA	3	NA	NA	5
	ornamentals, food and fiber crops, turf (sod farm)	320 lb ai/acre	80 acres	NA	NA	NA	4	NA	NA	7
	turf (golf course)	320 lb ai/acre	40 acres	NA	NA	NA	9	NA	NA	15
	turf (golf course)	320 lb ai/acre	20 acres	NA	NA	NA	18	NA	NA	30
Chemigation Monitor										
Monitoring Chemigation Applications Using Liquid Formulation (6)	No Metam Sodium data is available for this scenario.									
Soil Seal Irrigator										
Sealing Soil with Irrigation Water Following Shank Injection Applications Using Liquid Formulations (7)	No Metam Sodium data is available for this scenario.									
Mixer/Loader/Applicator										
Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data - occupational) (8)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	12 lb ai/1000 sq ft	1000 sq ft	**150**	ND	ND	NF	**350**	ND	NF
	potting soil	4 lb ai/1000 sq ft	1000 sq ft	**450**	ND	ND	NF	**1,000**	ND	NF
Mixing/Loading/Applying Water Soluble Liquids via hose-proportioner (using ORETF LCO hand-gun data - occupational) (9)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	350 lb ai/acre	5 acres	8.4	12	23	NF	25	**250**	NF
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	350 lb ai/acre	0.5 acres	84	**120**	230	NF	**250**	2,500	NF
Mixing/Loading/Applying Water Soluble Liquids via power sprayer (using ORETF LCO hand-gun data - occupational) (10)	drained water bodies and shorelines	350 lb ai/acre	5 acres	8.4	12	23	NF	25	**250**	NF
Mixing/Loading/Applying Liquids via cement mixer (using PHED Mixer/Loader data for Open-pour Liquids) (11)	potting soil	0.012 lb ai/cu ft	54 cu ft	**5400**	680,000	920,000	NF	**86,000**	860,000	NF
Mixing/Loading/Applying Liquids via shredder (using PHED Mixer/Loader data for Open-pour Liquids) (12)	potting soil	0.012 lb ai/cu ft	54 cu ft	**5400**	680,000	920,000	NF	**86,000**	860,000	NF

Table 5. Non-cancer Short-term Metam Sodium Occupational Handler Risk Summary											
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs				Inhalation MOEs		
				Baseline	PPE-G	PPE-G,DL	Eng Cont	Baseline	OV Respirator 90% PF	Eng Cont
Mixing/Loading/Applying Liquid with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids) (13)	sewer roots	0.212 lb ai/gal	1350 gallons	12	**1,500**	2,100	NF	**190**	1,900	NF
	sewer roots	0.212 lb ai/gal	675 gallons	24	**3,100**	4,200	NF	**390**	3900	NF
Mixing/Loading/Applying Liquids via Open Pour (using PHED Mixer/Loader data for Open-pour Liquids) (14)	tree replanting	16 lb ai/1000 sq ft	1000 sq ft	**220**	28000	37000	NF	**3500**	35000	NF

Footnotes

* MOEs that do not exceed HED's level of concern are shown in bold.
NA Not Applicable
ND No Data
NF Not Feasible
a Target for all crops is the soil except for turf, which may be applied to the foliar surface when the goal is to destroy the existing turf.
b Application rates are the maximum application rates determined from EPA registered labels for metam sodium.
c Amount handled per day values are HED estimates of acres, square feet, or cubic feet treated or gallons applied based on Exposure SAC SOP #9 "Standard Values for Daily Acres Treated in Agriculture," industry sources, and HED estimates.
d May over estimate exposure, PHED data is based on open pour mixing/loading.

Dermal Baseline: Long-sleeve shirt, long pants, and no gloves
PPE-G: Baseline plus chemical-resistant gloves.
PPE-G,DL: Coveralls worn over long-sleeve shirt and long pants, chemical-resistant gloves
Eng Controls: Closed mixing/loading system or enclosed cab
Inhalation Baseline: No respirator
OV Respirator: NIOSH/MSHA-approved cartridge or cannister respirator with an organic-vapor removing filter and dust/mist prefilter.

Intermediate-term Dermal Risks

For the agricultural crop scenarios, intermediate dermal MOEs for handlers are **less than 100** for the following scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- small areas of ornamentals, food, fiber crops at 5 acres treated per day (523 lb ai/acre)
- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 350 acres treated per day (63.3 lb ai/acre)
- peanuts-CBR resistant cultivators at 350 acres treated per day (32 lb ai/acre)
- wheat, barley at 350 acres treated per day (31.7 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (38 lb ai/acre)

Scenario 1e: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 350 acres treated per day (63.3 lb ai/acre)

- peanuts-CBR resistant cultivators at 350 acres treated per day (32 lb ai/acre)
- wheat, barley at 350 acres treated per day (31.7 lb ai/acre)

Scenario 1f: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 100 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (38 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- small areas of ornamentals, food, fiber crops at 5 acres treated per day (523 lb ai/acre)
- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- small areas of ornamentals, food, fiber crops at 0.5 and 5 acres treated per day (523 lb ai/acre)
- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchards (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection

Equipment (using PHED groundboom MLA closed cab data)

- small areas of ornamentals, food, fiber crops at 0.5 and 5 acres treated per day (523 lb ai/acre)
- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)
- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 80 and 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 80 and 128 acres treated per day (31.7 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

For the mixer/loader/applicator scenarios in commercial and small scale agricultural settings, the intermediate-term dermal MOEs are **less than 100** for the following scenarios:

Scenario 8: Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data-occupational)

- small areas of ornamentals, food, fiber crops at 1000 ft^2 treated per day (12 lb ai/1000 ft^2)

Scenario 9: Mixing/Loading/Applying Liquids via Hose Proportioner (using ORETF handgun data-occupational)

- small areas of ornamentals, food, fiber crops at 0.5 and 5 acres treated per day (350 lb ai/acre)

Scenario 13: Mixing/Loading/Applying Liquids with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids)

- sewer roots at 675 and 1,350 gallons handled per day (0.212 lb ai/gal)

Intermediate-term Inhalation Risks

For the agricultural crop scenarios using PHED data, the intermediate-term inhalation MOEs for handlers **are less than 100** for the following scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchard (replant/transplant) at 80 and 128 acres treated per day (320 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 350 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- orchard (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 350 acres treated per day (63.3 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA closed cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)
- peanuts-CBR susceptible cultivators at 80 and 128 acres treated per day (63.3 lb ai/acre)

- cotton, soybeans, sugar beets at 80 and 128 acres treated per day (38 lb ai/acre)
- peanuts-CBR resistant cultivators at 128 acres treated per day (32 lb ai/acre)
- wheat, barley at 128 acres treated per day (31.7 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)

- ornamentals, food, and fiber crops at 80 and 128 acres treated per day (338 lb ai/acre and 320 lb ai/acre)

For the mixer/loader/applicator scenarios in commercial and small scale agricultural settings, all intermediate-term inhalation MOEs **are greater than 100** at some level of personal protection.

Table 6: Non-cancer Intermediate-term Metam Sodium Occupational Handler Risk Summary

Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs			
				Baseline	PPE-G	PPE-G,DL	Eng Cont
Loader							
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) (1a)	small areas of ornamentals, food, fiber crops	523 lb ai/acre	5 acres	<1	4	5	11
	small areas of ornamentals, food, fiber crops	523 lb ai/acre	0.5 acres	0.3	40	54	**110**
	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	<1	<1	<1	1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	<1	<1	1	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	128 acres	<1	<1	<1	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	80 acres	<1	<1	1	1
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	<1	1	2	3
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	<1	2	3	6
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	<1	2	3	6
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	<1	3	5	9
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	128 acres	<1	3	3	7
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	80 acres	<1	4	6	11
	wheat, barley	31.7 lb ai/acre	128 acres	<1	3	4	7
	wheat, barley	31.7 lb ai/acre	80 acres	<1	4	6	11
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) (1b)	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	<1	<1	0	1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	<1	<1	1	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	128 acres	<1	<1	<1	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	80 acres	<1	<1	1	1
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) (1c)	ornamentals, food and fiber crops	338 lb ai/acre	350 acres	<1	<1	<1	<1
	ornamentals, food and fiber crops	320 lb ai/acre	350 acres	<1	<1	<1	<1
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	350 acres	<1	<1	1	1
	wheat, barley	31.7 lb ai/acre	350 acres	<1	1	1	3
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	350 acres	<1	1	1	3
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Drip Irrigation Nurse Tank (mechanical transfer system) (1d)	ornamentals, food and fiber crops	320 lb ai/acre	100 acres	<1	<1	<1	1
	ornamentals, food and fiber crops	239 lb ai/acre	100 acres	<1	<1	1	1
	cotton, soybeans, sugar beets	38 lb ai/acre	100 acres	<1	3	4	7

Table 6: Non-cancer Intermediate-term Metam Sodium Occupational Handler Risk Summary							
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs			
				Baseline	PPE-G	PPE-G,DL	Eng Cont
Loading Liquids to support Sprinkler Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1e)	ornamentals, food and fiber crops	338 lb ai/acre	350 acres	ND	ND	ND	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	350 acres	ND	ND	ND	1
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	350 acres	ND	ND	ND	7
	wheat, barley	31.7 lb ai/acre	350 acres	ND	ND	ND	14
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	350 acres	ND	ND	ND	14
Loading Liquids to support Drip Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1f)	ornamentals, food and fiber crops	320 lb ai/acre	100 acres	ND	ND	ND	5
	ornamentals, food and fiber crops	239 lb ai/acre	100 acres	ND	ND	ND	6
	cotton, soybeans, sugar beets	38 lb ai/acre	100 acres	ND	ND	ND	40
Applicator							
Applying Liquids via Shank Injection Equipment (using PHED groundboom data) (2)	small areas of ornamentals, food, fiber crops	523 lb ai/acre	5 acres	7	7	8	18
	small areas of ornamentals, food, fiber crops	523 lb ai/acre	0.5 acres	66	66	83	**180**
	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	0.4	<1	1	1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	0.6	1	1	2
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	128 acres	0.4	<1	1	1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	80 acres	0.7	1	1	2
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	2	2	3	6
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	3	3	4	10
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	4	4	5	10
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	6	6	7	16
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	128 acres	4	4	5	12
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	80 acres	7	7	9	19
	wheat, barley	31.7 lb ai/acre	128 acres	4	4	5	12
	wheat, barley	31.7 lb ai/acre	80 acres	7	7	9	19
Applying Water Soluble Liquids via Rotary Tiller Equipment (using PHED groundboom data) (3)	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	0.4	<1	1	1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	0.6	1	1	2
	ornamentals, food and fiber crops	320 lb ai/acre	128 acres	0.4	<1	1	1
	ornamentals, food and fiber crops	320 lb ai/acre	80 acres	0.7	1	1	2

Table 6: Non-cancer Intermediate-term Metam Sodium Occupational Handler Risk Summary							
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs			
				Baseline	PPE-G	PPE-G,DL	Eng Cont
Loader/Applicator							
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data) (4a) [d]	small areas of ornamentals, food, fiber crops	523 lb ai/acre	5 acres	<1	2	3	NA
	small areas of ornamentals, food, fiber crops	523 lb ai/acre	0.5 acres	1	16	25	NA
	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	128 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	80 acres	<1	<1	<1	NA
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	<1	1	1	NA
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	<1	1	1	NA
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	<1	1	1	NA
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	<1	1	2	NA
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	128 acres	<1	1	2	NA
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	80 acres	<1	2	3	NA
	wheat, barley	31.7 lb ai/acre	128 acres	<1	1	2	NA
	wheat, barley	31.7 lb ai/acre	80 acres	<1	2	3	NA

Table 6: Non-cancer Intermediate-term Metam Sodium Occupational Handler Risk Summary							
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs			
				Baseline	PPE-G	PPE-G,DL	Eng Cont
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA with closed cab) (4b) [d]	small areas of ornamentals, food, fiber crops	523 lb ai/acre	5 acres	NA	NA	NA	1
	small areas of ornamentals, food, fiber crops	523 lb ai/acre	0.5 acres	NA	NA	NA	10
	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	128 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops, orchard (replant/transplant)	320 lb ai/acre	80 acres	NA	NA	NA	<1
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	128 acres	NA	NA	NA	<1
	peanuts (CBR susceptible cultivators)	63.3 lb ai/acre	80 acres	NA	NA	NA	1
	cotton, soybeans, sugar beets	38 lb ai/acre	128 acres	NA	NA	NA	1
	cotton, soybeans, sugar beets	38 lb ai/acre	80 acres	NA	NA	NA	1
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	128 acres	NA	NA	NA	1
	peanuts (CBR susceptible cultivators)	32 lb ai/acre	80 acres	NA	NA	NA	1
	wheat, barley	31.7 lb ai/acre	128 acres	NA	NA	NA	1
	wheat, barley	31.7 lb ai/acre	80 acres	NA	NA	NA	1
Transferring Water Soluble Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with open cab) (5a) [d]	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops	320 lb ai/acre	128 acres	<1	<1	<1	NA
	ornamentals, food and fiber crops	320 lb ai/acre	80 acres	<1	<1	<1	NA
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with closed cab) (5b) [d]	ornamentals, food and fiber crops	338 lb ai/acre	128 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops	338 lb ai/acre	80 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops	320 lb ai/acre	128 acres	NA	NA	NA	<1
	ornamentals, food and fiber crops	320 lb ai/acre	80 acres	NA	NA	NA	<1
Chemigation Monitor							
Monitoring Chemigation Applications Using Liquid Formulation (6)	No Metam Sodium specific data is available for this scenario.						
Irrigator							
Irrigating Following Shank Injection Applications (7)	No Metam Sodium specific data is available for this scenario.						

Table 6: Non-cancer Intermediate-term Metam Sodium Occupational Handler Risk Summary							
Exposure Scenario	Crop or Target [a]	Application Rate [b]	Area Treated Daily [c]	Dermal MOEs			
				Baseline	PPE-G	PPE-G,DL	Eng Cont
Mixer/Loader/Applicator							
Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data - occupational) (8)	small areas of ornamentals, food, fiber crops	12 lb ai/1000 sq ft	1000 sq ft	4	ND	ND	NF
Mixing/Loading/Applying Water Soluble Liquids via hose-proportioner (using ORETF LCO hand-gun data - occupational) (9)	small areas of ornamentals, food, fiber crops	350 lb ai/acre	5 acres	0.2	<1	1	NF
	small areas of ornamentals, food, fiber crops	350 lb ai/acre	0.5 acres	2	3	6	NF
Mixing/Loading/Applying Water Soluble Liquids via power sprayer (using ORETF LCO hand-gun data - occupational) (10)	drained water bodies and shorelines	350 lb ai/acre	5 acres	No intermediate-term handler MOEs were calculated for this scenario.			
Mixing/Loading/Applying Liquids via cement mixer (using PHED Mixer/Loader data for Open-pour Liquids) (11)	potting soil	0.012 lb ai/cu ft	54 cu ft	No intermediate-term handler MOEs were calculated for this scenario.			
Mixing/Loading/Applying Liquids via shredder (using PHED Mixer/Loader data for Open-pour Liquids) (12)	potting soil	0.012 lb ai/cu ft	54 cu ft	No intermediate-term handler MOEs were calculated for this scenario.			
Mixing/Loading/Applying Liquid with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids) (13)	sewer roots	0.212 lb ai/gal	1350 gallons	0.3	36	49	NF
	sewer roots	0.212 lb ai/gal	675 gallons	0.6	73	99	NF
Mixing/Loading/Applying Liquids via Open Pour (using PHED Mixer/Loader data for Open-pour Liquids) (14)	tree replanting	16 lb ai/1000 sq ft	1000 sq ft	No intermediate-term handler MOEs were calculated for this scenario.			

Footnotes

* MOEs that do not exceed HED's level of concern are shown in bold.
NA Not Applicable
ND No Data
NF Not Feasible
a Target for all crops is the soil except for turf, which may be applied to the foliar surface when the goal is to destroy the existing turf.
b Application rates are the maximum application rates determined from EPA registered labels for metam sodium.
c Amount handled per day values are HED estimates of acres, square feet, or cubic feet treated or gallons applied based on Exposure SAC SOP #9 "Standard Values for Daily Acres Treated in Agriculture," industry sources, and HED estimates.
d May over estimate exposure, PHED data is based on open pour mixing/loading.

Dermal Baseline: Long-sleeve shirt, long pants, and no gloves
PPE-G: Baseline plus chemical-resistant gloves.
PPE-G,DL: Coveralls worn over long-sleeve shirt and long pants, chemical-resistant gloves
Eng Controls: Closed mixing/loading system or enclosed cab

For IT Inhalation MOEs, See ST tables. ST and IT have same NOAEL (1.11 mg/kg/day).

2.1.4 Cancer Metam Sodium Handler Exposure and Risk Assessment

This section presents the occupational handler exposure and cancer risk assessment from metam sodium.

2.1.4.1 Cancer Metam Sodium Handler Exposure and Risk Calculations

Cancer risks resulting from exposures to metam sodium were calculated using a linear low-dose extrapolation approach in which a *Lifetime Average Daily Dose* (LADD) is first calculated and then compared with a Q_1* that has been calculated for metam sodium based on dose response data ($Q_1* = 1.98 \times 10^{-1}$ $(mg/kg/day)^{-1}$). Absorbed average daily dose (ADD) levels were used as the basis for calculating the LADD values. Section 2.1.3.1 describes how the ADD values were first calculated for the non-cancer MOEs. These values also serve as the basis for the cancer risk estimates. Dermal and inhalation ADD values were first added together to obtain combined ADD values. LADD values were then calculated and compared to the Q_1* to obtain cancer risk estimates.

Lifetime Average Daily Dose: To calculate the carcinogenic risk from absorbed average daily dose, the values must be amortized over the working lifetime of occupational handlers. Current use patterns indicate that application occurs once per crop cycle (preplant/pre-transplant). HED considered two distinct handler populations in the cancer risk assessment:

- medium- to small-scale growers who would handle metam sodium approximately 5 days per year, and
- commercial (for-hire) applicators and large-scale private growers (e.g., cooperatives) who would handle metam sodium approximately 20 days per year.

Finally, a 35 year career and a 70 year lifespan were used to complete the calculations. LADD values were calculated using the following equation:

$$LADD = ADD \ x \ \frac{Exposure\ Frequency}{365\ Days\ per\ Year} \ x \ \frac{Exposure\ Duration}{Lifetime}$$

Where:

Lifetime Average Daily Dose	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg/kg/day, also referred to as LADD);
Average Daily Dose	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario on a daily basis (mg/kg/day, also referred to as ADD);
Exposure Frequency	=	The annual frequency of exposure to an individual (days/year);
Exposure Duration	=	The amount of a lifetime that an individual is exposed (35 years for Occupational); and
Lifetime	=	The average life expectancy of an individual (70

years).

Cancer Risks : Finally, cancer risk calculations were completed by comparing the LADD values to the Q_1* for metam sodium ($Q_1* = 1.98 \times 10^{-1}$ $(mg/kg/day)^{-1}$). Small- and medium-scale growers were estimated to handle metam sodium for 5 days per year and commercial handlers or large-scale growers were estimated to handler metam sodium for 20 days per year. Cancer risks were calculated using the following equation:

$$Cancer\ Risk = LADD \times Q1*$$

Where:

Cancer Risk	=	Probability of excess cancer cases over a lifetime (unitless);
Lifetime Average Daily Dose	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg//kg/day); and
Q_1*	=	Quantitative dose response factor used for linear, low-dose response cancer risk calculations $(mg/kg/day)^{-1}$.

2.1.4.2 Metam Sodium Cancer Risk Summary

Metam sodium cancer risks for **noncommercial** handlers and **commercial** handlers are summarized below in **Tables 7** and **8**, respectively. All the cancer risk calculations for occupational handlers exposed to metam sodium completed in this assessment are included in the appendices. For cancer risk estimates, it was assumed that noncommercial and commercial handlers are exposed for 5 and 20 days/year respectively. Assumptions exposure days per year will be updated based on results of USDA usage survey.

Cancer risks for ***noncommercial handlers*** are greater than $\mathbf{1.0 \times 10^{-4}}$ at maximum feasible mitigation for the following handler scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)
- orchards (replant/transplant) at 100 acres treated per day (320 lb ai/acre)
- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)
- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler Irrigation Nurse Tank (mechanical transfer system)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- turf (sod farms) at 350 acres treated per day (252 lb ai/acre)
- wheat, barley at 350 acres treated per day (162 lb ai/acre)
- ornamentals, food, and fiber crops at 350 acres treated per day (108 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)

Scenario 1f: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- tobacco plant beds at 100 acres treated per day (387 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- tobacco plant beds at 100 acres treated per day (387 lb ai/acre)
- orchards (replant/transplant) at 100 acres treated per day (320 lb ai/acre)
- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA closed cab data)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)
- tobacco plant beds at 100 acres treated per day (387 lb ai/acre)
- orchards (replant/transplant) at 100 acres treated per day (320 lb ai/acre)
- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)

- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)

- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 9: Mixing/Loading/Applying Liquids via Hose Proportioner (using ORETF handgun data-occupational)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 5 acres treated per day (350 lb ai/acre)

Scenario 10: Mixing/Loading/Applying Liquids via Power Sprayer (using ORETF handgun data-occupational)

- drained water bodies and shorelines at 5 acres treated per day (350 lb ai/acre)

Cancer risks for ***noncommercial handlers*** are between **1.0×10^{-4}** and **1.0×10^{-6}** at maximum feasible mitigation for the following handler scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)
- tobacco plant beds at 20 acres treated per day (387 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler Irrigation Nurse Tank (mechanical transfer system)

- tobacco plant beds at 20 acres treated per day (387 lb ai/acre)
- cotton, soybeans, and sugar beets at 350 acres treated per day (44.4 lb ai/acre)
- peanuts at 350 acres treated per day (27.5 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 1e: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- tobacco plant beds at 20 acres treated per day (387 lb ai/acre)
- orchards (replant/transplant) at 350 acres treated per day (320 lb ai/acre)
- turf (sod farms) at 350 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 350 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 350 acres treated per day (44.4 lb ai/acre)
- wheat, barley at 350 acres treated per day (162 lb ai/acre)
- peanuts at 350 acres treated per day (27.5 lb ai/acre)

Scenario 1f: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)
- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- turf (sod farms) at 100 acres treated per day (252 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, lawns at 5 acres treated per day (523 lb ai/acre)
- turf (golf courses) at 20 acres treated per day (252 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
  peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment

(mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 8: Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data-occupational)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 1000 square feet treated per day (12 lb ai/1000 ft^2)
- potting soil at 1000 square feet treated per day (4 lb ai/1000 ft^2)

Scenario 9: Mixing/Loading/Applying Liquids via Hose Proportioner (using ORETF hose-end data-occupational)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 0.5 acres treated per day (350 lb ai/acre)

Scenario 13: Mixing/Loading/Applying Liquids with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids)

- sewer roots at 675 and 1,350 gallons (0.212 lb ai/gallon)

Cancer risks for ***noncommercial handlers*** are less than **1.0×10^{-6}** at some level of mitigation for the following handler scenarios:

Scenario 11: Mixing/Loading/Applying Liquids via Cement Mixer (using PHED Mixer/Loader data for Open-pour Liquids)

- potting soil at 54 cubic feet treated per day (0.012 lb ai/1000 ft^3)

Scenario 12: Mixing/Loading/Applying Liquids via Shredder (using PHED Mixer/Loader data for Open-pour Liquids)

- potting soil at 54 cubic feet treated per day (0.012 lb ai/1000 ft^3)

Scenario 14: Mixing/Loading/Applying Liquids via Open Pour (using PHED Mixer/Loader data for Open-pour Liquids)

- tree replanting at 1000 square feet treated per day (16 lb ai/1000 ft^2)

Table 7. Summary of Noncommercial Handlers Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Noncommercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Mixer/Loader									
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) (1a)	small areas of seed beds, plant beds	523 lb ai/acre	5 acres	3.7e-03	9.0e-05	8.2e-05	3.5e-05	2.8e-05	1.5e-05
	tobacco plant beds	387 lb ai/acre	20 acres	1.1e-02	2.7e-04	2.4e-04	1.0e-04	8.2e-05	4.5e-05
	orchard replant/transplant sites	320 lb ai/acre	100 acres	4.6e-02	1.1e-03	1.0e-03	4.3e-04	3.4e-04	1.8e-04
	turf (sod farms)	252 lb ai/acre	100 acres	3.6e-02	8.7e-04	7.9e-04	3.4e-04	2.7e-04	1.5e-04
	turf (golf courses)	252 lb ai/acre	20 acres	7.2e-03	1.7e-04	1.6e-04	6.8e-05	5.3e-05	2.9e-05
	wheat, barley [d]	162 lb ai/acre	100 acres	2.3e-02	5.6e-04	8.2e-05	3.5e-05	2.8e-05	1.5e-05
	ornamentals and food crops	108 lb ai/acre	100 acres	1.5e-02	3.7e-04	3.4e-04	1.5e-04	1.1e-04	6.2e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	6.3e-03	1.5e-04	1.4e-04	6.0e-05	4.7e-05	2.6e-05
	peanuts	27.5 lb ai/acre	100 acres	3.9e-03	9.5e-05	8.7e-05	3.7e-05	2.9e-05	1.6e-05
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) (1b)	turf (sod farms)	252 lb ai/acre	100 acres	3.6e-02	8.7e-04	7.9e-04	3.4e-04	2.7e-04	1.5e-04
	turf (golf courses)	252 lb ai/acre	20 acres	7.2e-03	1.7e-04	1.6e-04	6.8e-05	5.3e-05	2.9e-05
	ornamentals and food crops	108 lb ai/acre	100 acres	1.5e-02	3.7e-04	3.4e-04	1.5e-04	1.1e-04	6.2e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	6.3e-03	1.5e-04	1.4e-04	6.0e-05	4.7e-05	2.6e-05
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) (1c)	tobacco plant beds	387 lb ai/acre	20 acres	1.1e-02	2.7e-04	2.4e-04	1.0e-04	8.2e-05	4.5e-05
	orchard replant/transplant sites	320 lb ai/acre	350 acres	1.6e-01	3.9e-03	3.5e-03	1.5e-03	1.2e-03	6.5e-04
	turf (sod farms)	252 lb ai/acre	350 acres	1.3e-01	3.0e-03	2.8e-03	1.2e-03	9.3e-04	5.1e-04
	wheat, barley [d]	162 lb ai/acre	350 acres	8.1e-02	1.9e-03	1.8e-03	7.6e-04	6.0e-04	3.3e-04
	ornamentals and food crops	108 lb ai/acre	350 acres	5.4e-02	1.3e-03	1.2e-03	5.1e-04	4.0e-04	2.2e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	350 acres	2.2e-02	5.3e-04	4.9e-04	2.1e-04	1.6e-04	9.0e-05
	peanuts	27.5 lb ai/acre	350 acres	1.4e-02	3.3e-04	3.0e-04	1.3e-04	1.0e-04	5.6e-05
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Drip Irrigation Nurse Tank (mechanical transfer system) (1d)	turf (sod farms)	252 lb ai/acre	100 acres	3.6e-02	8.7e-04	7.9e-04	3.4e-04	2.7e-04	1.5e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	1.5e-02	3.7e-04	3.4e-04	1.5e-04	1.1e-04	6.2e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	6.3e-03	1.5e-04	1.4e-04	6.0e-05	4.7e-05	2.6e-05
Loading Liquids to support Sprinkler Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1e)	tobacco plant beds	387 lb ai/acre	20 acres	ND	ND	ND	ND	ND	5.9e-06
	orchard replant/transplant sites	320 lb ai/acre	350 acres	ND	ND	ND	ND	ND	8.6e-05
	turf (sod farms)	252 lb ai/acre	350 acres	ND	ND	ND	ND	ND	6.8e-05
	wheat, barley [d]	162 lb ai/acre	350 acres	ND	ND	ND	ND	ND	1.0e-04
	ornamentals and food crops	108 lb ai/acre	350 acres	ND	ND	ND	ND	ND	2.9e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	350 acres	ND	ND	ND	ND	ND	1.7e-05
	peanuts	27.5 lb ai/acre	350 acres	ND	ND	ND	ND	ND	1.4e-05
Loading Liquids to support Drip Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11) (1f)	turf (sod farms)	252 lb ai/acre	100 acres	ND	ND	ND	ND	ND	1.9e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	ND	ND	ND	ND	ND	2.7e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	ND	ND	ND	ND	ND	1.2e-05

Table 7. Summary of Noncommercial Handlers Cancer Risks to Metam Sodium

Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Noncommercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Applicator									
Applying Liquids via Shank Injection Equipment (using PHED groundboom data) (2)	small areas of seed beds, plant beds	523 lb ai/acre	5 acres	5.5e-05	5.5e-05	5.1e-05	2.1e-05	1.8e-05	8.5e-06
	tobacco plant beds	387 lb ai/acre	20 acres	3.4e-04	3.4e-04	3.2e-04	1.3e-04	1.1e-04	5.3e-05
	orchard replant/transplant sites	320 lb ai/acre	100 acres	6.8e-04	6.8e-04	6.3e-04	2.6e-04	2.2e-04	1.0e-04
	turf (sod farms)	252 lb ai/acre	100 acres	5.3e-04	5.3e-04	5.0e-04	2.1e-04	1.7e-04	8.2e-05
	turf (golf courses)	252 lb ai/acre	20 acres	1.1e-04	1.1e-04	9.9e-05	4.1e-05	3.4e-05	1.6e-05
	wheat, barley [d]	162 lb ai/acre	100 acres	3.4e-04	3.4e-04	3.2e-04	1.4e-04	1.1e-04	5.3e-05
	ornamentals and food crops	108 lb ai/acre	100 acres	2.3e-04	2.3e-04	2.1e-04	8.9e-05	7.3e-05	3.5e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	9.4e-05	9.4e-05	8.7e-05	3.6e-05	3.0e-05	1.4e-05
	peanuts	27.5 lb ai/acre	100 acres	5.8e-05	5.8e-05	5.4e-05	2.3e-05	1.9e-05	9.0e-06
Applying Water Soluble Liquids via Rotary Tiller Equipment (using PHED groundboom data) (3)	turf (sod farms)	252 lb ai/acre	100 acres	5.3e-04	5.3e-04	5.0e-04	2.1e-04	1.7e-04	8.2e-05
	turf (golf courses)	252 lb ai/acre	20 acres	1.1e-04	1.1e-04	9.9e-05	4.1e-05	3.4e-05	1.6e-05
	ornamentals and food crops	108 lb ai/acre	100 acres	2.3e-04	2.3e-04	2.1e-04	8.9e-05	7.3e-05	3.5e-05
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	9.4e-05	9.4e-05	8.7e-05	3.6e-05	3.0e-05	1.4e-05
Loader/Applicator									
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data) (4a) [e]	small areas of seed beds, plant beds	523 lb ai/acre	5 acres	1.2e-03	1.4e-04	1.1e-04	7.9e-05	5.2e-05	NA
	tobacco plant beds	387 lb ai/acre	20 acres	3.5e-03	4.1e-04	3.3e-04	2.3e-04	1.5e-04	NA
	orchard replant/transplant sites	320 lb ai/acre	100 acres	1.4e-02	1.7e-03	1.4e-03	9.6e-04	6.4e-04	NA
	turf (sod farms)	252 lb ai/acre	100 acres	1.1e-02	1.3e-03	1.1e-03	7.6e-04	5.0e-04	NA
	turf (golf courses)	252 lb ai/acre	20 acres	2.3e-03	2.7e-04	2.1e-04	1.5e-04	1.0e-04	NA
	wheat, barley [d]	162 lb ai/acre	100 acres	7.3e-03	8.6e-04	6.9e-04	4.9e-04	3.2e-04	NA
	ornamentals and food crops	108 lb ai/acre	100 acres	4.9e-03	5.7e-04	4.6e-04	3.3e-04	2.2e-04	NA
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	2.0e-03	2.3e-04	1.9e-04	1.3e-04	8.9e-05	NA
	peanuts	27.5 lb ai/acre	100 acres	1.2e-03	1.5e-04	1.2e-04	8.3e-05	5.5e-05	NA
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA with enclosed cab) (4b) [e]	small areas of seed beds, plant beds	523 lb ai/acre	5 acres	NA	NA	NA	NA	NA	1.3e-04
	tobacco plant beds	387 lb ai/acre	20 acres	NA	NA	NA	NA	NA	3.9e-03
	orchard replant/transplant sites	320 lb ai/acre	100 acres	NA	NA	NA	NA	NA	1.6e-03
	turf (sod farms)	252 lb ai/acre	100 acres	NA	NA	NA	NA	NA	1.3e-03
	turf (golf courses)	252 lb ai/acre	20 acres	NA	NA	NA	NA	NA	2.5e-04
	wheat, barley [d]	162 lb ai/acre	100 acres	NA	NA	NA	NA	NA	8.1e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	NA	NA	NA	NA	NA	5.4e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	NA	NA	NA	NA	NA	2.2e-04
	peanuts	27.5 lb ai/acre	100 acres	NA	NA	NA	NA	NA	1.4e-04
Transferring Water Soluble Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with open cab) (5a) [e]	turf (sod farms)	252 lb ai/acre	100 acres	1.1e-02	1.3e-03	1.1e-03	7.6e-04	5.0e-04	NA
	turf (golf courses)	252 lb ai/acre	20 acres	2.3e-03	2.7e-04	2.1e-04	1.5e-04	1.0e-04	NA
	ornamentals and food crops	108 lb ai/acre	100 acres	4.9e-03	5.7e-04	4.6e-04	3.3e-04	2.2e-04	NA
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	2.0e-03	2.3e-04	1.9e-04	1.3e-04	8.9e-05	NA

Table 7. Summary of Noncommercial Handlers Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Noncommercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with closed cab) (5b) [e]	turf (sod farms)	252 lb ai/acre	100 acres	NA	NA	NA	NA	NA	1.3e-03
	turf (golf courses)	252 lb ai/acre	20 acres	NA	NA	NA	NA	NA	2.5e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	NA	NA	NA	NA	NA	5.4e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	NA	NA	NA	NA	NA	2.2e-04
Chemigation Monitor									
Monitoring Chemigation Applications Using Liquid Formulation (6)	No Metam Sodium data is available for this scenario.								
Soil Seal Irrigator									
Sealing Soil with Irrigation Water Following Shank Injection Applications Using Liquid Formulations (7)	No Metam Sodium data is available for this scenario.								
Mixer/Loader/Applicator									
Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data - occupational) (8)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	12 lb ai/1000 sq ft	1000 sq ft	3.6e-05	ND	ND	ND	ND	NF
	potting soil	4 lb ai/1000 sq ft	1000 sq ft	1.2e-05	ND	ND	ND	ND	NF
Mixing/Loading/Applying Water Soluble Liquids via hose-proportioner (using ORETF hand-gun data - occupational) (9)	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	350 lb ai/acre	5 acres	6.4e-04	4.6e-04	2.6e-04	4.1e-04	2.2e-04	NF
	small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns	350 lb ai/acre	0.5 acres	6.4e-05	4.6e-05	2.6e-05	4.1e-05	2.2e-05	NF
Mixing/Loading/Applying Water Soluble Liquids via power sprayer (using ORETF LCO hand-gun data - occupational) (10)	drained water bodies and shorelines	350 lb ai/acre	5 acres	6.4e-04	4.6e-04	2.6e-04	4.1e-04	2.2e-04	NF
Mixing/Loading/Applying Liquids via cement mixer (using PHED Mixer/Loader data for Open-pour Liquids) (11)	potting soil	0.012 lb ai/cu ft	54 cubic feet	9.3e-07	2.2e-08	2.0e-08	8.7e-09	6.8e-09	NF
Mixing/Loading/Applying Liquids via shredder (using PHED Mixer/Loader data for Open-pour Liquids) (12)	potting soil	0.012 lb ai/cu ft	54 cubic feet	9.3e-07	2.2e-08	2.0e-08	8.7e-09	6.8e-09	NF
Mixing/Loading/Applying Liquid with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids) (13)	sewer roots	0.212 lb ai/gal	1350 gallons	4.1e-04	9.8e-06	9.0e-06	3.9e-06	3.0e-06	NF
	sewer roots	0.212 lb ai/gal	675 gallons	2.0e-04	4.9e-06	4.5e-06	1.9e-06	1.5e-06	NF

Table 7. Summary of Noncommercial Handlers Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Noncommercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Mixing/Loading/Applying Liquids via Open Pour (using PHED Mixer/Loader data for Open-pour Liquids) (14)	tree replanting	16 lb ai/1000 sq ft	1000 sq ft	2.3e-05	5.5e-07	5.0e-07	2.2e-07	1.7e-07	NF

Footnotes

– **Noncommercial handler** exposure was considered to be 5 days per year for 35 years over a 70 year lifetime.
NA Not Applicable
ND No Data
NF Not Feasible
a Target for all crops is the soil except for turf, which may be applied to the foliar surface when the goal is to destroy the existing turf.
b Application rates are the typical application rates provided by USDA (2001) for metam sodium where possible. If typical rates were not available, the maximum label rates were used in place of typical rates.
c Amount handled per day values are HED estimates of acreage treated or gallons applied based on Exposure SAC SOP #9 “Standard Values for Daily Acres Treated in Agriculture,” industry input, and HED estimates.
d The average rates reported by USDA in 2001 for wheat and barley (162 lb ai/A) is significantly higher than the maximum label rate (31.7 lb ai/A) for control of “certain root diseases caused by early season fungi.” However, HED notes that wheat and barley also can be treated at the application rate on the label for ornamentals, food, and fiber crops (338 or 320 lb ai/A). Therefore, HED estimated cancer rates with the 162 lb ai/A label rate since that is the rate reported by USDA as the average rate for wheat and barley.
e May over estimate exposure, PHED data is based on open pour mixing/loading.

Dermal Baseline: Long-sleeve shirt, long pants, and no gloves
PPE-G: Baseline plus chemical-resistant gloves.
PPE-G,DL: Coveralls worn over long-sleeve shirt and long pants, chemical-resistant gloves
Eng Controls: Closed mixing/loading system or enclosed cab
Inhalation Baseline: No respirator
OV Respirator: NIOSH/MSHA-approved cartridge or cannister respirator with an organic-vapor removing filter and dust/mist prefilter.

Cancer risks for ***commercial handlers*** are greater than **1.0×10^{-4}** at maximum feasible mitigation for the following handler scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 1c: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 350 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 350 acres treated per day (44.4 lb ai/acre)
- wheat, barley at 350 acres treated per day (162 lb ai/acre)
- peanuts at 350 acres treated per day (27.5 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 1e: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 350 acres treated per day (108 lb ai/acre)

Scenario 1f: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)

Scenario 4a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data)

- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

- peanuts at 100 acres treated per day (27.5 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)

Scenario 4b: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then Applying them via Shank Injection Equipment (using PHED groundboom MLA closed cab data)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)
- wheat, barley at 100 acres treated per day (162 lb ai/acre)

Scenario 5a: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA open cab data)
- ornamentals, food, and fiber crops at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 5b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then Applying them via Rotary Tiller Equipment (using PHED groundboom MLA closed cab data)
- ornamentals, food, and fiber crops, turf (sod farms) at 100 acres treated per day (108 lb ai/acre)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 8: Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data-occupational)
- small areas of ornamentals, food, fiber crops at 1000 square feet treated per day (12 lb ai/1000 ft^2)

Scenario 9: Mixing/Loading/Applying Liquids via Hose Proportioner (using ORETF hand-gun data-occupational)
- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 5 acres treated per day (350 lb ai/acre)

Cancer risks for ***commercial handlers*** are between **1.0×10^{-4}** and **1.0×10^{-6}** at some level of mitigation for the following handler scenarios:

Scenario 1a: Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 1b: Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system)
- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 1d: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 1e: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 1f: Transferring Liquids from Tank Delivery Truck to Pick-up Truck and Subsequent Transfer to Drip Irrigation Nurse Tank (mechanical transfer system) - (Sodium tetrathiocarbonate study used as surrogate data Study # 770AA11)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 2: Applying Liquids via Shank Injection Equipment (using PHED groundboom data)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)
- peanuts at 100 acres treated per day (27.5 lb ai/acre)

Scenario 3: Applying Liquids via Rotary Tiller Equipment (using PHED groundboom data)

- cotton, soybeans, sugar beets at 100 acres treated per day (44.4 lb ai/acre)

Scenario 9: Mixing/Loading/Applying Liquids via Hose Proportioner (using ORETF hose-end data-occupational)

- small areas of ornamentals, food, fiber crops, seed beds, plant beds, tobacco plant beds, lawns at 0.5 acres treated per day (350 lb ai/acre)

Scenario 13: Mixing/Loading/Applying Liquids with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids)

- sewer roots at 675 and 1,350 gallons handled per day (0.212 lb ai/gallon)

There are no handler scenarios where cancer risks for ***commercial handlers*** are less than **1.0×10^{-6}** at maximum feasible mitigation.

Table 8. Summary of Commercial Handler Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Commercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Mixer/Loader									
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) (1a)	wheat, barley [d]	162 lb ai/acre	100 acres	9.3e-02	2.2e-03	2.0e-03	8.7e-04	6.8e-04	3.7e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	6.2e-02	1.5e-03	1.4e-03	5.8e-04	4.6e-04	2.5e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	2.5e-02	6.1e-04	5.6e-04	2.4e-04	1.9e-04	1.0e-04
	peanuts	27.5 lb ai/acre	100 acres	1.6e-02	3.8e-04	3.5e-04	1.5e-04	1.2e-04	6.4e-05
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) (1b)	ornamentals and food crops	108 lb ai/acre	100 acres	6.2e-02	1.5e-03	1.4e-03	5.8e-04	4.6e-04	2.5e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	2.5e-02	6.1e-04	5.6e-04	2.4e-04	1.9e-04	1.0e-04
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Sprinkler irrigation Nurse Tank (mechanical transfer system) (1c)	wheat, barley [d]	162 lb ai/acre	350 acres	3.2e-01	7.8e-03	7.1e-03	3.1e-03	2.4e-03	1.3e-03
	ornamentals and food crops	108 lb ai/acre	350 acres	2.2e-01	5.2e-03	4.8e-03	2.0e-03	1.6e-03	8.7e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	350 acres	8.9e-02	2.1e-03	2.0e-03	8.4e-04	6.6e-04	3.6e-04
	peanuts	27.5 lb ai/acre	350 acres	5.5e-02	1.3e-03	1.2e-03	5.2e-04	4.1e-04	2.2e-04
Transferring Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Drip Irrigation Nurse Tank (mechanical transfer system) (1d)	ornamentals and food crops	108 lb ai/acre	100 acres	6.2e-02	1.5e-03	1.4e-03	5.8e-04	4.6e-04	2.5e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	2.5e-02	6.1e-04	5.6e-04	2.4e-04	1.9e-04	1.0e-04
Loading Liquids to Support Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data, Study # 770AA11) (1e)	wheat, barley [d]	162 lb ai/acre	350 acres	ND	ND	ND	ND	ND	4.0e-04
	ornamentals and food crops	108 lb ai/acre	350 acres	ND	ND	ND	ND	ND	1.2e-04
	cotton, soybeans, sugar beets n)	44.4 lb ai/acre	350 acres	ND	ND	ND	ND	ND	6.9e-05
	peanuts	27.5 lb ai/acre	350 acres	ND	ND	ND	ND	ND	5.6e-05
Loading Liquids to Support Drip Irrigation Applications (Sodium tetrathiocarbonate study used as surrogate data, Study # 770AA11) (1f)	ornamentals and food crops	108 lb ai/acre	100 acres	ND	ND	ND	ND	ND	1.1e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	ND	ND	ND	ND	ND	5.0e-05
Applicator									

Table 8. Summary of Commercial Handler Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Commercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Applying Liquids via Shank Injection Equipment (using PHED groundboom data) (2)	wheat, barley [d]	162 lb ai/acre	100 acres	1.4e-03	1.4e-03	1.3e-03	5.3e-04	4.4e-04	2.1e-04
	ornamentals and food crops	108 lb ai/acre	100 acres	9.1e-04	9.1e-04	8.5e-04	3.5e-04	2.9e-04	1.4e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	3.8e-04	3.8e-04	3.5e-04	1.5e-04	1.2e-04	5.8e-05
	peanuts	27.5 lb ai/acre	100 acres	2.3e-04	2.3e-04	2.2e-04	9.0e-05	7.4e-05	3.6e-05
Applying Water Soluble Liquids via Rotary Tiller Equipment (using PHED groundboom data) (3)	ornamentals and food crops	108 lb ai/acre	100 acres	9.1e-04	9.1e-04	8.5e-04	3.5e-04	2.9e-04	1.4e-04
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	3.8e-04	3.8e-04	3.5e-04	1.5e-04	1.2e-04	5.8e-05
Loader/Applicator									
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA open cab data) (4a) [e]	wheat, barley [d]	162 lb ai/acre	100 acres	2.9e-02	3.4e-03	2.8e-03	2.0e-03	1.3e-03	NA
	ornamentals and food crops	108 lb ai/acre	100 acres	2.0e-02	2.3e-03	1.8e-03	1.3e-03	8.6e-04	NA
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	8.0e-03	9.4e-04	7.6e-04	5.4e-04	3.5e-04	NA
	peanuts	27.5 lb ai/acre	100 acres	5.0e-03	5.8e-04	4.7e-04	3.3e-04	2.2e-04	NA
Transferring Liquids from Tank Delivery Truck to Shank Injection Equipment (mechanical transfer system) and then applying them via Shank Injection Equipment (using PHED groundboom MLA with enclosed cab) (4b) [e]	wheat, barley [d]	162 lb ai/acre	100 acres	NA	NA	NA	NA	NA	3.2e-03
	ornamentals and food crops	108 lb ai/acre	100 acres	NA	NA	NA	NA	NA	2.2e-03
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	NA	NA	NA	NA	NA	8.9e-04
	peanuts	27.5 lb ai/acre	100 acres	NA	NA	NA	NA	NA	5.5e-04
Transferring Water Soluble Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with open cab) (5a) [e]	ornamentals and food crops	108 lb ai/acre	100 acres	2.0e-02	2.3e-03	1.8e-03	1.3e-03	8.6e-04	NA
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	8.0e-03	9.4e-04	7.6e-04	5.4e-04	3.5e-04	NA

Table 8. Summary of Commercial Handler Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Commercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Transferring Liquids from Tank Delivery Truck to Rotary Tiller Equipment (mechanical transfer system) and then applying them via Rotary Tiller Equipment (using PHED groundboom MLA with closed cab) (5b) [e]	ornamentals and food crops	108 lb ai/acre	100 acres	NA	NA	NA	NA	NA	2.2e-03
	cotton, soybeans, sugar beets	44.4 lb ai/acre	100 acres	NA	NA	NA	NA	NA	8.9e-04
Chemigation Monitor									
Monitoring Chemigation Applications Using Liquid Formulation (6)	No Metam Sodium specific data is available for this scenario.								
Soil Seal Irrigator									
Sealing Soil with Irrigation Water Following Shank Injection Applications Using Liquid Formulations (7)	No Metam Sodium specific data is available for this scenario.								
Mixer/Loader/Applicator									
Mixing/Loading/Applying Liquids via Sprinkling Can (using ORETF hose-end data - occupational) (8)	small areas of ornamentals, food, fiber crops	12 lb ai/1000 sq ft	1000 sq ft	1.5e-04	ND	ND	ND	ND	NF
Mixing/Loading/Applying Water Soluble Liquids via hose-proportioner (using ORETF hand-gun data - occupational) (9)	small areas of ornamentals, food, fiber crops	350 lb ai/acre	5 acres	2.5e-03	1.8e-03	1.1e-03	1.6e-03	8.7e-04	NF
	small areas of ornamentals, food, fiber crops	350 lb ai/acre	0.5 acres	2.5e-04	1.8e-04	1.1e-04	1.6e-04	8.7e-05	NF
Mixing/Loading/Applying Water Soluble Liquids via Power Sprayer (using ORETF hand-gun data - occupational) (10)	No commercial cancer risks were calculated for this scenario.								

Table 8. Summary of Commercial Handler Cancer Risks to Metam Sodium									
Exposure Scenario	Crop Type [a]	Typical Application Rate [b]	Area Treated [c]	Commercial Handler Cancer Risks					
				Baseline	PPE-G	PPE-G, DL	PPE-G-OV Respirator 90% PF	PPE-G, DL-OV Respirator 90% PF	Eng Control
Mixing/Loading/Applying Liquid via Cement Mixer (using PHED Mixer/Loader data for Open-pour Liquids) (11)	No commercial cancer risks were calculated for this scenario.								
Mixing/Loading/Applying Liquid via Shredder (using PHED Mixer/Loader data for Open-pour Liquids) (12)	No commercial cancer risks were calculated for this scenario.								
Mixing/Loading/Applying Liquid with Foaming Equipment (using PHED Mixer/Loader data for Open-pour Liquids) (13)	sewer roots	0.212 lb ai/gal	1350 gallons	1.6e-03	3.9e-05	3.6e-05	1.5e-05	1.2e-05	NF
	sewer roots	0.212 lb ai/gal	675 gallons	8.2e-04	2.0e-05	1.8e-05	7.7e-06	6.0e-06	NF
Mixing/Loading/Applying Liquid via Open Pour (using PHED Mixer/Loader data for Open-pour Liquids) (14)	No commercial cancer risks were calculated for this scenario.								

Footnotes

–	**Commercial handler** exposure was considered to be 20 days per year for 35 years over a 70 year lifetime.
NA	Not Applicable
ND	No Data
NF	Not Feasible
a	Target for all crops is the soil except for turf, which may be applied to the foliar surface.
b	Application rates are the typical application rates provided by USDA (2001) for metam sodium where possible. If typical rates were not available, the maximum label rates were used in place of typical rates.
c	Amount handled per day values are HED estimates of acreage treated or gallons applied based on Exposure SAC SOP #9 “Standard Values for Daily Acres Treated in Agriculture”.
d	The average rates reported for wheat and barley (162 lb ai/A) is significantly higher than the maximum label rate (31.7 lb ai/A). HED estimated non-cancer and cancer rates with the maximum label rate since legally that is the maximum that can be applied.
e	May over estimate exposure, PHED data is based on open pour mixing/loading.

Dermal Baseline:	Long-sleeve shirt, long pants, and no gloves
PPE-G:	Baseline plus chemical-resistant gloves.
PPE-G,DL:	Coveralls worn over long-sleeve shirt and long pants, chemical-resistant gloves
Eng Controls:	Closed mixing/loading system or enclosed cab
Inhalation Baseline:	No respirator
OV Respirator:	NIOSH/MSHA-approved cartridge or cannister respirator with an organic-vapor removing filter and dust/mist prefilter.

2.1.5 Non-cancer MITC Handler Exposure and Risk Assessment

The occupational handler exposure and non-cancer risk calculations for MITC are presented in this section.

2.1.5.1 Non-cancer MITC Handler Exposure and Risk Calculations

The inhalation MOEs for MITC were calculated using the equations:

$$\textbf{Acute MOE} = \frac{\textbf{NOAEL (ug/m}^3\textbf{)}}{\textbf{Inhalation Exposure Concentration (ug/m}^3\textbf{)}}$$

$$\textbf{ST, IT, LT MOE} = \frac{\textbf{HEC (ug/m}^3\textbf{)}}{\textbf{Inhalation Exposure Concentration (ug/m}^3\textbf{)}}$$

Where:

NOAEL	=	No observed effect level from human eye irritation study
HEC	=	Human equivalent concentration derived from animal study
Acute	=	Exposures occurring for up to 8 hours
ST	=	Short-term exposures occurring 1 to 30 days
IT	=	Intermediate-term exposures occurring up to 180 days
ST	=	Long-term exposures occurring for more than 180 days

2.1.5.2 Non-cancer MITC Risk Summary

Non-cancer risk data for occupational MITC exposure utilized in this assessment are included in **Appendix E**. A summary of the MOEs estimated for handlers exposure to MITC is included in **Table 9**. MOEs do not reflect the reduction of inhalation exposure resulting from the use of respirators or additional mitigation controls not used in the studies.

Acute and ST MOEs for most of the tasks assessed exceed the LOC. Most of tasks assessed involve some type of engineering control (e.g. closed mixing system, closed tractor cab, etc).

HED typically shows MOEs for handlers wearing respirators (when feasible) with a protection factor (PF) of 10. It is assumed that a respirator with a PF of 10 will reduce concentrations of MITC in the breathing zone by 90%. Full face respirators or ½ face respirators and face sealing goggles will reduce inhalation and eye exposure. Personal protective equipment required on current labels is discussed in **Section 1.6.5**.

Table 9. Handler MOEs for MITC

Exposure Scenario		MRID(s) used to Access Scenario	number of replicates	Sample time (mins)			MITC (ug/m3)		MOEs	
				Min	Max	Avg	Max	GM	Acute	ST/IT
Loader										
(1a)	Transferring Water Soluble Liquids from Tank Delivery Truck to Shank Injection Equipment	**429684-02***	10	3	17	6.6	1157	212	2	10
(1b)	Transferring Water Soluble Liquids from Tank Delivery Truck to Rotary Tiller Equipment	429584-01	10	3	11	7.2	1751	314	1	7
(1c)	Transferring Water Soluble Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Chemigation Nurse Tank	**429684-02***	10	43	78	63.4	2739	440	<1	5
		429584-01	5	8	12	10	125	342	14	6
(1d)	Transferring Water Soluble Liquids from Tank Delivery Truck to Pick-up Truck and subsequent transfer to Drip Irrigation Nurse Tank	**429684-02***	10	43	78	63.4	2739	440	<1	5
		429584-01	5	8	12	10	125	342	14	6
Applicator										
(2a)	Applying Water Soluble Liquids via Shank Injection Equipment-Personal Sampler Pumps (enclosed cab with charcoal filter)	**429684-02***	2	1	78	71	284	222	2	9
(2b)	Applying Water Soluble Liquids via Shank Injection Equipment-Personal Sampler Pumps (enclosed cab with cellulose filter)	**429684-02***	4	1	74	32	1791	1486	<1	1
(2c)	Applying Water Soluble Liquids via Shank Injection Equipment-Personal Sampler Pumps (open cab)	**429684-02***	4	1	77	33	3851	719	<1	3
(2d)	Applying Water Soluble Liquids via Shank Injection Equipment-In-cab Sampler Pumps (enclosed cab with charcoal filter)	451239-02 457037-03	9	1	176	126	664	454	1	4
(3a)	Applying Water Soluble Liquids via Rotary Tiller Equipment-Personal Sampler Pumps(enclosed cab with charcoal filter)	42958401	5	63	72	34	2493	596	<1	3
(3b)	Applying Water Soluble Liquids via Rotary Tiller Equipment (enclosed cab with cellulose filter)	42958401	5	56	63	30	1218	567	1	4

Table 9. Handler MOEs for MITC										
Exposure Scenario		MRID(s) used to Access Scenario	number of replicates	Sample time (mins)			MITC (ug/m3)		MOEs	
				Min	Max	Avg	Max	GM	Acute	ST/IT
Loader/Applicator										
(4c)	Transferring Water Soluble Liquids from Tank Delivery Truck to Shank Injection Equipment (closed system) and then applying them via Shank Injection Equipment (enclosed cab with charcoal filter)	451239-02	9	81	174	63	1220	566	1	4
Chemigation Monitor										
(6)	Monitoring Water Soluble Liquid Chemigation applications	451239-02 429584-01	10	121	241	180	349	102	2	20
		429684-02*	10	0.85	254	242.8	2806	891	<1	2
Irrigator										
(7)	Irrigating Following Shank Injection Application	451239-02 457037-03	11	107	202	76.73	329	171	2	12

[1]Acute MOEs are based on the maximum concentration

[2]ST/IT MOEs are based on the geometric mean concentration

*429684-02 may not be reflective of current cultural practices

2.1.6 Summary of Risk Concerns and Data Gaps for Handlers

There are many occupational handler scenarios for metam sodium and MITC that have risks associated with them that are above HED's level of concern. In addition, many occupational handler scenarios for metam sodium and MITC have data gaps.

2.1.6.1 Summary of Risk Concerns

The handler risk assessment for metam sodium and MITC indicates risk concerns for many handler scenarios, particularly when the application rate exceeds approximately 65 pounds active ingredient per acre.

For the majority of **agricultural scenarios**, including applications to ornamentals, food, and feed crops (at 320 and 338 lb ai/A) to tobacco plant beds (387 and 408 lb ai/A) and turf (at 320 and 338 lb ai/A), risks exceed the LOC even at maximum risk mitigation for most cancer and non-cancer assessments for exposures to metam sodium. Based on the available data for handlers, non-cancer MITC MOEs also exceeded the LOC for majority of scenarios assessed.

There is a lack of exposure data for handlers who load and apply on the same day. Industry sources indicate that approximately 90% of handlers who apply metam sodium with a tractor also did the mixing and loading.

For the applications in **commercial** (i.e., sewer system) **and small scale agricultural settings** (i.e., sprinkling can, hose proportioner, potting soil, and tree replant scenarios), the non-cancer and cancer risks to metam sodium exceed the LOC at some level of protection for most scenarios. There are no data available to assess non-cancer risks to MITC for these application techniques.

2.1.6.2 Summary of Data Gaps

Metam Sodium

No metam-sodium-specific data were available for handler exposure. Surrogate exposure data were used for all metam sodium assessments.

For metam sodium non-cancer and cancer exposure and risk assessments for the large agricultural scenarios, data from the Pesticide Handler Exposure Database (PHED) were used, as a surrogate, for all loading, applying, and loading/applying scenarios. These data may overestimate inhalation risks to handlers from metam sodium exposures, since the MITC handler data indicates that some metam sodium has degraded to MITC and therefore would no longer be available for inhalation as metam sodium. However, HED has no data to indicate what, if any, reduction in metam sodium inhalation risks would result.

The studies in PHED are based on application rates significantly lower than what is used for many of the field applications of metam sodium. A linear extrapolation from the rates in PHED to the anticipated rates for metam sodium may overestimate the exposure to handlers.

In metam sodium non-cancer and cancer exposure and risk assessments for the commercial (sewer) and small-scale agricultural (hose-proportioner, sprinkling can, potting soil, and tree replant) scenarios, surrogate data from PHED and the Outdoor Exposure Residential Task Force (ORETF) were used. For the potting soil and tree replant scenarios, PHED data for open pour mixing/loading of liquid formulations was used in the assessments. These data are based on large-scale mixing/loading operations in a large-scale agricultural setting and may not be a close surrogate for the exposures in the smaller scale settings with vastly different equipment. These should all be considered data gaps.

MITC

MITC-specific handler exposure data were available for some handler scenarios. The MITC-specific data were used in all applicable scenarios.

For MITC non-cancer exposure and risk assessments for the large agricultural scenarios, MITC-specific data were available for the following scenarios:

- loading to support shank injection applications,
- loading to support rotary tiller applications,
- loading/applying for sprinkler irrigation,
- loading/applying for drip irrigation,
- applying with shank injection equipment,
- applying with rotary tiller equipment,
- loading and then applying with power sprayer equipment,
- loading and then applying with shank injection equipment,
- loading and then applying with rotary tiller equipment, and
- monitoring sprinkler irrigation applications.

In MITC non-cancer exposure and risk assessments for the commercial (sewer) and small-scale agricultural (hose-proportioner, sprinkling can, potting soil, and tree replant) scenarios, no MITC-specific or surrogate data were available. Data from PHED and the Outdoor Exposure Residential Task Force (ORETF) were not considered reasonable surrogates, since the data for these two sources is based on active ingredients with low volatility. Therefore, these data were not used for the MITC assessment. As a result, HED was unable to estimate exposure and risk to MITC in these scenarios and these all should be considered data gaps. HED is concerned about exposures to MITC in these settings, since the equipment is handheld or in close proximity to the handlers' breathing zone.

Additional metam sodium and MITC handler data gaps exist for the following scenarios:

- applying via flood irrigation;
- applying via furrow irrigation;
- compacting by a ring roller or other device;
- laying tarps as soil seals immediately following an application;
- removing tarps from treated fields several days following an application;
- applying a water seal immediately following an application; and
- aerating or loosening the soil several days following an application.
- greenhouse applications

HED has no chemical-specific or reasonable surrogate data to estimate exposure and risk to metam sodium and MITC during these handler activities and these all should be considered data gaps.

Data gaps for handler and bystander are also summarized in **Appendix H**.

2.1.7 Recommendations For Refining Occupational Handler Risk Assessment

In order to refine this occupational risk assessment, data on actual use patterns including rates, timing, and area treated would better characterize metam sodium and MITC risks. Exposure studies for many equipment types that lack data or that are not well represented in PHED (e.g., because of low replicate numbers or data quality) should also be considered based on the data gaps identified above and based on a review of the quality of the data used in this assessment.

2.2 Occupational and Residential Postapplication Exposures and Risks

Metam sodium is applied in:

- large-scale agricultural settings with shank injection, rotary tiller, or chemigation equipment,
- small- or medium-scale agricultural settings with sprinkling can, hose proportioner, cement mixer, shredder, or open pour equipment, and
- commercial settings with foam applications equipment.

Once mixed with water or added to soil, metam sodium rapidly breaks down into several degradates – with the key degradate being MITC.

2.2.1 Data and Assumptions for Postapplication Exposure Scenarios

For MITC bystander exposure resulting from metam sodium applications, the two main types of available air monitoring data are ‘off-site’ and ‘ambient’. All of the available off-site and ambient monitoring was conducted in California.

Off-site monitoring includes application site-specific air sampling that takes place in the immediate vicinity and coinciding with a specific pesticide application. Normally, 8 to 16 samplers surround the application site, at distances varying from 30 to several hundred feet. Samples are collected beginning with the start of pesticide application and ends a few days after the pesticide application is completed. This data is normally used to estimate acute exposures. The California Air Resources Board (CARB) conducts this monitoring under California's toxic air contaminant program, when requested by DPR. DPR also conducts this type of monitoring on a case-by-case basis. DPR may supplement the monitoring data with computer modeling. Registrants have also conducted offsite monitoring for fumigants to support the registration of their products.

Ambient monitoring included air sampling that occurs in towns at locations where people work or live, such as schools, fire houses, office buildings, etc. In California, ambient monitoring is conducted in a region and season of high use, but not each year. Ambient monitoring is conducted in four to eight towns in a region of high use. One of these monitoring sites is usually located in the middle of large city to estimate the urban background concentration. Normally, 24-hr samples are collected for four days/week, for four to eight weeks during a season of high use. CDPR normally uses this data to estimate seasonal and chronic exposures. CARB conducts this monitoring under California's toxic air contaminant program, when requested by DPR. DPR conducts this type of monitoring infrequently. DPR may supplement this monitoring with computer modeling.

In the case of MITC, CARB and DPR have both conducted application-site monitoring. CARB has also conducted ambient monitoring, including monitoring for several weeks during 2001 in Salinas and Bakersfield as urban background concentration sites.

CARB also has a network of ambient stations that monitor toxic air pollutants for 24 hours, every 12 days, at 20 urban locations. This is not part of the toxic air contaminant program. The only pesticides included in this monitoring network are methyl bromide and 1,3-dichloropropene. According to CDPR, there are no plans to add MITC to the network in the near future.

2.2.1.1 Off-site Monitoring Data

There were twelve studies that measure off-site MITC concentrations associated with metam sodium applications. The study reports provided data from 14 different application sites (6 sprinkler, 6 shank injection, and 2 drip). In the majority of studies, consecutive 4-hour samples were collected from sampling stations for the first 4 postapplication days (starting at the time of application). The available off-site monitoring studies include data for 8 application/sealing method combinations which are:

* Sprinkler Applications with no sealing

* Sprinkler Applications with standard water sealing
* Sprinkler Applications with intermittent water sealing
* Shank Injection Applications with no sealing
* Shank Injection Applications with standard water sealing
* Shank Injection Applications with intermittent water sealing
* Drip Applications with a tarp
* Drip Applications with no sealing

The follow provides a brief summary of the 12 study reports (studies listed in chronological order of the report date).

1.

MRID:	426599-01
Report Title/Date:	Field Volatility of Metam-Sodium During and After Applications/ January 26, 1993
HED Review:	D281787
Date of Study:	Summer 1992 (night-time application)
Application Method(s):	Chemigation/Sprinkler
Application Rate:	320 lbs ai/acre to a 7 acre fallow field in Madera County, California from
Total Acres Treated:	7 acres
Sealing Method(s):	none
Sample Distances:	4 sampling stations, 5, 25, 125, and 500 meters (northwest)
Soil Type:	Loamy Sand
Issues of Concern:	* Samplers all placed in the same direction * The power generator failed during the 8 to 12 hour sampling interval * Field fortification samples were said to represent storage stability as well; however, analysis dates are not known and the order they were analyzed in relation to the field samples in not known

2.

MRID:	MRID not assigned (C92-070A)
Report Title/Date:	Ambient Air Monitoring in Contra Costa County During March 1993 After an Application of Metam Sodium to a Field/July 14, 1993
HED Review:	D281774
Date of Study:	Spring 1993 (daytime application)
Application Method(s):	Shank injection
Application Rate:	57.2 lbs ai/acre
Total Acres Treated:	A single application over three days to a 95 acre field
Sealing Method(s):	none
Sample Distances:	3 sample stations, 13.7 meters (north, southeast, southwest)
Soil Type:	Clay Loam
Issues of Concern:	* No field fortification and concurrent laboratory fortification samples collected * No information on the validation of the methods used * The study was not conducted at the maximum application rate

3.

MRID: MRID not assigned (C92-070B)
Report Title/Date: Ambient Air Monitoring for MITC in Kern County During Summer 1993 After a Ground Injection Application of Metam-Sodium to a Field/ April 27, 1994
HED Review: D281778
Date of Study: Summer 1993 (daytime application)
Application Method(s): Shank Application
Application Rate: 155 lbs ai/acre
Total Acres Treated: A single application over three days to an 85 acre field
Sealing Method(s): none
Sample Distances: 4 sampling stations, 18.3 meters (west, northeast, and south) and 36.3 meters (east)
Soil Type: Sandy Loam
Issues of Concern:
* No quality control samples collected
* The study was not conducted at the maximum application rate
* Only one field blank sample was collected and analyzed
* Samples from sampling Series 3 and 4 were exposed to high temperatures resulting in lower than expected residue values

4.

MRID: MRID not assigned (C94-046A)
Report Title/Date: Ambient Air Monitoring for MIC and MITC After a Soil Injection Application of Metam Sodium in Kern County During August 1995/ May 20, 1997
HED Review: D281790
Date of Study: Summer 1995 (daytime-nighttime application)
Application Method(s): Shank Injection
Application Rate: 155 lbs ai/acre
Total Acres Treated: 80 acres (carrots)
Soil Type: not specified
Sealing Method(s): none
Sample Distances: 4 sampling stations, 11 meters (east) 11.9 meters (north, south) 18.3 meters (west)
Issues of Concern:
* The study was not conducted at the maximum application rate
* Detailed information regarding application equipment was not provided

5.

MRID: 457037-05
Report Title/Date: Santa Barbara County Pilot Study of Intermittent Sealing for a Shank Injection Application/December 18, 2001
HED Review: D290247
Date of Study: Summer 2000 (daytime application)
Application Method(s): Shank Injection
Application Rate: 320 lbs ai/treated acre
Total Acres Treated: 2 fields, 10 acres each
Soil Type: Sandy Loam
Sealing Method(s): Intermittent water sealing

Sample Distances:	4 sampling stations, 150 meters located at northeast, southeast, northwest, southwest corners
Issues of Concern:	* Non-GLP pilot study * No quality control samples collected or analyzed * No study protocol provided * No field blank samples were collected * Sampling was done for only 1 day

6.

MRID:	457037-04
Report Title/Date:	Determination of Methyl Isothiocyanate Offsite Air Movement from the Application of Metam-Sodium Through Shank Injection/ March 1, 2001
HED Review:	D290246
Date of Study:	June, 2000 (daytime application)
Application Method(s):	Shank injection
Application Rate:	320 lbs ai/treated acre
Total Acres Treated:	40 acres (for carrots)
Sealing Method(s):	Intermittent water sealing
Soil Type:	Clay Loam
Sample Distances:	16 stations, 150 m and 300 m (around all sides), 500 m and 700 m (on a diagonal to the southeast) and 700 m (on a diagonal to the southwest).
Issues of Concern:	* Field fortification samples were spiked in the laboratory and shipped frozen to the test site rather than being spiked concurrently in the field with the test samples.

7.

MRID:	457037-06
Report Title/Date:	Lancaster Pilot Study of Intermittent Sealing for a Sprinkler Irrigation Application/December 18, 2001
HED Review:	D290249
Date of Study:	Winter 2000 (daytime application)
Application Method(s):	Chemigation/sprinkler
Application Rate:	320 lb ai/acre
Total Acres Treated:	16 acres (each site)
Soil Type:	Sandy Loam
Sealing Method(s):	Intermittent (site 1) and standard (site 2) water sealing
Sample Distances:	4 sampling stations, 150 meters (north, south, east, and west)
Issues of Concern:	* Non GLP pilot study * No quality control samples collected * A study protocol was not provided * Duplicate samples were only collected during one sampling interval at the four sampling locations per interval * No field blank samples were collected * Sampling was done for only 1 day

8.

MRID:	457037-07
Report Title/Date:	Panama Lane Pilot Study of Intermittent Sealing for a Chemigation Application/December 18, 2001
HED Review:	D290251
Date of Study:	Summer 2001 (daytime application)
Application Method(s):	Chemigation/sprinkler
Application Rate:	203 lbs ai/acre
Total Acres Treated:	12 acres (each site)
Soil Type:	Sandy Loam
Sealing Method(s):	Intermittent (site 1) and standard (site 2) water sealing
Sample Distances:	4 sampling stations, 150 meters (north, south, east, and west)
Issues of Concern:	* No quality control samples collected or analyzed with the study * A study protocol was not provided * No duplicate samples collected

9.

MRID:	457037-08
Report Title/Date:	Orange County Drip Application Study Modeling Results Prepared for the Metam-Sodium Task Force/December 18, 2001
HED Review:	D290252
Date of Study:	Winter 1997 (evening application)
Application Method(s):	Chemigation/Drip
Application Rate:	75 gallons per acre (320 lb ai/acre).
Total Acres Treated:	12 acres (sites 1) and 4 acres (site 2)
Sealing Method(s):	No seal (site 1) and 1.5mm plastic tarp (site 2)
Sample Distances:	10 sampling stations, 3 meters (north, south, east, west), 6.1 meters (north, north east), 15.2 meters (north, north east), 45.7 meters (north, north east)
Soil Type:	not specified
Issues of Concern:	* Non-GLP Study * A study protocol was not provided * No raw data provided * No LOQ was provided

10.

MRID:	457037-02
Report Title/Date:	Determination of Methyl Isothiocyanate Offsite Air Movement from the Chemigation of Metam-Sodium Through Sprinkler Irrigation/January 10, 2002
HED Review:	D290245
Date of Study:	Summer 2001 (daytime application)
Application Method(s):	Chemigation/sprinkler
Application Rate:	320 lb ai/acre
Total Acres Treated:	18 acres
Soil Type:	Silt Loam
Sealing Method(s):	Intermittent
Sample Distances:	16 sampling stations, 137meters (north, south, east, west, southeast, southwest), 274 meters (southeast), 411 meters, 530 meters (southwest), 549 meters (southeast)

Issues of Concern	* Field fortification samples were spiked in the laboratory and shipped frozen to the test site rather than being spiked concurrently in the field with the test samples.

11.

MRID:	MRID not assigned (Wofford, 1999)
Report Title/Date:	Air Monitoring for Methyl Isothiocyanate During a Sprinkler Application of Metam-sodium/June 1994
HED Review:	D290254
Date of Study:	Summer 1993 (night application)
Application Method(s):	Chemigation/sprinkler irrigation
Application Rate:	320 lbs ai/acre
Total Acres Treated:	19 acres
Soil Type:	Loam
Sealing Method(s):	Standard water sealing
Sample Distances:	10 sampling stations, 5 meters (north, south, east, west), 75 meters (north east, south east, south west, north west), 150 meters (north, south)
Issues of Concern:	* Non-GLP study * Retention and breakthrough studies were not discussed * No field recovery was provided * Quality control recoveries for one level of fortification were provided but not discussed * No storage stability data provided * Raw residue data were not corrected for the continuous quality control recovery data provided in Appendix C of the report (89% for silica and 88% for charcoal) * The Metam Sodium Alliance reported that a nocturnal inversion occurred. They also report that the application was conducted with air temperatures that exceeded 90 F.

12.

MRID:	451239-01 & 457037-01 (referred to as **457037-01** for the rest of this document)
Report Title/Date:	Study Review of Determination of Methyl Isothiocyanate Offsite Air Movement From the Application of Metam-Sodium Through Shank Injection and Sprinkler Irrigation/December 14, 1999
HED Review:	D281791
Date of Study:	Summer 1999 (daytime application)
Application Method(s):	Chemigation/sprinkler irrigation (site 1) and shank injection (site 2)
Application Rate:	320 lbs ai/acre
Total Acres Treated:	Site 1 - consisted of 4 side by side 20 acre rectangular plots treated with Sprinkler application followed by standard water sealing. Metam sodium was applied as follows : Plot 1 treated on 6/15/99 from 7:22am to 2:30 pm, Plot 2 treated on 6/16/99 from 7:00am to 1:00 pm, Plot 3 treated on 6/17/99 from 6:50am to 1:00 pm, Plot 4 treated on 6/18/99 from 6:55am to 1:10 pm. Site 2 - one 80 acre field treated with shank injection

Sealing Method(s):	Standard water sealing
Sample Distances:	Site 1 - 10 sampling stations, 150 meters (3 east), 300 meters (3 east), 700 meters (3 east), 970 meters (2 west)
Soil Type:	
Issues of Concern:	* The report states that samples were positioned at downwind and upwind locations. However, during the late night and early morning periods, the wind direction varied considerably, such that there was no definitive upwind location from the application zone. * Storage stability data were not provided. * Field fortification levels did not include the entire range of the actual residues amounts detected in the field. * Field fortification recoveries from samples collected at Site 1 (sprinkler irrigation) were high (as high as 3,444 and 1,357% for the June 16 and June 18, 1999 0.5 µg/samples, respectively) * Concurrent laboratory recoveries exceeded 120 percent for both test sites * Control sorbent tube samples contained higher MITC concentrations than expected. The study author surmised that this was the result of background concentrations of MITC. However, the first sampling event took place after the first application event at both test sites. * Even though the study was conducted at two test sites, they were in the same proximity and did not provide geographic/climatological diversity.

HED notes the following general limitations/issues the above studies:

- All of the field volatility studies were conducted in California. Currently, CDPR has a technical information bulletin (TIB) for metam sodium application that identifies certain application practices for the application of metam sodium (i.e. regarding water sealing, air temperature, wind speed, time of application, etc.). As noted in the study summaries, these practices were not followed in all of the studies. DPR's TIB does NOT apply to other states where metam sodium is used.
- In most of the studies, sampling was NOT continued until the nature of the dissipation curve was clearly established.
- Three of studies are pilot studies (MRIDs 457037-05, 457037-06, and 457037-07) and reportedly do not reflect currently used intermittent sealing methods.
- No samples were collected within the treated area. This data could be used for estimating postapplication worker exposures.
- Most of the studies were conducted at only one test site.

2.2.1.2 Ambient Monitoring Data

The available ambient monitoring data conducted in the last 10 years for MITC included 3 studies. All three studies were conducted in California. The following provides a brief summary of the studies:

1. Seiber (1999)

MRID: MRID was not assigned (MITC concentrations taken directly from DPR 2002 MITC Risk Assessment)

Report Title/Date: Determination of Ambient MITC Residues in Indoor and Outdoor Air in Townships near Fields with Metam Sodium. June 1999

Location: Bakersfield, California Area townships (Lamont, Weedpatch, and Shafter)

Date of Study: Summer 1997 and Winter 1998

Sampling stations: Seiber et al. (1999) conducted a study to monitor ambient air concentrations of MITC in Bakersfield-area townships during summer, 1997, and winter, 1998. These townships were Lamont, Weedpatch, and Shafter for summer monitoring and Lamont, Weedpatch, and Arvin for winter monitoring. MITC was monitored indoors and/or outdoors (AM and/or PM samples) for each sampling station.

During summer, sampling took place in May, June, July, and August of 1997. During winter, sampling took place in January and March of 1998. Sampling occurred for time periods of 11 to 12 hours during four day periods.

There were known applications of metam-sodium in those townships where the air monitoring study took place. However, data collected from those sampling stations did not represent absolute downwind air concentrations of MITC. Overall for the summer samples, the wind direction from the treated fields toward the sampling stations occurred 0-44% of the time during the various sampling periods. For the winter samples, the range was 2-16%. The submitted report indicated that during an application season, concentrations of volatile components related to the pesticide application will typically be elevated in air basin, and remain so until the application season has ended. The report concluded that this phenomenon would also lead to elevated residues in townships contained within the air basin without the necessity of a wind vector for carrying residues from a specific application site.

The LOQ of MITC in field air is on the order of 60-70 ng/m3. When it is necessary, half of the LOQ (32.5 ng/m3) was used for samples indicated less than LOQ. The LOD was not reported. The number of samples > LOQ and < LOD was not provided. Meteorological data was not provided in DPR's report.

2. Kern (2001)

MRID: MRID was not assigned (MITC concentrations taken directly from November 17, 2001 DPR report)

Report Title/Date: Final Report for the 2001 Ambient Air Monitoring for Chloropicrin and Metam Sodium Breakdown Products in Kern County.

	November 17, 2001
Location:	Kern County, CA
Date of Study:	Summer 2001
Sampling stations:	Monitoring was conducted in Kern County from June 30 through August 31 , 2001 , to coincide with the use of metam sodium prior to planting of a variety of crops.
	The sampling site selection specifically focused on the use of metam sodium prior to planting carrots. Ambient air samples were collected at five sites throughout the carrot growing regions of Kern County and urban background samples were also collected in Bakersfield.
	Four samples of 24 hours in duration were collected randomly over the full seven-day week during the sampling period (usually four sample periods on weekdays).
	Of the 198 ambient air samples, 87 contained concentrations of MITC above the LOQ of 0.42 ug/m3, 68 were found to have results of "detected," 41 were below the LOD. Two were invalid due to the sampling flow rate outside the control limit. Meteorological data was not provided in DPR's report.
3.	Monterey/Santa Cruz (2001)
MRID:	MRID was not assigned (MITC concentrations taken directly from January 15, 2004 DPR report)
HED Study Review:	NA (MITC concentrations taken directly from DPR report)
Report Title/Date:	Ambient Air Monitoring for Chloropicrin and Breakdown Products of Metam Sodium in Monterey and Santa Cruz Counties. January 15, 2004.
Location:	Monterey County, CA and Santa Cruz County, CA
Date of Study:	Fall 2001
Sampling:	Monitoring was conducted in Monterey and Santa Cruz Counties from September 8, 2001 through November 8, 2001 to coincide with the primary use of the soil fumigants prior to the planting of strawberries. The sampling site selection specifically focused on areas of historic use of these fumigants prior to plantings.
	Ambient air samples were collected at 4 sites in Monterey County and 2 sites in Santa Cruz County. Samples of 24 hours duration were collected randomly over the full 7-day week during the sampling period (usually 4-sample period week).
	Of the 192 samples collected, only three samples had detectable concentrations of MITC. One had a concentration of 0.43 ng/m3 and two had detectable results below the LOQ of 0.42 ng/m3 (Det). These three samples were collected at Salsipuedes Elementary School in Watsonville. Results for 186 samples (97%) were below

the LOD and three samples were invalid. Meteorological data was not provided in DPR's report.

2.2.2 Parameters Affecting Postapplication Inhalation Exposures

Several factors influence the air concentration levels of MITC following metam sodium applications to agricultural fields, including:

- the rate at which MITC is formed during the degradation of metam sodium,
- the rate at which MITC is released from treated soil into the atmosphere, and
- the amount of metam sodium applied in a geographic area.

Factors that influence the rate at which MITC is formed during the degradation of metam sodium include:

- the pH of the soil,
- the moisture level of the soil, and
- the temperature of the soil.

Factors that influence the rate at which MITC is released from treated soil into the atmosphere, include:

- the type and effectiveness of the soil seal, if any – seals range from tarps, soil compaction with rollers or drags, and adding a layer of water immediately following application and/or for a few days following application;
- the type of application – application can be by shank injection, rotary tiller, sprinkler irrigation, or through various handheld or stationary equipment;
- the texture and content of the soil – clay soils and soils high in organic matter tend to inhibit release of MITC, whereas loose textured soils tend to release MITC, and
- soil moisture levels – soils with high moisture levels tend to inhibit release of MITC, whereas low moisture soils tend to release MITC
- time of application, night versus day, and atmospheric conditions.

Factors that influence the amount of metam sodium applied in a geographic area, include:

- Size (acres) of the area treated in a day;
- Number of consecutive days metam sodium is applied in a geographic area; and
- Application rate – the pounds of metam sodium applied per acre.

Note: that the size or frequency of applications among separate owner/operators in a geographic area is not limited or specified by current pesticide labeling.

2.2.3 Occupational and Residential Postapplication Exposures

Once metam sodium applied to soil or mixed with water, it rapidly and completely breaks down to MITC and other degradates. In soil, metam sodium usually converts to MITC within one day following application with the decomposition rate depending on soil temperature, soil composition, and soil moisture. Warm soil temperature, increased clay or organic matter, small soil particle size, and low soil moisture facilitate rapid conversion of metam sodium to MITC. MITC accounts for the fumigant activity of metam sodium.

2.2.3.1 Postapplication Dermal Exposures

The Worker Protection Standard for Agricultural Pesticides prohibits entry into a treated area by any person – other than a trained and appropriately PPE-equipped pesticide handler – until inhalation risks are no longer a concern. Therefore, only handlers are permitted to enter treated areas to perform tasks, such as:

- sealing the soil with water, tarps, drags, or rollers;
- removing the tarpaulin seal; and
- aerating treated soil.

Entry into metam-sodium-treated areas by unprotected persons will not be permitted until all metam sodium has degraded into MITC and MITC inhalation exposures are no longer a concern. As a consequence, HED does not anticipate that postapplication dermal exposures to metam sodium will occur in agricultural settings and, therefore, no postapplication dermal risks were calculated for metam sodium.

HED also does not anticipate dermal exposures to metam sodium applied as a foam to sewers. Unauthorized personnel are not expected to be in sewers.

2.2.3.2 Postapplication Inhalation Exposures

Exposures Following Field Application of Metam Sodium

HED anticipates that a wide array of individuals potentially can be exposed via the inhalation route to MITC by working in or near and/or living near areas that have been treated with metam sodium. Off-site monitoring studies provided inhalation postapplication exposure data for MITC. These studies examined MITC air concentration levels at measured distances from the edge of a treated field at various time periods immediately after metam sodium applications.

HED believes that postapplication exposures to MITC can occur over several days following a single metam sodium application and may occur for several weeks or months for people living and working in high use areas.

Exposures Following Soil Aeration

HED also has concerns about postapplication inhalation exposures to MITC following removal of the soil seal and/or soil aeration. Metam sodium label instructions recommend sealing the soil immediately following application. (Some labels require the use of a tarpaulin if the application is applied near (within one-half mile) of populated areas such as residential areas, schools, hospitals, commercial or office buildings, factories, etc.) Sealing methods include applying irrigation water and/or plastic tarps or packing soil with a roller or drag. Metam sodium labels recommend for heavy soils that users cultivate sealed areas approximately 5 to 7 days following application to aerate the soil (see page 8 of Vapam HL Soil Fumigant Label EPA Reg No 5481-468 dated 1/6/2004 under heading 'Cultivation of Soil Before Planting'). Labels also indicate that planting or transplanting cannot occur for 14 to 30 days following application – with the longer period applicable to soils that were sealed following application or to soils that are heavy, wet, or cold.

Based on the labeling information and on the postapplication study data that indicate significantly lower MITC air concentration levels near fields where the soils have been sealed immediately following metam sodium applications, HED believes that MITC air concentration levels may spike again when the soil seal is removed and/or the soil is aerated. At this time, HED has no data to indicate MITC air concentration levels in or near metam-sodium-treated fields when the soil seal is removed or the soil is aerated.

Exposures Following Potting Soil Treatments

HED has concerns about postapplication exposures to occupational workers and residential bystanders following applications to potting soil. HED believes that these applications are likely to take place in sheltered settings, such as sheds, where air circulation is somewhat restricted. However, at this time there are no data about MITC air concentration levels following applications to potting soil.

Exposures Following Sewer Treatments

HED has concerns about postapplication exposures to occupational workers and residential bystanders following applications to sewers. HED believes that exposures to residential bystanders may occur if there are cracks in the sewer structure that would permit MITC to escape the sewer confinement. HED also is concerned about entry by occupational workers into treated sewers before MITC levels have dissipated. However, at this time there are no data about MITC air concentration levels following applications to sewers.

2.2.4.1 Occupational Exposure Scenarios

Traditional postapplication occupational exposure assessments concentrate on postapplication dermal exposures to treated surfaces. However, in the postapplication exposure assessment following metam sodium applications, HED is concerned about inhalation exposures to MITC to occupational workers who are performing tasks:

Workers Near Treated Areas

Based on available MITC air concentration data, HED has concerns about occupational workers performing tasks near – but outside of – a metam-sodium-treated field. The WPS does not address situations involving workers performing tasks outside the treated area. These workers may be employees of the owner/operator of the agricultural establishment where the application is taking place, but they also may be employees on another nearby worksite. The exposure and risk associated with this scenario is addressed in **Section 3.4**

Workers In Treated Areas

The Worker Protection Standard for Agricultural Pesticides (WPS) completely prohibits occupational workers and other persons from entering treated areas following applications of fumigant pesticides until inhalation exposures are no longer a concern. The entry prohibition is applicable to the area (i.e., field) to which the fumigant was applied. Entry into fumigant-treated is permitted for handlers only and only when they are performing one of the following tasks: adding or adjusting a soil seal, to check on air concentration levels, or to aerate the treated area. The exposure and risk associated with this scenario is addressed in **Section 3.5**

2.2.4.2 Residential Exposure Scenarios

Based on available MITC air concentration data, HED has concerns about residential bystanders located near – but outside of – a metam-sodium-treated field. These may be adults or children who live and/or work near the treated field.

2.2.5 MITC Residential Bystander Risk Estimates

2.2.5.1 Risk Based on Off-Site Monitoring Data

Approach for Estimating Acute Exposure

The acute NOAEL of 660 ug/m3 is based on 1 to 8 hours of exposure. Ideally, acute MOEs would be estimated by comparing the NOAEL to 1-hour MITC exposure samples. In general, offsite air samples were taken for 4 hours and were used to estimate acute MOEs. It should be noted that 4-hour samples may not reflect 1-hour MITC peaks that could have occurred during a given 4-hour period and therefore may under represent to a small degree peak 1-hour MITC concentrations off-site.

Acute MOEs were calculated for each 4-hour sample. Summary tables show the number of samples taken at given distance (i.e. 'n' equals the sum of all the sample stations at that distance), the number of sample stations with concentrations that result in MOEs less than 10 (n <10) , and the range of MOEs (min and max).

The values from samples taken at similar distances around the fields were not averaged so that downwind locations would not be artificially lowered by concentrations measured at upwind locations. HED believes that it is not appropriate to group concentrations taken around a field into 1 sample distribution (e.g. samples taken 150 meters at points N, S, E, W of a field). Similarly, HED believes that it is not appropriate to average the 4-hour samples taken at each location over the 4-day sample period because this would underestimate the 1-hour MITC downwind concentrations. The intent of this exercise was to determine if a person located at a downwind location for 1 to 8 hours would have an MOEs of less than 10. Because air samples were not taken in every direction and distance from the treated fields, air dispersion modeling (and possibly future probabilistic/distributional models) will also be used to further characterize the extent to which bystanders are exposed to the concentrations that result in MOEs less than 10 (i.e. exposures that are greater than 66 ug/m3).

Approach for Estimating ST Exposure

The short-term (ST) inhalation HEC of 487 ug/m3 for MITC is applicable for residential bystander daily exposure (24 hour average) that could occur for 1 to 30 days. For this exposure scenario, 24-hour TWAs were estimated for each of the sampling stations and then compared to the ST HEC (HEC / 24hr TWA = ST MOE).

Risks were calculated for all of the available studies even though some may not be reflect current application practices or may not be compliant with current CDPR's TIB requirements and EPA labels. A summary of the risks estimated for all of the studies is included as **Appendix F**.

Table 10a shows acute and ST MOEs for a (1) sprinkler applications with standard water sealing, (2) sprinkler application with intermittent water sealing, (3) shank injection application with standard water sealing, (4) shank injection application with intermittent water sealing (5) drip application with no seal, and (6) drip application with a tarp. For each of these application scenarios, the most representative of the available studies was used to estimate acute and ST MOEs. MOEs for sprinkler application without water sealing was not included in **Table 10a** since the Metam Sodium Alliance and other stakeholders report that it no longer occurs in the United States (*SRRD should verify whether this is the case and ensure that labels prohibit sprinkler applications without water sealing*). MOEs for shank injection without a water seal were also not included in **Table 10a** based on several QA/QC issues with the data and concerns about some methodologies and inconsistencies.

Bar graphs of the estimated 4-hour and 24-hour TWA MITC concentrations for shank and sprinkler applications using both standard and intermittent water sealing are presented in **Appendix G** (time vs MITC concentration). All MITC concentrations were adjusted to reflect the application rate of 320 lbs ai per acre (i.e. the maximum rate on most but not all metam sodium product labels). 4-hour and 24-hour TWA MITC concentrations bar graphs for 274 to 300 meters are shown as **Graphs 1** to **8** (right after Table 10b).

As shown in **Table 10a**, in almost every study, there was at least one time period (and sometimes a substantial fraction of time periods) where the acute or ST MOE exceed the LOC. A 1 to 8 hour exposure to an MITC concentration of 66 ug/m^3 would result in an MOE of 10. Similarly, 24 hour average exposures to 16.2 ug/m^3 would result in an MOEs of 30.

There were several acute and ST MOEs that exceed the LOC in the most recent study submitted with measurements at distance up to 1,000 meters (0.6 miles). In the study (MRID 457037-01), metam sodium was applied with shank injection and sprinklers using a standard water sealing. In many cases the 24 hour concentration used to estimate ST MOEs exceeded LOC for acute exposures (~82% of 24-hr TWAs are greater than 66 ug/m3).

These point estimates are deterministic and do not show the distribution of risk to the bystander population. However, the risks estimated do show that if bystanders were located at the sample locations for 1 to 24 hours during the 4 days after application, their exposures would exceed the acute and ST LOCs for many time periods. For example, the MITC concentrations at the sample station located 300 meters east (station 'A') of the field edge in site1 of MRID 457037-01 exceed the 66 ug/m^3 9 out of 24 time periods (36 of 96 hours sampled) and exceed the 16.2 ug/m3 on all 4 days that sampling was conducted. Future probabilistic modeling will help to more fully characterize the likelihood that this will occur for the bystander population.

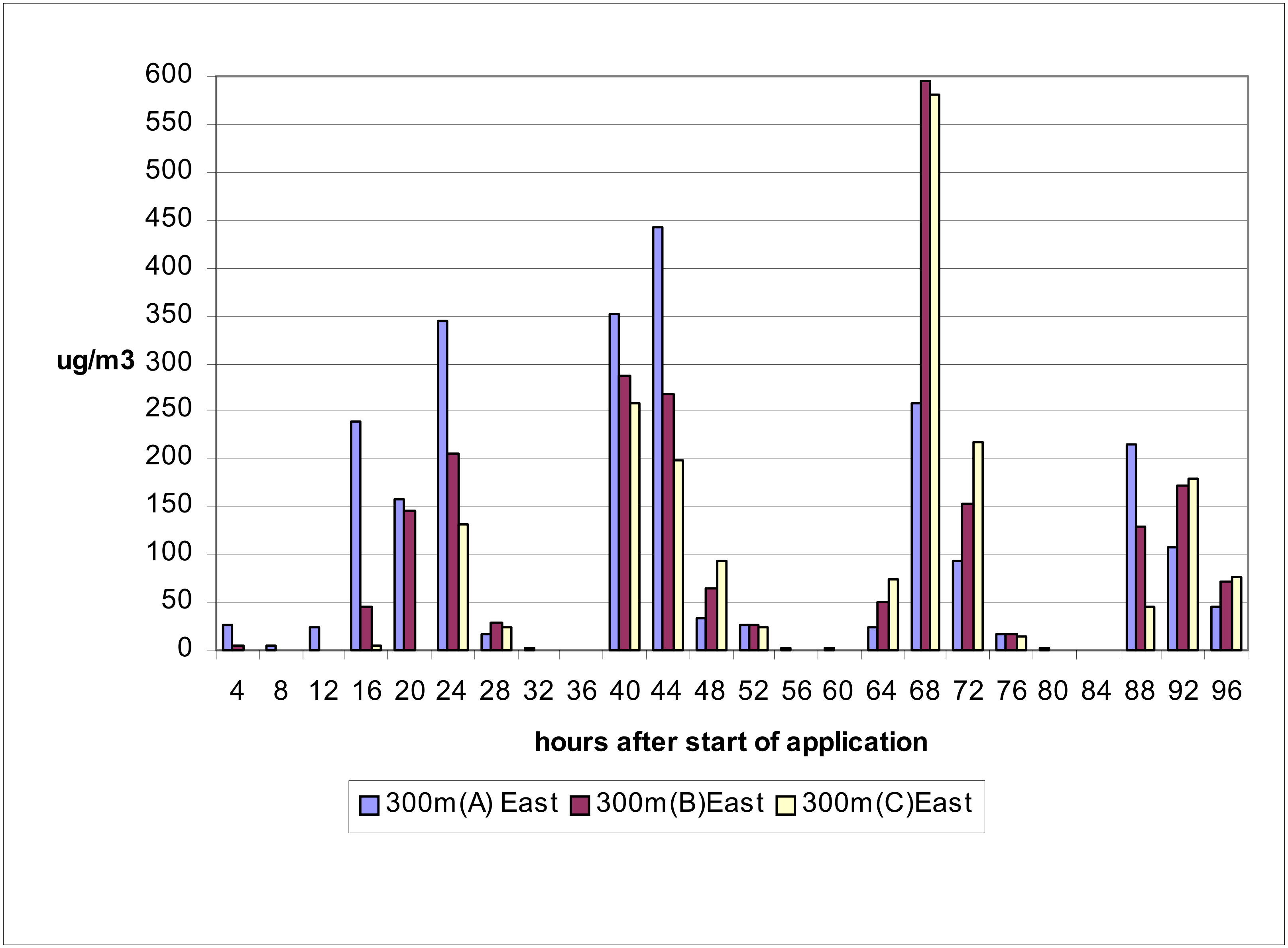
Table 10b summarizes the meteorological conditions reported for each of the studies in **Table 10a**.

Table 10a. Off-Site MOEs												
Application Equipment	Type of Seal	Study Location (Year)/ MRID/ Soil Type	Distance from Field		Acute MOEs				ST MOEs			
			meters	feet	n	n < 10	Min	Max	n	n <30	Min	Max
Sprinkler	Standard Water Seal	Kern County (1999) 457037-01: Site 1 Sandy Loam Soil	150	492	72	37	1	13200	12	12	2	5
			300	984	72	27	1	13200	12	12	3	21
			700	2297	72	12	2	13200	12	10	5	46
			1000	3281	48	2	5	13200	8	1	13	1938
	Intermittent Water Seal	Kern County (2001) 457037-02 Silt Loam Soil	137	449	96	20	3	4299	16	11	4	1225
			274	899	192	10	4	4514	362	18	9	2319
			411	1348	24	0	17	4281	4	0	33	72
			549	1801	24	0	17	4281	4	0	47	99
Shank Injection	Standard Water Seal	Kern County (1999) 457037-01: Site 2 Sandy Loam Soil	150	492	72	24	1	13200	12	9	1.9	61
			300	984	72	17	1	13200	12	9	3	61
			700	2297	72	17	1	13200	12	9	4	53
			1000	3281	48	2	5	13200	8	1	13	1716
	Intermittent Water Seal	Lost Hill (2001) 457037-04 Clay Loam	150	492	116	9	2	1973	20	6	4	1208
			300	984	187	6	3	1993	32	4	8	1220
			500	1640	24	0	12	1617	4	0	46	1166
			700	2297	48	0	17	1637	8	0	45	1169
Drip	none	Orange County (1997) 457037-08: Site 1 Soil type no specified	3	10	20	0	15	375	Insufficient data to estimate 24-hour TWAs			
			6.1	20	10	1	7	60				
			15.2	50	10	1	7	63				
			45.7	150	10	0	12	93				
	Tarp	Orange County (1997) 457037-08: Site 2 Soil type no specified	3	10	18	1	8	440				
			6.1	20	12	1	6	13200				
			15.2	50	12	1	9	13200				
			45.7	150	12	1	8	252				

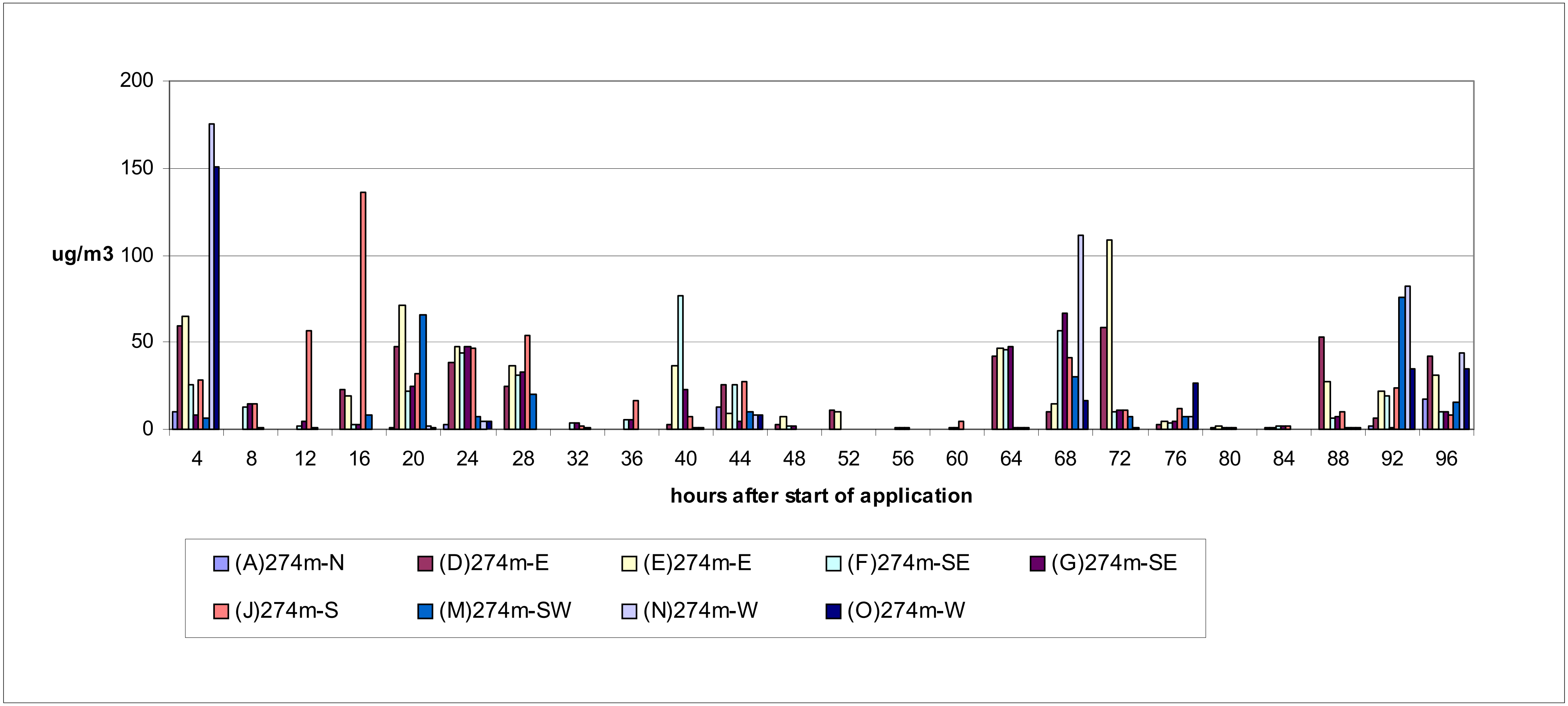
There were a total of 1392 samples collected in the six application sites. The samples times ranged from 152 to 334 minutes and average of 241 minute

Table 10b. Meteorological Conditions Reported for Off-Site Monitoring Studies								
Study/ Application Method/ Sealing Method	Air Temperature (°F)		Soil Temp (°F)	Relative Humidity (%)	Wind Direction (approx.)	Wind Speed (mph)		Vertical Wind Speed (mph)
	2m	10m				2m	10m	
457037-01 Site 1 Sprinkler- Std water seal	59-106	58-95	76-94	23-83	From N-N/W	0-8	0-10	0-0.9
457037-02 Sprinkler- Int water seal	60-93	60- 94	not specified	25-35 afternoon 70-90 night/morning	From N-N/W	0-9	0-10	not specified
457037-01 Site 2 Shank Injection- Std water seal	61-105	63-106	71-107	20-74	From N-N/W	0-7	0-9	0-0.9
457037-04 Shank Injection Int water seal	69-105		79-98	28-75	not specified	2-10		not specified
457037-08 Drip no tarp	50-81		not specified	not specified	not specified	0-21		not specified
457037-08 Drip Tarp	54-69		not specified	not specified	not specified	0-13		not specified

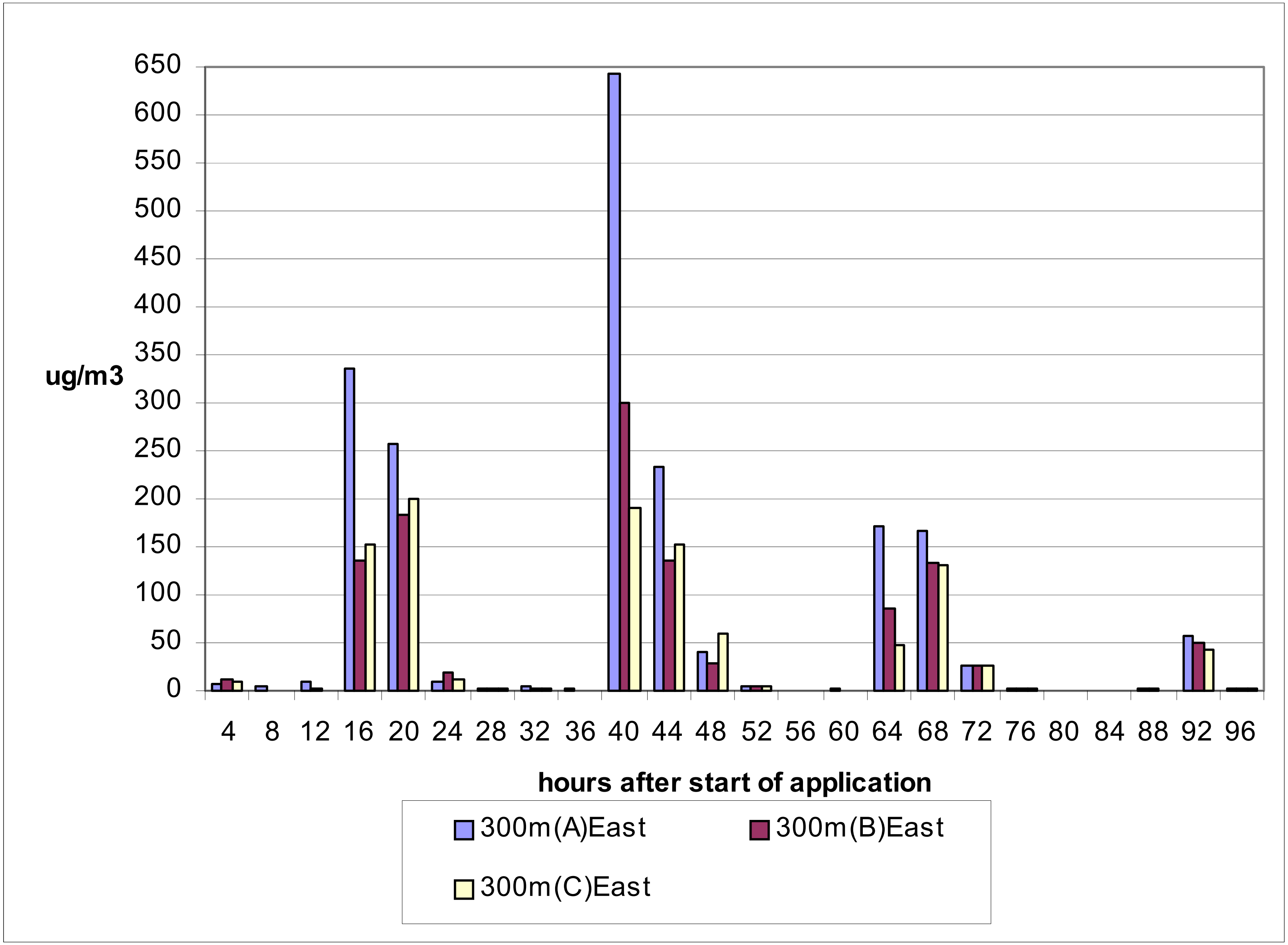
Graph 1. 4 Hour MITC Concentrations for 457037-01 Site 1, Sprinkler Application with Standard Water Seal



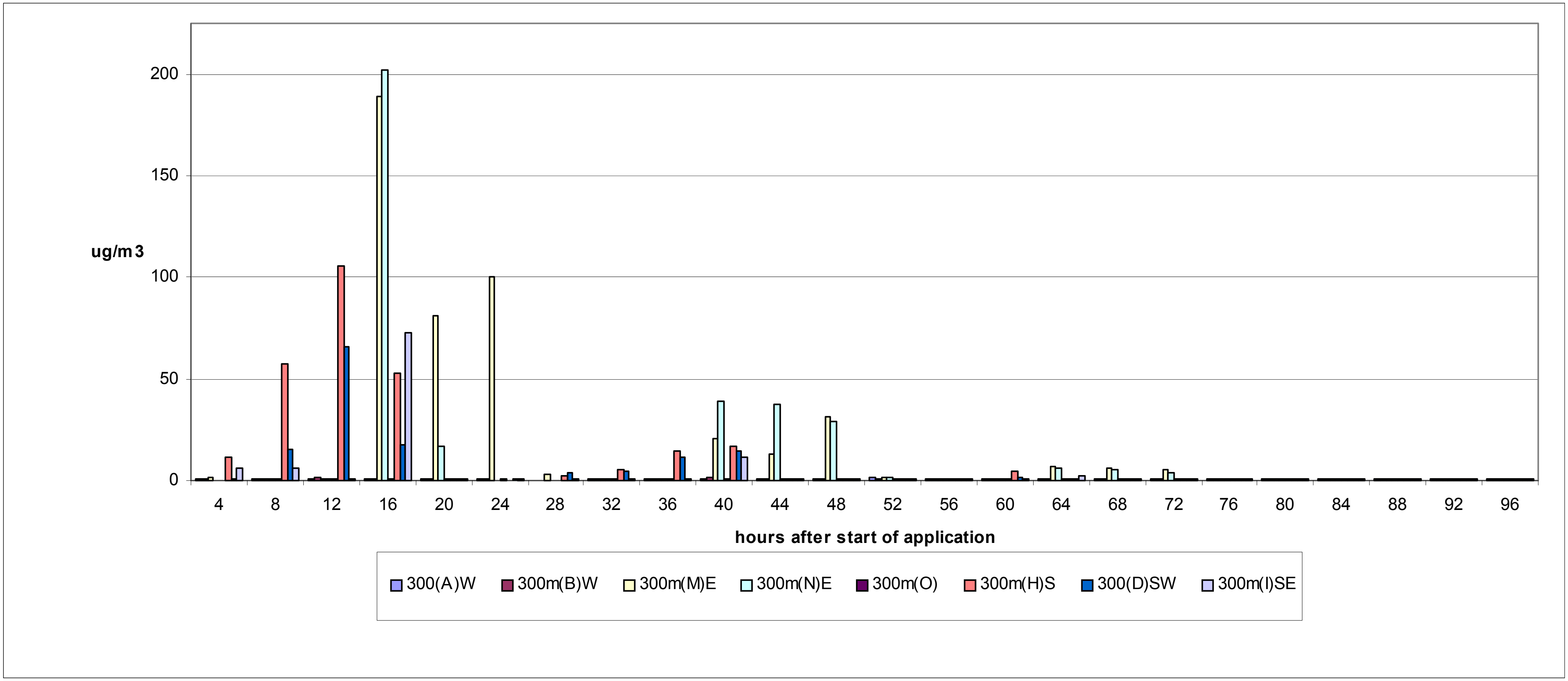
Graph 2. 4 Hour MITC Concentrations for 457037-02, Sprinkler Application with Intermittent Water Seal



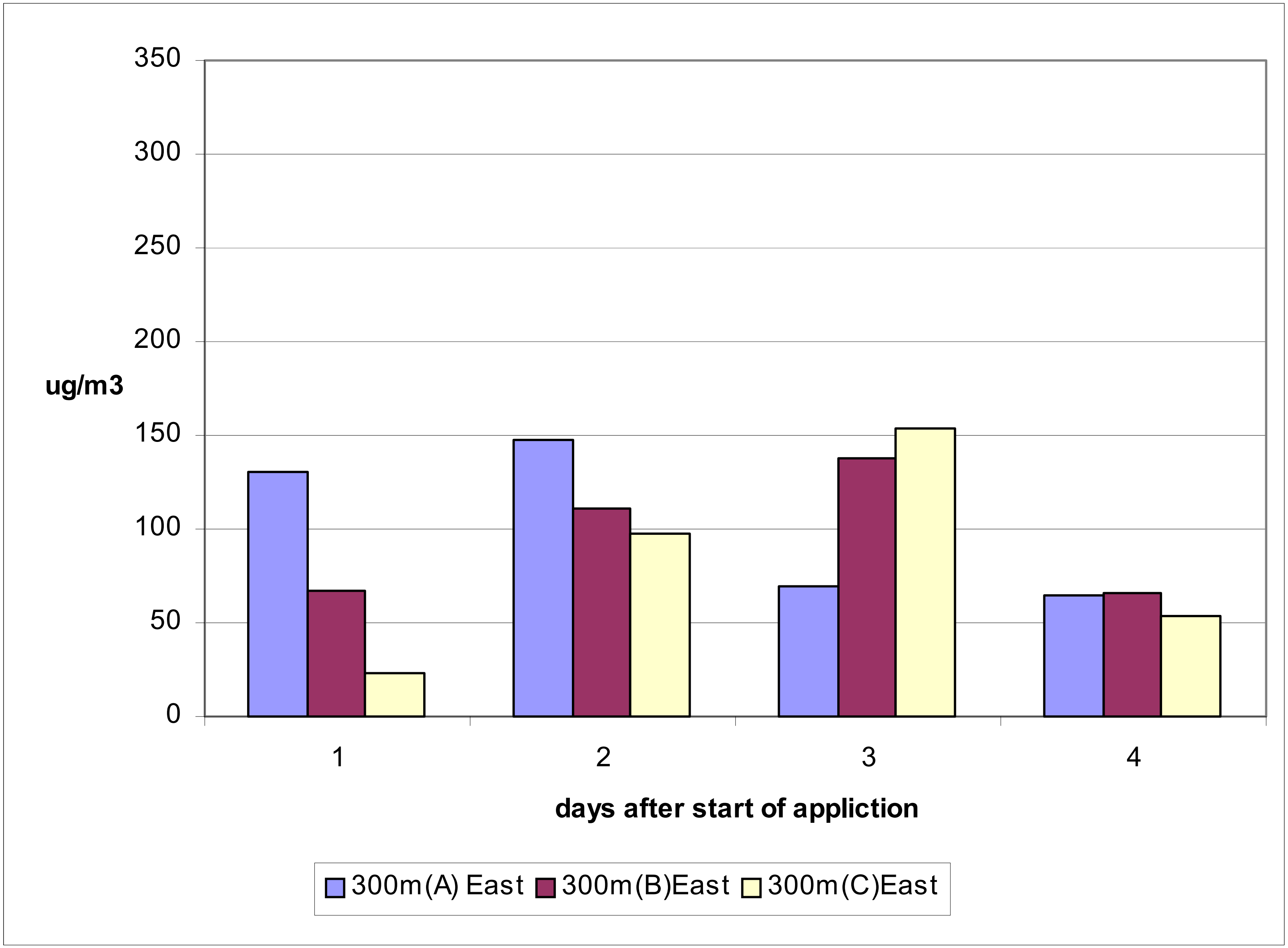
Graph 3. 4 Hour MITC Concentrations for 457037-01, Site 2, Shank Injection Application with Standard Water



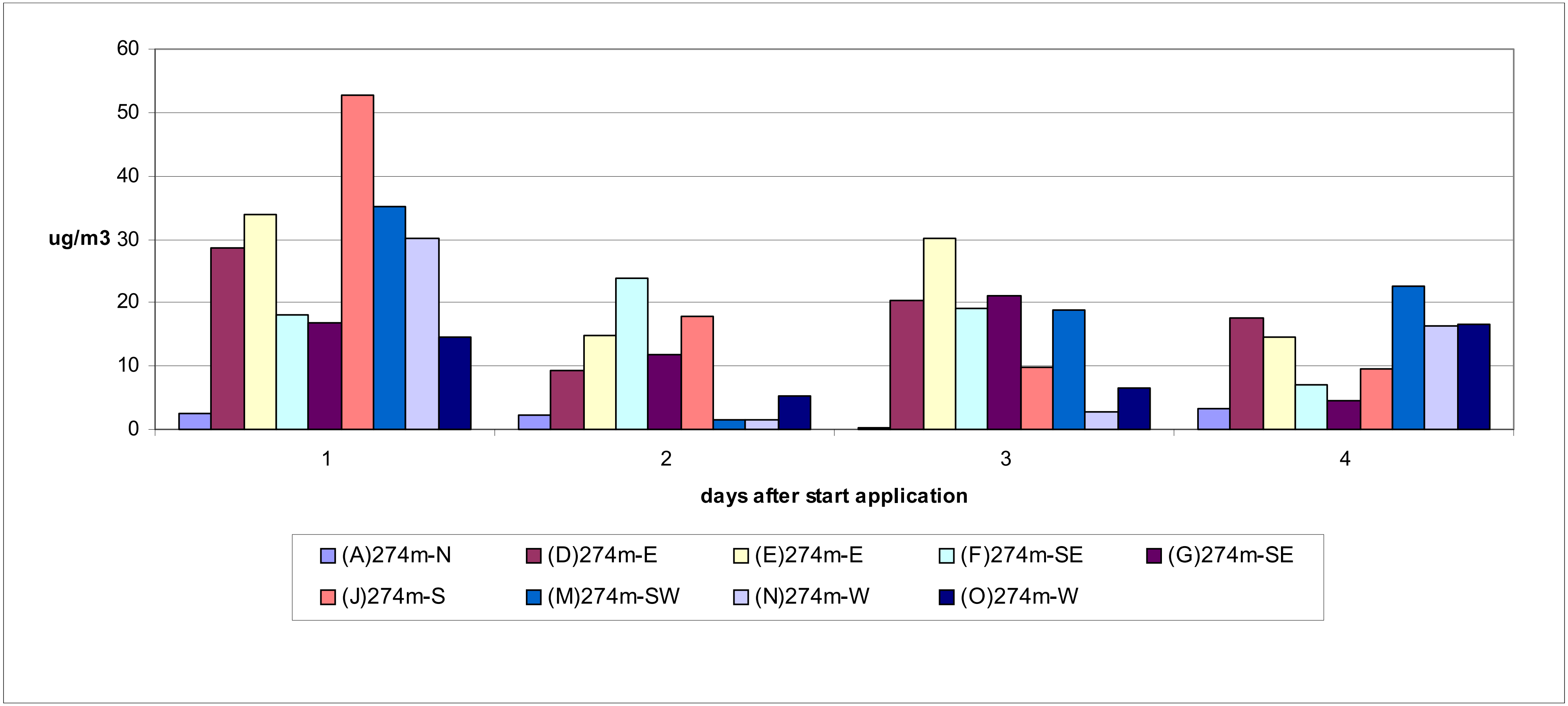
Graph 4. 4 Hour MITC Concentrations for 457037-02, Sprinkler Application with Intermittent Water Seal



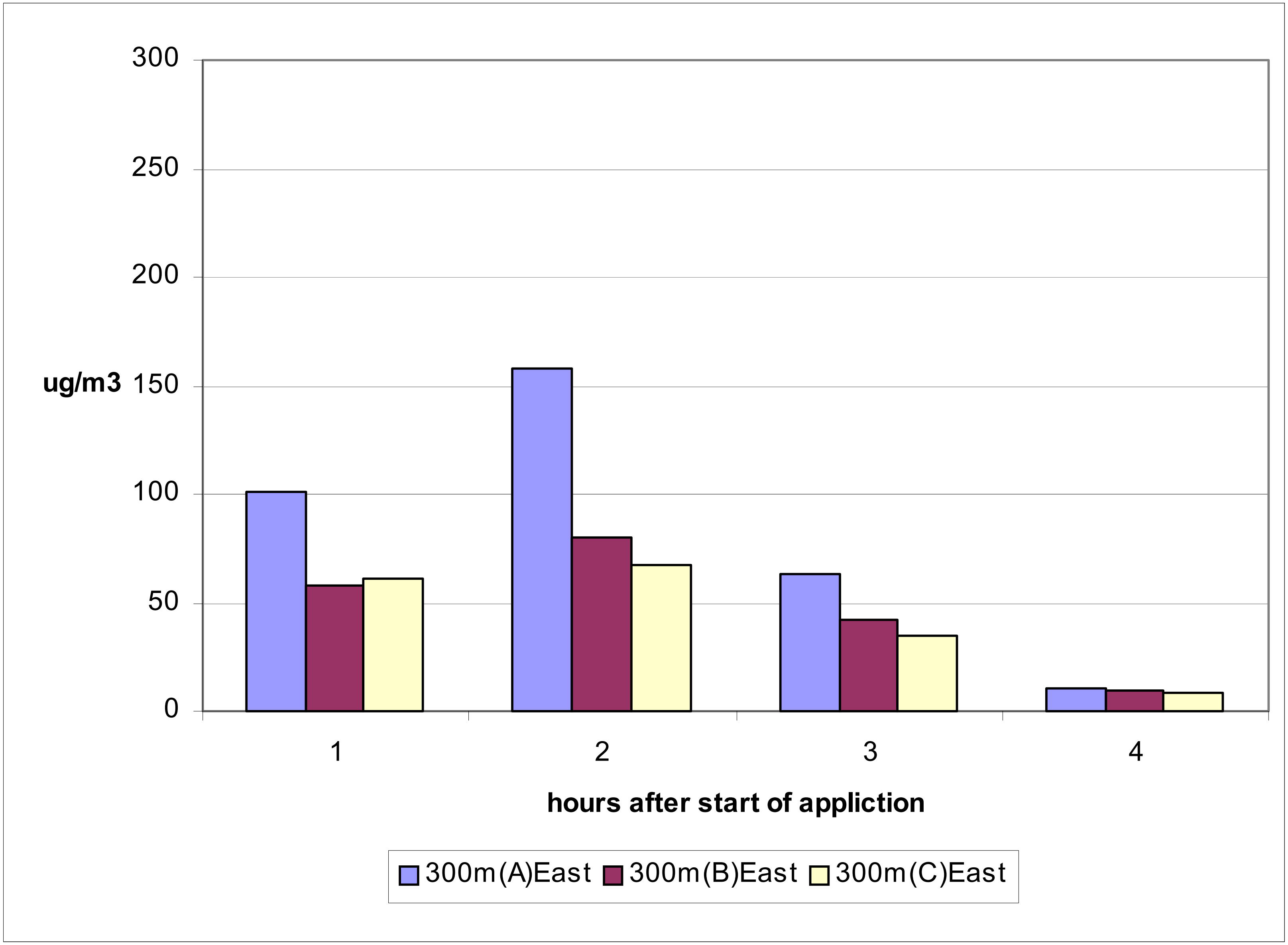
Graph 5. Estimated 24-hour TWA MITC Concentrations for 457037-01 Site 1, Sprinkler Application with Standard Water Seal



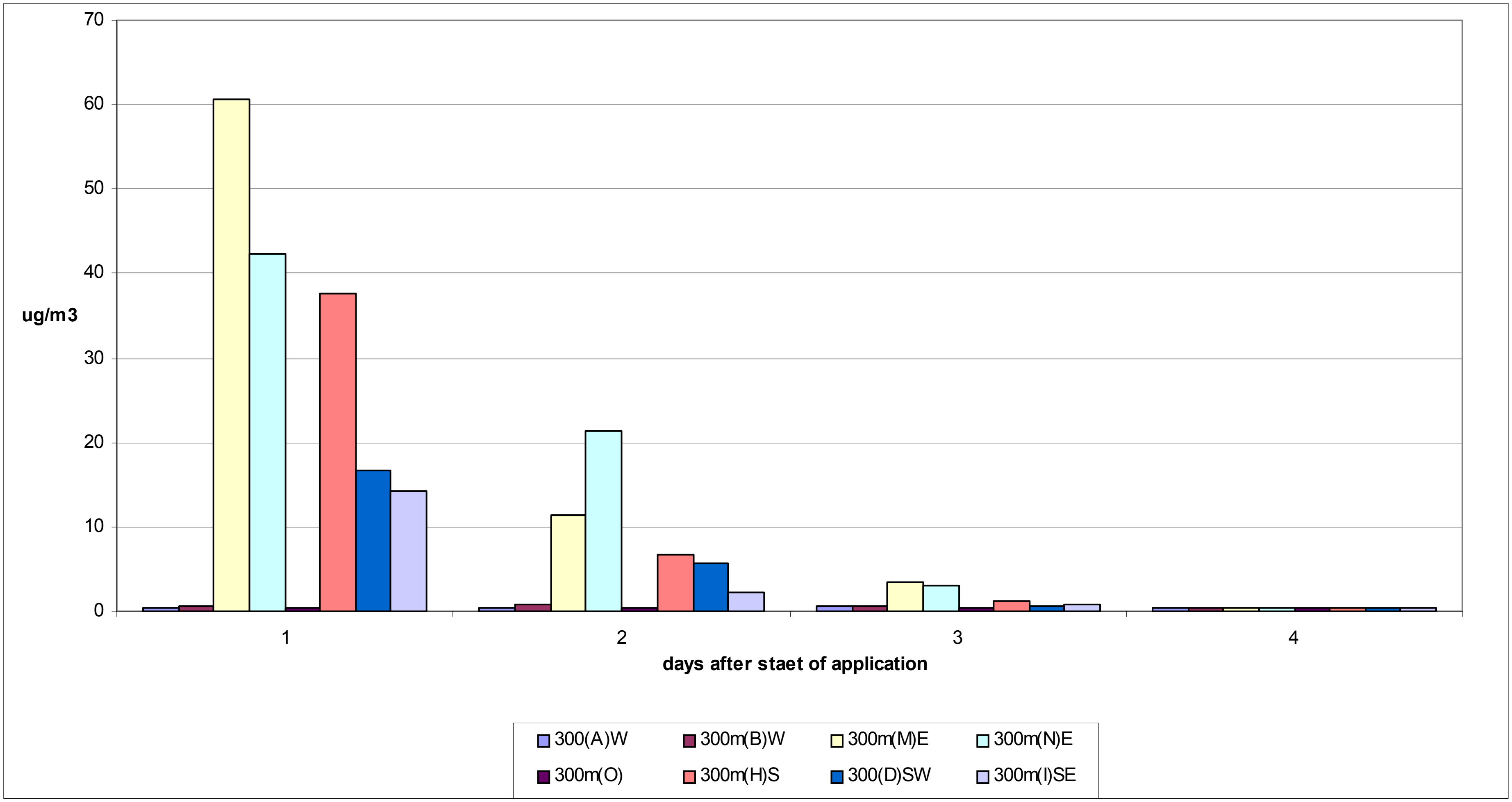
Graph 6. Estimated 24-hour TWA MITC Concentrations for 457037-02, Sprinkler Application with Intermittent Water Seal



Graph 7. Estimated 24-hour TWA MITC Concentrations for 457037-01, Site 2, Shank Injection Application with Standard Water



Graph 8. Estimated 24-hour TWA MITC Concentrations for 457037-02, Sprinkler Application with Intermittent Water Seal



2.2.5.2 Risk Based on Ambient Monitoring Data

For each of the ambient studies identified in **Section 2.2.1.2**, the maximum and average MITC 24-hour concentration was estimated. Acute MOEs were calculated based on the maximum concentration and the ST/IT MOE was based on the average.

The agency considers exposures for more than 180 days per year as long-term (LT). Registrants believe that exposures to bystanders are not long-term. However, CDPR estimated that bystanders in California are exposed to MITC for 188 days per year. In the study conducted by Sieber (1999), MITC 24-hour TWA concentrations up to 4.9 ug/m^3 were estimated for the inside of homes in the winter time. In that same study MITC concentrations measured inside and outside home were equivalent. HED has no other data on frequency of exposure for bystanders in the California or other metam sodium use areas in the US. Long term exposure were estimate by amortizing 24-hour concentration for 188 days per year. Exposure estimates can be refined with additional usage data and long-term monitoring data.

Table 11 summarizes the estimated acute, ST, IT, and LT MOEs based on the available ambient data. None of the estimated acute, ST, IT, and LT MOEs exceed the LOC.

Table 11. Ambient MOEs

Study	Duration of Study	Location	n	MITC Conc (ug/m3)			MOEs		
				Max	Avg 24-hr	Study Average	Acute	ST/IT	LT
Bakersfield (Seiber *et al.*, 1999)	12 hour samples 4 samples/month during May, June, July, Jan, Feb, March	Summer - inside	88	19.62	0.77	0.58	34	637	1624
		Summer - outside	41	23.05	0.97		29	500	
		Winter - inside homes	14	4.90	0.32		135	1546	
		Winter - outside	31	3.62	0.28		182	1771	
Kern (2001)	24 hour samples 33 sample days during 8 week period	ARB	33	1.7	0.50	1.00	388	974	946
		ARV	33	4.4	1.00		150	487	
		CRS	33	0.3	0.10		2640	4870	
		MET	33	4.3	0.40		153	1218	
		MVS	33	22.0	2.50		30	195	
		VSD	33	9.6	1.50		69	325	
Monterey/Santa Cruz (2001)	24 hour samples 32 sample days during 8 week period	CHUT	31	0.042	0.04	0.05	15714	11595	20480
		LJET	32	0.042	0.04		15714	11595	
		MEST	32	0.042	0.04		15714	11595	
		PMST	31	0.042	0.04		15714	11595	
		SALT	32	0.042	0.04		15714	11595	
		SEST	32	0.43	0.07		1535	7269	

MITC values were based on values reported by DPR.
Acute MOE = 660 ug/m3 NOAEL / maximum MITC Concentration
ST/IE MOE = 487 ug/m3 HEC / Avg 24-hr Concentration
LT MOE = 487ug/m3 HEC / [(Avg 24-hr Concentration for Study) * (188 days/365 days)]

2.2.7 Postapplication Assessment Data Gaps and Uncertainties

Available off-site and ambient monitoring data were available for the state of California only. Metam sodium is also widely used in other states including Washington, Arizona, and Florida. It has been suggested by registrants and other stakeholders that off-site monitoring data conducted in areas such as Kern County, California represents a reasonable worst case of MITC concentrations compared to other metam sodium use areas based on the soil type (sandy loam) and meteorological conditions. The registrants should provide the Agency data to characterize the representativeness of available off-site monitoring data.

The results of the acute and ST bystander MOEs for off-site monitoring indicate MOEs that exceed the LOC. As previously mentioned, there were several issues of concern for many of these studies.

There was no off-site monitoring for several application methods (e.g. rotary tiller applications or for handheld/stationary equipment) and sealing methods (e.g. rolling and dragging to compact soil). Studies reflecting these methods are considered data gaps.

HED has no data for MITC air concentration levels within a treated area 48 hours after the applications are completed which is the time current labels allow workers to reenter.

HED has no data on MITC air concentration levels when soil is disturbed prior to planting. Metam sodium labels recommend for heavy soils that users cultivate sealed areas approximately 5 to 7 days following application to aerate the soil. Also, 5 to 14 days after metam sodium is applied with spray blade injection, the soil cap/mound is fattened.

HED also has no data to accurately assess the distance from the edge of a treated field where exposure to MITC is no longer of concern. Available off-site monitoring data did not assess air concentration levels at distances of sufficient length to permit HED to calculate at the distance that acute MOEs = 10 and ST MOEs = 30.

Data uncertainties, include insufficient information on the influence of the following on MITC air concentration levels immediately following metam sodium applications:

- wind speed and direction,
- air and soil temperature,
- application rate,
- tarps as a soil seal,
- size of treated area,
- indoor versus outdoor exposures, and
- various application equipment and application techniques.

All postapplication exposure and risk estimates in this assessment are based on a **single treated field.** The exposure and risk for exposure from multiple treated fields **was not** factored in any of the calculations used in this assessment.

There was no data submitted to evaluate applications in small areas such as greenhouses (with open sides) or lawns. These are also considered data gaps. Data gaps for handler and bystander are also summarized in **Appendix H**.

3.0 Postapplication Occupational and Residential (Bystander) Exposures and Risks Based on Dispersion Modeling

Since the available methyl isothiocyanate (MITC) data were insufficient to permit HED to establish the distance from the perimeter of treated fields where risks would not be a concern to occupational agricultural workers or bystanders. HED used the Industrial Source Complex (ISC) dispersion model to estimate ambient MITC air concentrations in and near treated fields. The ISC permitted HED to factor into the MITC postapplication exposure and risk assessment some of the items listed as uncertainties for the traditional postapplication risk assessment, including wind speed, wind direction, air temperature, and size of treated area. The model was used to predict MITC air concentration levels at varying distances from the perimeter of metam-sodium-treated fields.

3.1 Data and Assumptions for Postapplication Dispersion Modeling

3.1.1 Assumptions for Postapplication Dispersion Modeling

A series of assumptions and exposure factors served as the basis for completing the postapplication dispersion modeling for MITC. The assumptions and factors used in the model include:

- **ICS Analysis Exposure Durations:**
  - For *occupational workers performing tasks near treated areas*, an exposure duration of **8 hours** is used;
  - For *occupational workers reentering treated areas*, exposure durations of **1 and 8 hours** are used;
  - For *residential bystanders*, exposure durations of **1 and 24 hours** are used, representing acute and short-term exposures.

- **Size of Treated Areas:** Sizes of treated areas from the different field volatility studies ranged from 4 acres to 80 acres. The ratio of the field lengths to the field widths for the treated fields in the field volatility studies ranged from 1:1 to 16:1. For the sake of simplicity, it was assumed that the treated areas were square and that one side was oriented from North to South with the origin at the southwest corner. Analysis were performed for treated-areas sizes of 1, 5, 10, 20, and 40 acres. **Table 12** depicts the treated-areas sizes and the associated side dimensions that were used in the analysis.

Table 12: Field Sizes and Corresponding Side Dimension Used in ISC Analysis	
Field Size (acres)	**Side Dimension (m)**
1	64
5	142
10	201
20	285
40	402

- **Meteorological Data:** ISC calculates downwind air concentrations using hourly meteorological conditions, that include wind speed and atmospheric stability. The lower the wind speed and the more stable the environment, the higher the air concentrations are going to be close to a treated area (or source). Conversely, if wind speed increases or the atmosphere is less stable, then air concentrations are lowered in proximity to the treated area. Atmospheric stability is essentially a measure of how turbulent the atmosphere is at any given time. Stability is affected by solar radiation, wind speed, cloud cover, and temperature among other factors. If the atmosphere is unstable then more off-target movement of airborne residues is possible because they are pushed up into the atmosphere and moved away from the source thereby lowering concentrations in close proximity to the source (e.g., treated field). To simplify modeling the transport of soil fumigant vapors from a treated field, a single wind direction, wind speed, and stability category are used for a given period. The Agency has not decided upon a particular set of meteorological conditions for final regulatory purposes but instead has decided to present a series of results based on a range of possible, and plausible, meteorological conditions in order to allow for a more informed risk management decision (**Table 13**). [Note: DPR based its buffer zone estimates on a windspeed of 1.4 m/s and a class C atmospheric stability value for a 24-hour period and a windspeed of 1 m/s and a class F atmospheric stability value for a 1-hour period. Both factors are, in and of themselves, likely to be protective, but when coupled together are generally thought to be very conservative. These conditions are included in the range of conditions considered in the Agency's assessment as detailed in **Table 13.**] Discussions with CDPR indicated that a rural mixing height of 692 meters was applicable during modeling to account vertical mixing during "C"stability conditions.

Table 13. Meteorological Combinations Used in ISC Calculations		
Wind Speed (mph)	**Wind Speed (m/s)**	**Stability Category**
2.25	1	F
2.25	1	D
3.1*	1.4*	C*
4	1.8	C
5	2.2	C
6	2.7	C
7	3.1	C
8	3.6	C
9	4	C
10	4.5	C
10	4.5	B

= The lower the assigned "letter" the less stable the atmosphere. Categories A to D are generally seen in daylight conditions. Nighttime conditions are generally even more stable than even the most stable daylight conditions.
* = Conditions used in DPR assessment and risk management decisions.

3.1.2 Determining Flux Rates for Use in Postapplication Dispersion Modeling

For those studies where sufficient information was available to estimate the flux rates for MITC being released from treated fields, the following study-specific information were entered into the appropriate ISC input files, along with a constant flux rate of 0.01 g/m^2-s:

- the dimensions of the treated fields,
- the locations of the sampler masts, and
- the available meteorological data for the period in question

The air concentrations predicted from the model were compared to the measured concentrations reported in the field volatility study. The estimated flux rates were determined by dividing the average measured value by the average modeled value and multiplying the result by the model flux rate (0.01 g/m^2-s) and by a conversion factor of $1x10^6$ µg/g. Least squares and major axis regressions were also performed on the measured and modeled data and the results were similar to those obtained using the aforementioned averaging method. The averaging method was also used to estimate the flux rate in the five studies where flux rates were reported. These techniques are consistent with the methodology outlined in California's Department of Pesticide Regulation's Workbook for Gaussian Modeling Analysis of Air Concentration Measurements.

To estimate the risk from potential MITC inhalation exposure to residential bystanders, HED estimated the MITC air concentration using 1- and 24-hour time frames. However, flux rates were estimated using 4-hour periods, starting from the time the soil fumigant is first applied to 48 hours after the start of application. Average estimates were determined for 24-hours using the 4-hour flux rates. A 1-hour estimate could only be determined assuming that the flux rate remained constant over the 4 hours.

The risk for potential inhalation exposure to occupational agricultural workers performing tasks near treated fields was estimated from an average 8-hour flux rate using the 4-hour flux rates, similar to the method mentioned above for residential bystanders.

To determine the flux rates for a particular application method, HED employed a three-step approach, HED:

- first normalized all of the 4-hour flux rates using the maximum agricultural application rate for metam sodium of 320 lbs ai/acre (not including applications to turf or to tobacco planting beds), to normalize the study application rates to the maximum agricultural rate.
- then estimated the maximum 4-, 8-, and 24-hour average flux rates for each field volatility study.
- lastly compared field studies with similar application and sealing methods and the largest flux rates for the 4-, 8-, and 24-hour time periods were selected.

It should be noted that because of the way data were reported in the drip irrigation study, some of the flux rates had to be estimated for missing time periods. As a result, the average flux rate values appear higher for tarped fields than they do for untarped fields.

3.1.3 Flux Rates for Postapplication Dispersion Modeling

Metam sodium produces MITC when applied to soil. Several studies were submitted to EPA that measured MITC air concentration levels following applications of metam sodium with shank injection, sprinkler, and drip application equipment. The air concentration levels were measured at various time periods following application (e.g., 4 hours, 8 hours, 24 hours, etc.), at various distances from the edge of the treated field (e.g., 15 meters, 150 meters, 300 meters, etc.) and in various directions from the treated field (e.g., north, south, east, west, etc.). In all, 12 postapplication exposure studies were submitted covering 13 application sites – six were conducted following metam sodium applications using shank injection equipment, six were conducted following metam sodium applications using sprinkler irrigation equipment, and one was conducted following metam sodium applications using drip irrigation equipment. Soil sealing methods for the available off-site studies included standard water sealing, intermittent water sealing, and tarps. HED had several QA/QC issues with the studies and concerns about some methodologies and inconsistencies.

Flux rates (i.e., the emission rate of MITC from the treated area divided by the size of the treated area) were estimated directly for five of the ten studies. Three of the remaining five studies provided enough information that MITC flux rates could be estimated using the ISC model. A list of the studies is provided in Table 14. Summaries of the flux rates, both reported and estimated, are provided in Tables 15, 16, and 17.

Table 14. Summary of Field Volatility Studies Used in Metam Sodium Ambient Air Concentration Analysis						
Study ID	**Application Method**	**Application Rate (lbs ai/acre)**	**Study Date**	**Application Time**	**Seal Type**	**Flux Rate Determined ?**
457037-02	Sprinkler irrigation	318	37123	Day 1, 05:00 - 11:30	Intermittent	No
457037-06	Sprinkler irrigation	320	36597	Day 1, 07:30 - 12:30	Intermittent and Standard	Yes
457037-07	Sprinkler irrigation	203	37061	Day 1, 05:00 - 11:00	Intermittent and Standard	Yes
EH94-02	Sprinkler irrigation	320	34183	Day 1, 19:40 - Day 2, 01:40	Standard	No
426599-01	Sprinkler irrigation	320	33725	Day 1, 16:52 - 20:52	None	Yes
457037-01	Shank Injection Sprinkler irrigation	160*** 320	36507	Day 1, 07:30 - 11:30	Standard Standard	Yes**
457037-04	Shank Injection	160***	36689	Day 1, 06:50 - 11:40	Intermittent	No
457037-05	Shank Injection	160***	36668	Day 1, 07:30 - 11:30	Intermittent and Alternate	Yes
C94-046A*	Shank Injection	155	34933	Day 1, 12:00 - 24:00	None	No
457037-8	Drip Irrigation	320	35463	Day 1, 18:00 - 22:00	Tarped and Untarped Fields	Yes

* - Insufficient information to estimate flux rate.
** - Report provided did not include flux rates. Flux rates for study found in supplemental report.
*** - For shank injection, only 50% of the field was treated. Therefore, the application rates of 320 lbs ai/treated acre were converted to 160 lbs ai/total acre by dividing by 2.

Table 15. Flux Rates (in μg/m²-s) Reported and Estimated from Field Volatility Studies for Sprinkler Irrigation																			
Day	Period (Start Hour and End Hour)	457037-01		457037-02		457037-06				457037-07				EH94-02		426599-01			
		Standard Seal		Intermittent Seal		Intermittent Seal		Standard Seal		Intermittent Seal		Standard Seal		Standard Seal		No Seal			
Flux Rate Reported or Estimated?		Reported	%[1]	Estimated	%[1]	Reported	%[1]	Reported	%[1]	Reported	%[1]	Reported	%[1]	Estimated	%[1]	Reported	%[1]		
1	0 - 4	35.85	1	60.45	2	21.1	1	16	1	77.63	5	89.77	6	297	12	0.0296	<1		
1	4 - 8	91.65	5	12.56	3	NR	-	NR	-	34.09	7	148.8	15	274	23	0.0757	<1		
1	8 - 12	41.42	7	53.42	5	45.5	3	36.7	2	159.19	17	318.325	35	127	28	0.0555	<1		
1	12 - 16	119.3	12	26.91	6	NR	-	NR	-	16.97	18	320.525	55	86	31	0.0482	<1		
1	16 - 20	66.77	15	11.38	6	34.7	4	22.2	3	17	19	212.23	68	45	33	0.0193	<1		
1	20 - 24	232.25	24	9.73	6	NR	-	NR	-	15.85	20	135.28	77	58	36	0.0169	<1		
2	0 - 4	7.21	24	21.22	7	12.9	5	12.8	4	21.47	21	NR	-	38	37	0.0107	<1		
2	4 - 8	62.26	26	3.20	7	NR	-	NR	-	31.29	23	NR	-	18	38	0.0085	<1		
2	8 - 12	41.42	28	17.48	8	3.2	5	4.6	4	27.38	25	NR	-	18	39	0.0045	<1		
2	12 - 16	40.98	30	13.19	9	NR	-	NR	-	16.97	26	NR	-	14	39	0.0035	<1		
2	16 - 20	51	32	5.54	9	2.6	5	1.9	4	17	27	NR	-	11	40	0.0029	<1		
2	20 - 24	6.29	32	1.83	9	NR	-	NR	-	25.26	29	NR	-	11	40	0.0018	<1		

NR - Not reported or was not estimated.
[1] % indicates the Cumulative percentage lost from the total amount applied.

Table 16. Flux Rates (in μg/m²-s) Reported and Estimated from Field Volatility Studies for Shank Injection									
Day	Period (Start Hour and End Hour)	457037-01		457037-04		457037-05			
		Standard Seal		Intermittent Seal		Intermittent Seal		Alternate Seal	
Flux Rate Reported or Estimated?		Reported	%[1]	Estimated	%[1]	Reported	%[1]	Reported	%[1]
1	0 - 4	3.5	0	6.03	0	7.41	1	8.73	1
1	4 - 8	21.42	2	28.37	3	NR	-	NR	-
1	8 - 12	15.95	3	30.91	5	30.54	3	25.65	3
1	12 - 16	51.07	7	15.35	6	19.75	5	11.36	4
1	16 - 20	64.26	13	3.92	7	0.59	5	3.04	4
1	20 - 24	32.86	15	10.25	8	NR	-	NR	-
2	0 - 4	3.5	15	2.58	8	0.65	5	1.25	4
2	4 - 8	5.2	16	3.95	8	NR	-	NR	-
2	8 - 12	5.04	16	6.47	3	4.03	6	3.8	5
2	12 - 16	82.71	23	3.29	9	NR	-	NR	-
2	16 - 20	64.26	28	1.56	9	0	6	0.16	5
2	20 - 24	63.29	33	2.3	9	NR	-	NR	-

NR - Not reported or was not estimated.
[1] % indicates the Cumulative percentage lost from the total amount applied.

Table 17. Flux Rates (in μg/m²-s) Reported and Estimated from Field Volatility Studies for Drip Irrigation					
Day	Period (Start Hour and End Hour)	457037-08			
		Tarped Field		Untarped Field	
Flux Rate Reported or Estimated?		Reported	%[1]	Reported	%
1	0 - 4	14.93	1	3.68	0
1	4 - 8	10.61 *	1	6.54 *	0
1	8 - 12	6.29	1	9.39	1
1	12 - 16	3.87	1	3.98	1
1	16 - 20	3.87**	2	3.98**	1
1	20 - 24	3.87**	2	3.98**	1
2	0 - 4	3.7	2	10.36	2
2	4 - 8	NR	-	NR	-
2	8 - 12	NR	-	NR	-
2	12 - 16	2.35	2	2.05	2
2	16 - 20	NR	-	NR	-
2	20 - 24	NR	-	NR	-

NR - Not reported or was not estimated.

Notes:
* - No values were reported for this period. Values were calculated by taking the average of Periods 0-4 and 8-12 for Day 1, assuming linearity between two periods. **This time period occurred between 10pm and 1am. However, this value may be an under estimate if the flux rate peaked during this time frame.**
** - No values were reported during these periods. It was assumed that the flux rates for these periods were the same as those reported in Period 12-16 for Day 1. **This time period occurred between 10am and 6pm. However, this value may be an under estimate if the flux rate peaked during this time frame.**
[1] % indicates the Cumulative percentage lost from the total amount applied.

To be conservative, HED selected the maximum flux rates from the aforementioned studies for the different application methods, sealing methods, and time periods of concern. Pilot studies were excluded from consideration. These studies included 457037-05, 457037-06, and 457037-07. However, because the only available data for drip irrigation was from a pilot study, Study 457037-08 was included in the flux rate analysis. The remaining studies were analyzed to determine the maximum flux rates. For example, for sprinkler irrigation with standard seal, the maximum flux rates occurred in study 457037-01. The maximum 1-hour flux rate occurred during Day 1, between hours 20 and 24. The maximum 8-hour flux rate occurred during Day 1, between hours 16 and 24. The maximum 24-hour flux rate occurred during Day 1, between hours 0 and 24.

To normalize the flux rates for various application and sealing methods, the maximum application rate of 320 lbs ai/acre was used. The flux rates are shown in **Table 18.**

Table 18. Flux Rates Used in Analysis

Application Method	Conditions	Study Basis	Study Application Rate (lbs ai/acre)	1-hour Flux Rate (ug/m^2-s)	8-hour Flux Rate (ug/m^2-s)	24-hour Flux Rate (ug/m^2-s)
Sprinkler irrigation	Standard Seal	457037-01	320	232	149	98
	Intermittent Seal	457037-02	320	61	40	29
Shank Injection	Standard Seal	457037-01	160*	83	74	37
	Intermittent Seal	457037-04	160*	31	30	16
Drip Irrigation	Tarped	457037-08	320	15	13	7
	Untarped	457037-08	320	10	8	5

* - Equivalent to 320 lbs ai/treated acre.

3.2 MITC Occupational and Residential Postapplication Exposure Scenarios

3.2.1 Occupational Exposure Scenarios

Traditional postapplication occupational exposure assessments concentrate on postapplication dermal exposures to treated surfaces. However, in the postapplication exposure assessment following metam sodium applications, HED is concerned about inhalation exposures to MITC to occupational workers who are performing tasks:

- in treated areas, and
- near treated areas.

Workers Entering into Treated Areas: The Worker Protection Standard for Agricultural Pesticides (WPS) completely prohibits occupational workers and other persons from entering treated areas following applications of fumigant pesticides until inhalation exposures are no longer a concern. The entry prohibition is applicable to the area (i.e., field) to which the fumigant was applied. Entry into fumigant-treated is permitted for handlers only and only when they are performing one of the following tasks: adding or adjusting a soil seal, to check on air concentration levels, or to aerate the treated area. HED estimated the acute MOEs for the time at which the entry prohibition period on current labels is over (i.e 48 hours).

Workers Performing Tasks Near Treated Areas: Based on available MITC air concentration data, HED has concerns about occupational workers performing tasks near – but outside of – a metam-sodium-treated field. The WPS does not address situations involving workers performing tasks outside the treated area. HED estimated ST MOEs for occupational workers (i.e. occupational bystanders).

3.2.2 Residential Exposure Scenarios

Based on available MITC air concentration data, HED has concerns about residential bystanders located near – but outside of – a metam-sodium-treated field. These may be adults or children who live and/or work near the treated field. Acute and ST MOEs were estimated for residential bystanders. (*Acute MOEs estimated for residential bystanders would be the same for occupational bystanders*)

3.3 Non-cancer MITC Inhalation Risks for Residential Bystanders

HED ran ISC for each of the various application and sealing methods, treated-area sizes, and meteorological conditions to estimate the ambient concentration at different downwind distances.

Table 19 shows the estimated acute MOEs for at various distances for the different applications methods, sealing methods, and meteorological conditions. MOEs of 10 or greater are in **bold font**.

Table 20 shows the ST MOEs at the various distances for the different applications methods, sealing methods, and meteorological conditions. MOEs of 30 or greater are in **bold font**.

Table 19. ISC Calculated Acute MOEs At Selected Distances Downwind														
App. Meth.	ER (%)	Fld Size (A)	Dist (m)	Differing Meteorological Conditions										
				1 m/s 2.3 mph	1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab F	Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Sprinkler Irrigation, Standard Seal	2	1	25	<1	<1	<1	0	<1	1	1	1	1	1	1
			100	<1	<1	1	1	1	1	2	2	2	2	4
			500	1	2	6	8	**10**	**12**	**14**	**17**	**18**	**21**	**47**
		5	25	<1	<1	<1	<1	<1	<1	<1	1	1	1	1
			100	<1	<1	<1	1	1	1	1	1	1	1	2
			500	<1	1	2	2	3	3	4	4	5	6	12
		10	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	1	1
			100	<1	<1	<1	<1	1	1	1	1	1	1	2
			500	<1	<1	1	1	2	2	2	3	3	3	7
		20	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
			100	<1	<1	<1	<1	<1	1	1	1	1	1	1
			500	1	<1	1	1	1	1	2	2	2	2	4
		40	25	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1
			100	<1	<1	<1	<1	<1	<1	<1	1	1	1	1
			500	<1	<1	1	1	1	1	1	1	2	2	3
Sprinkler Irrigation, Intermittent Seal	1	1	25	<1	1	1	2	2	2	3	3	3	4	5
			100	1	1	3	4	5	6	6	8	8	9	**16**
			500	2	7	**24**	**31**	**39**	**47**	**55**	**60**	**66**	**83**	**165**
		5	25	<1	<1	1	1	1	1	2	2	2	2	4
			100	<1	1	2	2	2	3	3	4	4	5	7
			500	1	2	6	8	**10**	**12**	**14**	**17**	**18**	**21**	**44**
		10	25	<1	<1	1	1	1	1	1	2	2	2	3
			100	<1	1	1	2	2	2	3	3	3	4	6
			500	1	1	4	5	6	8	9	**10**	**12**	**13**	**26**
		20	25	<1	<1	1	1	1	1	1	1	2	2	3
			100	<1	<1	1	1	2	2	2	3	3	3	5
			500	<1	1	3	4	4	5	6	7	8	9	**17**
		40	25	<1	<1	<1	1	1	1	1	1	1	2	2
			100	<1	<1	1	1	1	2	2	2	2	3	4
			500	<1	1	2	3	3	4	5	5	6	7	**12**

Table 19. ISC Calculated Acute MOEs At Selected Distances Downwind														
App. Meth.	ER (%)	Fld Size (A)	Dist (m)	Differing Meteorological Conditions										
				1 m/s 2.3 mph	1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab F	Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Shank Injection, Standard Seal	2	1	25	<1	<1	1	1	1	2	2	2	2	3	4
			100	<1	1	2	3	3	4	5	6	6	7	**12**
			500	2	5	**18**	**23**	**28**	**35**	**39**	**47**	**51**	**55**	**132**
		5	25	<1	<1	1	1	1	1	1	1	2	2	3
			100	<1	<1	1	1	2	2	3	3	3	4	5
			500	1	2	5	6	8	9	**10**	**12**	**14**	**15**	**33**
		10	25	<1	<1	<1	1	1	1	1	1	1	2	2
			100	<1	<1	1	1	1	2	2	2	3	3	4
			500	<1	1	3	4	5	6	7	8	9	**10**	**19**
		20	25	<1	<1	<1	1	1	1	1	1	1	1	2
			100	<1	<1	1	1	1	1	2	2	2	2	3
			500	<1	1	2	3	3	4	5	5	6	7	**12**
		40	25	<1	<1	<1	<1	1	1	1	1	1	1	2
			100	<1	<1	1	1	1	1	1	2	2	2	3
			500	<1	1	2	2	2	3	3	4	4	5	9
Shank Injection, Intermittent Seal	1	1	25	1	1	2	3	4	4	5	6	7	8	**11**
			100	1	2	6	7	9	**11**	**13**	**15**	**17**	**18**	**31**
			500	4	**13**	**47**	**60**	**73**	**94**	**110**	**132**	**132**	**165**	**330**
		5	25	<1	1	2	2	2	3	3	4	4	5	7
			100	1	1	3	4	5	6	7	8	**9**	**10**	**14**
			500	2	4	**13**	**17**	**20**	**24**	**29**	**33**	**37**	**41**	**94**
		10	25	<1	1	1	2	2	2	3	3	4	4	6
			100	1	1	2	3	4	5	5	6	7	8	**11**
			500	1	3	8	10	13	15	18	21	23	25	51
		20	25	<1	1	1	1	2	2	2	3	3	4	5
			100	<1	1	2	3	3	4	4	5	6	6	9
			500	1	2	6	7	9	**11**	**12**	**14**	**16**	**18**	**33**
		40	25	<1	<1	1	1	2	2	2	3	3	3	4
			100	<1	1	2	2	3	3	4	4	5	5	8
			500	1	2	4	5	6	8	9	**10**	**12**	**13**	**23**

Table 19. ISC Calculated Acute MOEs At Selected Distances Downwind														
App. Meth.	ER (%)	Fld Size (A)	Dist (m)	Differing Meteorological Conditions										
				1 m/s 2.3 mph	1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab F	Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Drip Irrigation, Tarped Field	<1	1	25	1	2	5	6	8	9	**11**	**12**	**14**	**15**	**22**
			100	2	5	**12**	**15**	**19**	**23**	**26**	**30**	**35**	**39**	**66**
			500	8	**28**	**94**	**132**	**165**	**220**	**220**	**220**	**330**	**330**	**660**
		5	25	1	1	3	4	5	6	7	8	9	10	14
			100	1	3	6	8	**10**	**12**	**14**	**16**	**18**	**20**	**30**
			500	4	9	**26**	**35**	**41**	**51**	**60**	**66**	**73**	**83**	**165**
		10	25	1	1	3	3	4	5	6	7	8	9	**12**
			100	1	2	5	6	8	**10**	**11**	**13**	**14**	**16**	**24**
			500	3	6	**17**	**21**	**26**	**31**	**37**	**44**	**47**	**55**	**110**
		20	25	1	1	2	3	4	4	5	6	7	7	**10**
			100	1	2	4	5	6	8	9	**10**	**12**	**13**	**19**
			500	2	4	**11**	**15**	**18**	**22**	**25**	**29**	**33**	**37**	**66**
		40	25	<1	1	2	3	3	4	4	5	6	6	9
			100	1	1	3	4	5	6	7	9	9	**11**	**16**
			500	1	3	8	**11**	**13**	**16**	**18**	**21**	**24**	**26**	**47**
Drip Irrigation, Untarped Field	<1	1	25	2	3	7	9	**11**	**14**	**16**	**19**	**21**	**24**	**33**
			100	4	8	**18**	**23**	**29**	**35**	**39**	**47**	**51**	**60**	**94**
			500	**12**	**41**	**165**	**220**	**220**	**330**	**330**	**330**	**330**	**660**	**660**
		5	25	1	2	5	6	7	9	**10**	**12**	**13**	**15**	**21**
			100	2	4	9	**12**	**15**	**18**	**21**	**24**	**26**	**30**	**44**
			500	5	**13**	**39**	**51**	**60**	**73**	**83**	**110**	**110**	**132**	**330**
		10	25	1	2	4	5	6	8	9	**10**	**11**	**13**	**18**
			100	2	3	8	**10**	**12**	**14**	**17**	**19**	**21**	**24**	**35**
			500	4	9	**24**	**31**	**39**	**47**	**55**	**66**	**73**	**83**	**165**
		20	25	1	2	3	4	5	7	8	9	**10**	**11**	**16**
			100	1	3	6	8	9	**12**	**13**	**15**	**17**	**19**	**29**
			500	3	6	**17**	**22**	**26**	**33**	**37**	**44**	**47**	**55**	**110**
		40	25	1	1	3	4	5	6	7	**8**	**9**	**10**	**14**
			100	1	2	5	6	8	**10**	**11**	**13**	**14**	**16**	**24**
			500	2	5	**12**	**16**	**19**	**24**	**28**	**33**	**37**	**41**	**73**

Table 20. ISC Calculated ST MOEs At Selected Distances Downwind

App. Meth.	ER (%)	Fld Size (A)	DW Dist (m)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Sprinkler Irrigation, Standard Seal	24	1	25	<1	1	1	1	1	1	1	2	2	2
			100	1	1	2	2	3	3	3	4	4	7
			500	3	11	14	17	21	24	29	**32**	**35**	**81**
		5	25	<1	<1	<1	1	1	1	1	1	1	2
			100	<1	1	1	1	1	2	2	2	2	3
			500	1	3	4	5	6	7	8	9	10	21
		10	25	<1	<1	<1	<1	1	1	1	1	1	1
			100	<1	1	1	1	1	1	1	2	2	3
			500	1	2	2	3	4	4	5	5	6	12
		20	25	<1	<1	<1	<1	1	1	1	1	1	1
			100	<1	<1	1	1	1	1	1	1	1	2
			500	<1	1	2	2	2	3	3	4	4	8
		40	25	<1	<1	<1	<1	<1	1	1	1	1	1
			100	<1	<1	<1	1	1	1	1	1	1	2
			500	<1	1	1	1	2	2	2	3	3	5
Sprinkler Irrigation, Intermittent Seal	7	1	25	1	2	2	3	4	4	5	5	6	8
			100	2	5	6	7	9	10	12	13	15	24
			500	11	**37**	**49**	**61**	**70**	**81**	**97**	**97**	**122**	**244**
		5	25	1	1	2	2	2	3	3	3	4	5
			100	1	2	3	4	5	5	6	7	8	11
			500	3	10	13	16	19	22	26	29	**32**	**70**
		10	25	<1	1	1	2	2	2	3	3	3	5
			100	1	2	2	3	4	4	5	5	6	9
			500	2	6	8	10	12	14	16	18	20	**41**
		20	25	<1	1	1	1	2	2	2	3	3	4
			100	1	2	2	2	3	3	4	4	5	7
			500	2	4	6	7	8	10	11	12	14	26
		40	25	<1	1	1	1	1	2	2	2	2	4
			100	1	1	2	2	2	3	3	4	4	6
			500	1	3	4	5	6	7	8	9	10	18

Table 20. ISC Calculated ST MOEs At Selected Distances Downwind

App. Meth.	ER (%)	Fld Size (A)	DW Dist (m)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Shank Injection, Standard Seal	18	1	25	1	1	2	2	3	3	4	4	5	7
			100	2	4	5	6	7	8	9	10	12	19
			500	8	29	**37**	**44**	**54**	**70**	**81**	**81**	**97**	**244**
		5	25	<1	1	1	1	2	2	2	3	3	4
			100	1	2	2	3	4	4	5	5	6	9
			500	3	8	10	12	15	17	20	22	26	**54**
		10	25	<1	1	1	1	2	2	2	2	3	4
			100	1	1	2	2	3	3	4	4	5	7
			500	2	5	6	8	10	11	13	14	16	32
		20	25	<1	1	1	1	1	2	2	2	2	3
			100	1	1	2	2	2	3	3	3	4	6
			500	1	3	4	5	7	7	9	10	11	20
		40	25	<1	1	1	1	1	1	2	2	2	3
			100	<1	1	1	2	2	2	3	3	3	5
			500	1	2	3	4	5	6	6	7	8	14
Shank Injection, Intermittent Seal	8	1	25	2	3	4	5	6	7	9	10	11	15
			100	3	8	11	13	16	18	21	23	27	**44**
			500	19	70	81	97	122	162	162	244	244	487
		5	25	1	2	3	3	4	5	6	6	7	10
			100	2	4	6	7	8	10	11	12	14	20
			500	6	18	23	29	**35**	**41**	**49**	**54**	**61**	**122**
		10	25	1	2	2	3	4	4	5	5	6	8
			100	1	3	4	5	7	8	9	10	11	16
			500	4	12	15	18	22	26	29	32	37	81
		20	25	1	2	2	2	3	4	4	5	5	7
			100	1	3	4	4	5	6	7	8	9	13
			500	3	8	10	12	15	17	20	22	26	**49**
		40	25	1	1	2	2	3	3	4	4	4	6
			100	1	2	3	4	4	5	6	7	7	11
			500	2	6	7	9	11	13	15	16	19	**32**

Table 20. ISC Calculated ST MOEs At Selected Distances Downwind													
App. Meth.	ER (%)	Fld Size (A)	DW Dist (m)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Drip Irrigation, Tarped Field	2	1	25	4	8	10	12	15	17	19	22	24	**35**
			100	8	19	24	**30**	**37**	**41**	**49**	**54**	**61**	**97**
			500	**44**	**162**	**244**	**244**	**244**	**487**	**487**	**487**	**487**	
		5	25	2	5	6	8	10	11	13	14	16	22
			100	4	10	13	16	19	22	26	29	**32**	**49**
			500	14	**41**	**54**	**70**	**81**	**97**	**97**	**122**	**122**	**244**
		10	25	2	4	5	7	8	9	11	12	14	19
			100	3	8	10	12	15	17	20	22	26	**37**
			500	9	26	**35**	**41**	**49**	**61**	**70**	**70**	**81**	**162**
		20	25	2	4	5	6	7	8	9	10	12	17
			100	3	6	8	10	12	14	16	18	20	**30**
			500	7	18	23	29	**35**	**41**	**44**	**49**	**61**	**122**
		40	25	1	3	4	5	6	7	8	9	10	15
			100	2	5	7	8	10	12	14	15	17	24
			500	5	13	17	21	26	29	**35**	**37**	**44**	**81**
Drip Irrigation, Untarped Field	1	1	25	5	11	14	17	20	23	27	**30**	**35**	**49**
			100	11	27	**35**	**41**	**49**	**61**	**70**	**81**	**81**	**162**
			500	**61**	**244**	**244**	**487**	**487**	**487**	**487**	**487**	**487**	
		5	25	3	7	9	11	14	15	18	19	22	**32**
			100	6	14	18	22	27	**30**	**35**	**41**	**44**	**70**
			500	19	**61**	**81**	**97**	**122**	**122**	**162**	**162**	**162**	**487**
		10	25	3	6	8	9	11	13	15	17	19	27
			100	5	11	14	17	21	24	29	**32**	**35**	**54**
			500	13	**37**	**49**	**61**	**70**	**81**	**97**	**97**	**122**	**244**
		20	25	2	5	7	8	10	11	13	15	16	23
			100	4	9	11	14	17	19	23	26	29	**41**
			500	10	26	**32**	**41**	**49**	**54**	**61**	**70**	**81**	**162**
		40	25	2	4	6	7	9	10	11	13	14	20
			100	3	7	9	12	14	16	19	21	23	**35**
			500	7	19	24	29	**35**	**41**	**49**	**54**	**61**	**97**

3.4 Non-cancer MITC Inhalation Risks to Occupational Bystanders

HED ran ISC for each of the various application and sealing methods, treated-area sizes, and meteorological conditions to estimate the ST MOEs at various distances for occupational workers (**Table 21**). The LOC for ST MITC exposures are MOEs less than 30.

Table 21. ISC Calculated ST MOEs At Selected Distances Downwind

App. Meth.	ER (%)	Fld Size (A)	DW Dist. (M)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Sprinkler Irrigation, Standard Seal	12	1	25	1	2	2	2	3	3	4	4	5	7
			100	2	4	5	6	7	8	10	11	12	20
			500	9	31	39	49	60	68	79	89	97	227
		5	25	<1	1	1	2	2	2	3	3	3	4
			100	1	2	3	3	4	4	5	6	6	9
			500	3	8	11	13	16	18	21	23	27	57
		10	25	<1	1	1	1	2	2	2	2	3	4
			100	1	2	2	2	3	3	4	4	5	7
			500	2	5	7	8	10	11	13	15	17	34
		20	25	<1	1	1	1	1	2	2	2	2	3
			100	1	1	2	2	2	3	3	4	4	6
			500	1	4	5	6	7	8	9	10	11	21
		40	25	<1	1	1	1	1	1	2	2	2	3
			100	<1	1	1	2	2	2	3	3	3	5
			500	1	3	3	4	5	6	7	7	8	15
Sprinkler Irrigation, Intermittent Seal	3	1	25	3	6	7	9	11	12	14	16	18	26
			100	6	14	18	22	27	30	36	39	44	76
			500	32	113	146	186	227	255	292	340	340	1021
		5	25	2	4	5	6	7	8	9	10	12	17
			100	3	7	9	11	14	16	19	21	23	35
			500	10	30	39	49	58	68	79	89	97	204
		10	25	1	3	4	5	6	7	8	9	10	14
			100	3	6	7	9	11	13	15	16	19	27
			500	7	19	25	30	37	43	50	55	62	128
		20	25	1	3	3	4	5	6	7	8	9	12
			100	2	5	6	7	9	10	12	13	15	22
			500	5	13	17	21	25	29	34	38	43	79
		40	25	1	2	3	4	4	5	6	7	8	11
			100	2	4	5	6	7	9	10	11	12	18
			500	4	10	12	15	19	21	25	28	31	55

Table 21. ISC Calculated ST MOEs At Selected Distances Downwind													
App. Meth.	ER (%)	Fld Size (A)	DW Dist. (M)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Shank Injection, Standard Seal	12	1	25	1	3	4	5	6	7	8	9	10	14
			100	3	7	10	12	14	17	19	21	24	40
			500	17	62	79	97	120	136	157	170	204	511
		5	25	1	2	3	3	4	4	5	6	6	9
			100	2	4	5	6	8	9	10	11	13	19
			500	5	17	21	26	32	36	43	47	54	113
		10	25	1	2	2	3	3	4	4	5	5	8
			100	1	3	4	5	6	7	8	9	10	15
			500	4	10	13	16	20	23	27	30	33	68
		20	25	1	1	2	2	3	3	4	4	5	7
			100	1	3	3	4	5	6	6	7	8	12
			500	3	7	9	11	14	16	18	20	23	43
		40	25	1	1	2	2	2	3	3	4	4	6
			100	1	2	3	3	4	5	5	6	7	10
			500	2	5	7	8	10	12	13	15	17	30
Shank Injection, Intermittent Seal	5	1	25	3	7	10	12	14	16	19	21	24	34
			100	8	18	24	29	36	41	47	52	60	102
			500	43	157	204	227	292	340	408	408	511	1021
		5	25	2	5	6	8	9	11	12	14	16	22
			100	4	10	12	15	19	21	25	28	31	46
			500	13	41	52	64	79	89	107	113	128	292
		10	25	2	4	5	6	8	9	11	12	13	19
			100	3	8	10	12	15	17	20	22	25	36
			500	9	26	33	40	50	57	66	73	82	170
		20	25	2	4	5	6	7	8	9	10	11	16
			100	3	6	8	10	12	14	16	18	20	29
			500	7	18	22	28	34	39	45	50	57	107
		40	25	1	3	4	5	6	7	8	9	10	14
			100	2	5	7	8	10	11	13	15	16	24
			500	5	13	17	20	25	29	33	37	42	73

Table 21. ISC Calculated ST MOEs At Selected Distances Downwind

App. Meth.	ER (%)	Fld Size (A)	DW Dist. (M)	Differing Meteorological Conditions									
				1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
				Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Drip Irrigation, Tarped Field	1	1	25	8	17	22	27	33	38	44	49	55	79
			100	18	43	55	66	82	93	107	120	136	227
			500	97	340	408	511	681	681	1021	1021	1021	2042
		5	25	5	11	14	18	21	25	29	32	36	51
			100	10	22	29	35	43	50	58	64	73	107
			500	30	93	120	146	186	204	255	255	292	681
		10	25	4	9	12	15	18	21	24	27	30	43
			100	8	18	23	28	34	39	45	51	57	82
			500	21	58	76	93	113	128	157	170	186	408
		20	25	4	8	11	13	16	18	21	23	27	38
			100	6	14	18	22	28	32	37	41	46	68
			500	15	41	52	64	79	89	102	113	128	255
		40	25	3	7	9	11	14	16	18	20	23	33
			100	5	12	15	19	23	26	30	34	38	57
			500	12	30	39	46	57	66	76	85	97	170
Drip Irrigation, Untarped Field	0.6	1	25	13	28	36	44	54	62	73	79	89	128
			100	29	68	89	107	136	157	186	204	227	408
			500	157	511	681	1021	1021	1021	2042	2042	2042	
		5	25	8	18	23	29	35	40	46	52	58	82
			100	16	36	46	57	70	82	93	102	120	170
			500	50	157	204	255	292	340	408	408	511	1021
		10	25	7	15	20	24	30	34	40	44	50	70
			100	13	29	37	45	55	64	73	82	93	136
			500	34	97	120	146	186	204	255	292	292	681
		20	25	6	13	17	21	26	30	35	38	43	62
			100	10	23	30	36	45	51	60	66	76	107
			500	25	66	85	102	128	146	170	186	204	408
		40	25	5	12	15	18	22	26	30	33	38	54
			100	8	19	25	30	37	43	50	55	62	93
			500	19	49	62	76	93	107	128	136	157	292

3.5 Entry Prohibition Intervals for Occupational Workers Reentering Treated Areas

According to the *ISC User's Guide, Volume II - Description of Model Algorithms, Section 1.2.3, The Short-term Area Source Model*, ISCST can estimate air concentrations for receptors located in an area source, – in this case in a field treated with metam sodium – provided the fields are more than a few meters across. used this estimate to quantify the entry prohibition interval for occupational workers.

HED examined workers reentering treated areas 48 hours after treatment. Using the flux rates from the appropriate studies at 48 hours, HED estimated the maximum concentration occurring at the edge of the treated field using ISC and the wind speed/stability categories used in the previous analysis. **Table 22** depicts the flux rates used for the various application methods, derived from values depicted in **Tables 15** through **17. Table 23** shows the acute MOEs for maximum concentrations occurring in treated fields 48 hours after treatment. The LOC for acute MITC exposure are MOEs of less than 10.

Table 22. Flux Rates Used in Analysis

Application Method	Conditions	Study Basis	Study Application Rate (lbs ai/acre)	Flux Rate at 48-hours (ug/m^2-s)
Sprinkler irrigation	Standard Seal	457037-01	320	6.3
	Intermittent Seal	457037-02	318	1.8
Shank Injection	Standard Seal	457037-01	160*	63
	Intermittent Seal	457037-04	160*	2.3
Drip Irrigation**	Tarped	457037-08	320	2.4
	Untarped	457037-08	320	2.1

* - Equivalent to 320 lbs ai/treated acre.
** - Flux rates were not available at the 48-hour time frame. Last reported flux rates were reported for Hours 12-16 on Day 2.

Table 23. Estimated Acute MOEs based on Maximum ISC Calculated Air Concentrations (μg/m^3) after 48 hours												
App. Meth.	Fld Size (A)	Differing Meteorological Conditions										
		1 m/s 2.3 mph	1 m/s 2.3 mph	1.4 m/s 3.1 mph	1.8 m/s 4 mph	2.2 m/s 5 mph	2.7 m/s 6 mph	3.1 m/s 7 mph	3.6 m/s 8 mph	4.0 m/s 9 mph	4.5 m/s 10 mph	4.5 m/s 10 mph
		Stab F	Stab D	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab C	Stab B
Sprinkler Irrigation, Standard Seal	1	1	2	4	5	6	8	9	10	12	13	18
	5	1	2	3	4	5	6	7	8	9	11	15
	10	1	1	3	4	5	6	7	8	9	10	13
	20	1	1	3	4	4	5	6	7	8	9	12
	40	1	1	3	3	4	5	6	7	7	8	12
Sprinkler Irrigation, Intermittent Seal	1	4	7	14	18	22	28	31	37	41	47	60
	5	3	6	12	15	18	22	25	30	33	37	51
	10	3	5	10	13	17	21	24	28	30	35	47
	20	3	5	10	12	15	19	21	25	28	31	44
	40	2	4	9	12	14	17	20	24	25	29	41
Shank Injection, Standard Seal	1	<1	<1	<1	1	1	1	1	1	1	1	2
	5	<1	<1	<1	<1	1	1	1	1	1	1	1
	10	<1	<1	<1	<1	<1	1	1	1	1	1	1
	20	<1	<1	<1	<1	<1	1	1	1	1	1	1
	40	<1	<1	<1	<1	<1	<1	1	1	1	1	1
Shank Injection, Intermittent Seal	1	3	6	11	14	17	21	24	29	31	37	47
	5	2	4	9	12	14	17	20	23	25	29	39
	10	2	4	8	11	13	16	18	21	24	26	37
	20	2	4	8	10	12	15	17	19	22	24	35
	40	2	3	7	9	11	14	16	18	20	23	31
Drip Irrigation, Tarped Field	1	3	5	11	14	17	21	24	28	30	35	47
	5	2	4	9	11	13	17	19	22	24	28	39
	10	2	4	8	10	12	15	17	21	23	25	35
	20	2	3	7	9	12	14	16	19	21	24	33
	40	2	3	7	9	11	13	15	17	19	22	30
Drip Irrigation, Untarped Field	1	3	6	12	16	19	24	28	31	35	39	55
	5	3	5	10	13	15	19	22	25	29	31	44
	10	2	4	9	12	14	17	20	24	25	29	41
	20	2	4	8	11	13	16	18	21	24	26	37
	40	2	4	8	10	12	15	17	20	22	25	35

3.6 Summary of Risk Concerns for Dispersion Modeling

Several studies were submitted to EPA that measured MITC air concentration levels following applications of metam sodium with shank injection or sprinkler equipment. The air concentration levels were measured at various time periods following application (e.g., 2 hours, 8 hours, 24 hours, etc.), at various distances from the edge of the treated field (e.g., 15 meters, 150 meters, 300 meters, etc.) and in various directions from the treated field (e.g., north, south, east, west, etc.). In some of the studies, the application was sealed into the soil with water immediately following application, in other studies the application was intermittently (i.e., thin seal of water applied on consecutive days) sealed into the soil with water, and in still other studies, no soil seal was applied. HED had several QA/QC issues with the studies and concerns about some methodologies and inconsistencies.

In several of the studies, the reported flux rates were somewhat sinusoidal. For instance, as shown in **Table 15**, the flux rate for the Study 457037-07 decreased to 15.85 $\mu g/m^2$-s during Day 1, Period 20-24, but then rose to 31.29 $\mu g/m^2$-s during Day 2, Period 4-8. In such cases, if the reported flux rate was at or below the required flux rate for a particular period, but then rose above the required flux rate at a later period, the entry prohibition time would be selected when the reported flux rate decreased below the required flux rate and remained below it.

Data uncertainties, include insufficient information on the influence of the following on MITC air concentration levels immediately following metam sodium applications:

- wind speed and direction,
- air and soil temperature,
- application rate,
- tarpaulins as a soil seal,
- size of treated area,
- dissipation time of MITC
- indoor versus outdoor exposures, and
- various application equipment and application techniques.

3.7 Risk Characterization for Dispersion Modeling

HED believes that the air concentrations estimated in this report and the corresponding distances to those concentrations represent the highest quality results that could be produced given the application, meteorological, and toxicology data collected from the various available field volatility studies. HED believes that the distances represent reasonable worse-case estimates because maximum flux rates are coupled with medium- to high-end estimates of treated area acreage and low-end wind speeds to generate estimates that likely will fall in the upper percentiles of actual distance distributions.

4.0 References

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5/13/04 HED memo from A. Lowit to M. Stasikowski. Quantification of carcinogenic potential for MITC with metam sodium cancer slope factor (DP293345)

4/2/04 HED memo from Anna Lowit. Metam Sodium (039003), Metam Potassium (039002), Dazomet (035602), and MITC (068103) Report of the Hazard Identification Assessment Review Committee.

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Johnson, B., Barry, T., Wofford, P. (1999). Workbook for Gaussian Modeling Analysis of Air Concentration Measurements. California Department of Pesticide Regulation. September 1999. EH99-03.

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8/17/94 HED memo from A. Mehta, Comments on CA Risk Assessment on MITC

9/30/02 HED Memo from S. Recore. Review of Mixer/Loader/Applicator Inhalation Monitoring Study Using Personal Sampling Pumps. (DP Barcode D285487, MRID 42958401)

9/30/02 HED Memo from S. Recore. Review of Mixer/Loader/Applicator Inhalation Monitoring Study Using Personal Sampling Pumps (DP Barcode D285486, MRID 42968402)

5/30/03 HED Memo from S. Recore. Review of Determination of Methyl Isothiocyanate Inhalation Exposure to Workers as They Apply Metam-Sodium through Shank Injection and Sprinkler Irrigation. (DP Barcode D273316, MRID 42968402)

5/13/04 HED Memo from S. Recore. Review of Determination of Methyl Isothiocyanate Inhalation Exposure to Workers During Application Metam-Sodium through Shank Injection. (DP Barcode D290873, MRID 45703703)

MRID 42440501, Rosenheck, L. (1992) Worker Mixer/Loader and Applicator Exposure from Field Applications of Metam-Sodium: Lab Project Number: EF-91-360. Unpublished study prepared by Morse Laboratories and Pan-Agricultural Laboratories Inc.

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