United States Environmental Protection Agency

Environmental Fate and Ecological Risk Assessment for the Registration of Soap Salts

Potassium Salts of Fatty Acids (PC Code 079021);
Ammonium Salts of Fatty Acids (PC Code 031801); and
Sodium Salts of Fatty Acids (PC Code 079009)

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I. Executive Summary

This risk assessment phase of registration review addresses the potential risks of the pesticide active ingredients potassium, ammonium, and sodium salts of fatty acids to the environment. Soap salts products are registered as acaricides, algaecides, herbicides, insecticides, and animal repellents. They are intended for residential, agricultural, or commercial use. Application rates for potassium and ammonium salts of fatty acids may be applied at rates as high as 205 lb a.i./A and 103.8 lb a.i./A, respectively, and as low as 1 lb a.i./A and less for both salts. Sodium salts are formulated as a soap bar enclosed in one-ounce mesh bag hung or staked above the ground, and because how the sodium salt was formulated, the application rate is undefined. There are no technical products; there are only formulated products containing the active ingredients because soap salts are formed through an integrated manufacturing process.

Potassium salts of fatty acids mainly disrupt the exoskeleton in insects, causing insects to die; and also disrupt the photosynthetic process in plants, killing the plant. They are used to control a variety of taxa including insects, mosses, algae, lichens, liverworts and other weeds. Use sites include many food and feed crops, ornamental flower beds, house plants, trees, shrubs, walks and driveways, and on dogs, puppies and cats. Some potassium salts of fatty acids are used as multi-purpose food additives. The Food and Drug Administration (FDA) classifies the potassium salts as GRAS (generally recognized as safe) to humans. Ammonium and sodium salts of fatty acids mainly act as a repellent on forage and grain crops, on vegetables and field crops, in orchards, and on nursery stock, ornamentals, flowers, lawns, turf, vines, shrubs and trees, affecting the olfactory nerves of deer and rabbits, repelling these animals away from the target area; however, ammonium salts can be formulated as a herbicide to control annual weeds. FDA also classifies the ammonium and sodium salts as GRAS for packaging only.

Potassium and ammonium salts are typically applied by ground equipment (hand-held, hose-end, foliar, pump, power, and knapsack sprayer) although some aerial applications are allowed. Sodium salts are typically placed by homeowners in gardens, averaging 5 bags per garden. To date, no information has been provided to USEPA on the extent of soap salt use, and given the wide ranging use patterns, soap salts could be used practically anywhere in the United States. Soap salts in their non-pesticidal uses are widely used in the U.S.

Potential Risks to Non-target Organisms

The results of this screening-level risk assessment on the registered uses of soap salts indicate there are LOC exceedances for non-target organisms and plants from potassium salt uses at and greater than 10 lb a.i./A with aerial applications and at and greater than 63 lb a.i./A with ground applications and from ammonium salts uses at and greater than 63 lb a.i./A with only aerial applications. There are no LOC exceedances for ammonium salts with ground applications. Due to the number of assumptions incorporated into this assessment and the uncertainty with the available information, discussed below, it is uncertain whether the LOC exceedances constitute a potential affect for Listed species.

There is no LOC exceedance for the sodium salts, because the only use is as an animal repellent in one-ounce mesh bags. This use pattern is not expected to result in meaningful exposure to wildlife. Therefore, the sodium salt uses are concluded to have No Effect on Listed species.

Ecologically, there is high uncertainty in the assumptions that triggered the direct adverse effects of soap salts (*e.g.* potassium and ammonium salts of fatty acids) to aquatic species. The available toxicity data are for soap salt mixtures of unknown composition as to fatty acid chain length. Likewise, there is uncertainty as to which fatty acids will result in exposure, and whether those acids are appreciably toxic to wildlife. Thus, the LOC exceedances were evaluated further on whether soap salts would be toxic enough to cause effects to the receptors if exposed. The defined-chain-length fatty acid data suggest the adverse effects to these non-target organisms are highly uncertain.

At least one other organization (HERA, 2003) has concluded that commercial uses of soap salts pose minimal risks to wildlife.

The product labels are unclear on the number of applications allowed and do not appear to limit the maximum number of applications per year or define a recommended minimum interval between applications; however, it appears that additional risks would not be expected with multiple applications. The exposure concentrations calculated in GENEEC2 increased only 3% after 50 applications were made weekly or per year, which suggests the risk conclusions would remain unchanged even with multiple applications.

Also, the acute and chronic toxicological endpoints used in the assessment for the active ingredients were estimated based on the purity reported in their ecotoxicity studies using the formulated products as the test material. While the percentage of soap salts was specified, the composition as to chain lengths was not. It was not possible to get the actual endpoints for individual fatty acids from technical grade studies because the active ingredients are formed only after being mixed through an integrated process. Data for related products of known composition (the soluble fatty acid, nonanoic or pelargonic acid) was used to characterize the toxicity of the soap salts. Lastly, the composition of registered soap salt products, specifically the range of fatty acid chain lengths, is variable. Due to long-chain soap salts precipitation caused by metal ions (Ca, Mg, Fe, etc.) in the environment, longer chain length products should not pose risks to aquatic organisms because exposure is not expected. Shorter-chain products may be soluble enough to cause exposure, although it is uncertain if these exposures will result in toxicity.

The Agency believes there is no direct effect to aquatic organisms, for fatty acid salts of chain length C14 and higher, because such fatty acids are not sufficiently soluble in environmental water for toxic effects to be expressed. For shorter chain-length fatty acids (C9 – C11) there is uncertainty, because the available toxicity data is not clear as to what chain-length mixtures were tested. However, acute toxicity data for nearly pure nonanoic (pelargonic) acid, which is representative of the shorter chain-length fatty acids, indicate that it does not reach levels of concern with a Tier I exposure assessment.

The exposure to terrestrial plants is uncertain because aerial or broadcast spraying as directed are applied at rates much lower than 10 lb a.i./A and spray drift exposure from spot treatments at high rates are not expected to produce the same amount of exposure as with broadcast spraying. The terrestrial plant risk assessment predicts that soap salts is more toxic to plants when exposed to the foliage via spray drift than through the roots as a result of surface water runoff; therefore, the exposure route of greatest concern to non-target terrestrial plants is by spray drift. Using default model inputs, the LOC exceedances for terrestrial plants exposed to spray drift extend up to >997 feet from the edge for aerial applications at the maximum application rate; however, only extend up to 7 feet from the edge if ground applications rather than aerial use was utilized. Modeling also suggests that using coarser droplet spectra would reduce the distance, whereas very fine droplet spectra would increase the distance. Also, if the products are applied via spot treatments instead of broadcast applications it is expected that distances of concern off the treated field would be reduced as well.

Toxicity was negligible in the avian and mammalian studies.

Minimal risk is likely for these taxonomic groups assessed (birds, reptiles, terrestrial-phase amphibians, mammals, bees, and estuarine/marine fish) exposed to soap salts as a group. Therefore, the registered uses of soap salts are concluded to have No Effect on Listed birds, reptiles, terrestrial-phase amphibians, mammals, bees, and estuarine/marine fish).

It is unclear if registered soap salt products applied at high application rates are broadcast across the landscape or represent spot treatments. For assessment purposes, EFED has assumed that the high rates are broadcast. In making this assumption, EFED believes that exposure estimates for aquatic resources are possibly overly conservative for those uses that may be spot treated because the underlying assumption in the models is that 100% of the field is treated with the pesticide. In order to better characterize the importance of this assumption on the overall risk conclusions EFED has provided an estimate of the threshold of spot treatment for each taxa where the LOC would no longer be exceeded. As an example EFED estimated that for the highest application rate (i.e. 205 lbs a.i./acre) for freshwater fish if a site were only spot treated at less than 16% of the entire field the LOC would not be exceeded and no effect would be likely for this use. If the % of actual area treated is higher than the estimated threshold, EFED believe that the potential for a direct effect to that taxa exists. However, EFED does not have information to allow for an estimate of what is a reasonable assumption of a maximum percentage of a field that may be spot treated that can be used to determine what % of area is a typical spot treatment. Also, the existing labels do not specify whether any of the registered uses can only be spot treated. Additional data are needed on how much % of an area a typical spot treatment is before EFED can make a definitive call on whether effects are likely from these uses. Until a determination for listed species can be made, the risks of soap salts to aquatic organisms from spot treatments at high application rates are uncertain.

Overall, for algaecide, herbicide, acaricide, insecticide, and animal repellent uses at estimated maximum application rates, exposure levels, composition of registered soap salt products, and available effects data, soap salts used as directed indicate uncertain direct effects for those taxa identified above from the registered uses (**Table I.1** – Potassium/Ammonium Salts and **Table I.2** – Sodium Salts). Such findings suggest concern for indirect effects to listed animal and plant species with both narrow (i.e., species that are obligates or have very specific habitat or feeding requirements) and general dependencies (i.e., cover type requirements) as a resource or important habitat component.

Table I.1. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Potassium and Ammonium Salts, Based on Best Available Data.

Listed Plant Taxon	Potential Direct Effects
Terrestrial and semi-aquatic plants – monocots and dicots	Uncertain – LOC exceedances were observed for broadcast applications; uncertain if LOC exceedances exists for spot treatments at high application rates
Aquatic plants	

Listed Animal Taxon	Potential Direct Effects			
	Acute	Notes	Chronic	Notes
Terrestrial invertebrates	Uncertain	While soap salts are used as insecticides, bee toxicity data indicate low toxicity	N/A	No tools available to measure chronic effects. Listed invertebrates might be affected if they are present on the treated site at the time of application.
Mammals	No effect	No toxic effects at highest dose tested	No effect	Undergo rapid degradation in less than a day, unlikely for wildlife to consume 100% of diet in treated spots, and fatty acid is an important diet for wildlife, chronic effects are not likely
Birds	No effect	No toxic effects at highest dose tested	No effect	
Reptiles	No effect	Based on birds as surrogate	No effect	
Terrestrial-phase Amphibians	No effects		No effect	
Freshwater fish	Uncertain	LOC exceedances were observed for broadcast applications; uncertain if LOC exceedances exists for spot treatments at high application rates	No effects	No LOC exceedances
Aquatic-phase Amphibians			No effects	
Freshwater invertebrates			Uncertain	It is uncertain whether aquatic organisms are exposed to more-toxic (long-chain) fatty acids due to solubility limitations; more-soluble (short-chain) fatty acids do not appear to be sufficiently toxic to cause adverse effects.
Estuarine/marine fish			No effects	No LOC exceedances
Estuarine/marine invertebrates			No effects	

<table>
<tr><th colspan="5">Table I.2. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Sodium Salts, Based on Best Available Data.</th></tr>
<tr><th>Listed Plant Taxon</th><th colspan="4">Potential Direct Effects</th></tr>
<tr><td>Terrestrial and semi-aquatic plants – monocots and dicots</td><td colspan="4">No Effect</td></tr>
<tr><td>Aquatic plants</td><td colspan="4">No Effect</td></tr>
<tr><th rowspan="2">Listed Animal Taxon</th><th colspan="4">Potential Direct Effects</th></tr>
<tr><th>Acute</th><th>Notes</th><th>Chronic</th><th>Notes</th></tr>
<tr><td>Terrestrial invertebrates</td><td>No Effect</td><td rowspan="9">The one active product registration is a low volume, minor use product intended for homeowner use only, typically hanging bags, which results in low potential for runoff and spray drift; significant concentrations are not expected to reach the receptors. This use pattern is not expected to result in meaningful exposure.</td><td>N/A</td><td>No tools available to measure chronic effects</td></tr>
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<tr><td>Birds</td><td>No Effect</td><td>No Effect</td></tr>
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<tr><td>Amphibians</td><td>No Effect</td><td>No Effect</td></tr>
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<tr><td>Freshwater invertebrates</td></tr>
<tr><td>Estuarine/marine fish</td></tr>
<tr><td>Estuarine/marine invertebrates</td></tr>
</table>

Additional Considerations for Listed Species

Based on this screening-level assessment, there are potential risks of direct effects to listed aquatic organisms, terrestrial invertebrates, and plants (terrestrial and aquatic nonvascular) and non-listed aquatic invertebrates (freshwater and estuarine/marine) and plants (terrestrial and aquatic nonvascular) from the use of soap salts on some of its registered use sites, especially with those high application rates. Listed species of aquatic organisms, terrestrial invertebrates, and plants (terrestrial and aquatic nonvascular) may also be affected through indirect effects because of the potential direct effects on listed and non-listed species. Potential direct effects on listed aquatic organisms, terrestrial invertebrates, and plants (terrestrial and aquatic nonvascular) and non-listed aquatic invertebrates (freshwater and estuarine/marine) and plants (terrestrial and aquatic nonvascular) from the use of soap salts may be associated with modification of primary constituent elements of designated critical habitats, where such designations have been made. However, at this current stage of the Registration Review process, it is premature to make effects determinations for listed species until further refinements are conducted. In order to make effects determinations for individual species, useful refinements may include analyses of 1) more detailed, species-specific ecological and biological data; 2) more detailed and accurate information on soap salts use patterns; and 3) sub-county level spatial proximity data for the co-occurrence of potential effects areas and listed species and any designated critical habitat. Examples of such refinements are described below.

EFED is currently developing tools that are expected to further refine the assessment and are designed to support effects determinations for individual federally listed species and their designated critical habitats (where applicable). Scientific information obtained from the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and other reliable sources is being collated by EFED to address all currently listed species. The information will be stored in an Office of Pesticide Programs Pesticide Registration Information SysteM (PRISM) knowledgebase. The listed species knowledgebase will consist of an information repository that houses biological and behavioral information relevant to individual species (*e.g.*, habitat, diet, and life history, including specific temporal and spatial associations) and a document repository that contains supporting documents (*e.g.*, USFWS recovery plans) and electronic information (*e.g.*, GIS data files). For terrestrial taxa, the biological information relevant to risk quotient (RQ) calculations (*e.g.*, diet and body weight) will be used to parameterize exposure estimates to derive species-specific RQs using a method consistent with currently used methods in the T-REX and T-HERPS models.

Refinements may also include more detailed analyses of the registered uses and their use patterns that result in LOC exceedances for federally listed species in the screening-level assessment. The analyses may include more information on where, when, and how soap salts are used to control plant growth and insect infestation. Actual usage data (when available) and national land-cover datasets that indicate potential use sites (*e.g.*, national land cover dataset (NLCD), crop data layer (CDL)) may be used to support a more refined analysis of where soap salts are reasonably expected to be used. Similarly, refinements for the timing of applications and how soap salts are used may be based on the analysis of additional usage data, beyond what were available at the time of the screening-level assessment, and a more in-depth exploration of agronomic practices.

In addition, a committee of the National Research Council (NRC) has been tasked with providing advice on ecological risk assessment tools and scientific approaches under ESA and FIFRA (Project Identification Number DELS-BEST-11-01). The committee has been asked to review the use of "best available data"; methods for evaluating sublethal, indirect, and cumulative effects; the state of the science regarding assessment of mixtures and pesticide inert ingredients; the development, application, and interpretation of results from predictive models; uncertainty factors; and what constitutes authoritative geospatial and temporal information for the assessment of individual species and habitat effects. The Agency anticipates that this NRC report, tentatively expected in Spring 2013, will provide recommendations to ensure the scientific soundness and maximize the utility of risk assessment refinements for listed species.

The refinements based on individual species data; additional, detailed usage information, when available; and further recommendations from the NRC report are expected to help to more accurately identify potential areas of effect and to better inform effects and habitat determinations for listed species and any designated critical habitats. For example, if soap salts are used when a particular species of concern is not present (*e.g.*, it is migratory) or is not co-located in space, then risk of potential direct effects to the species may often be precluded. If LOCs are still exceeded for aquatic organisms, terrestrial invertebrates, and plants (terrestrial and aquatic nonvascular) after conducting the refined analyses, further analyses of the potential spatial and temporal co-occurrence of listed species of concern (and any designated critical habitat) may be conducted. The extent of possible refinement in the analyses of spatial/temporal co-occurrence will largely depend on the scale and quality of the available sub-county level use site (*e.g*., NLCD, CDL) and species location data.

Exposure Characterization Summary

The fatty acid salts used in commercial pesticide products range in chain length from about C8 (octanoic acid) to C18 (octadecanoic acid). The physical properties of these acids vary directly with the chain length. The chief physical property that affects exposure in this case is solubility in water. In the open environment, in the presence of divalent metal cations such as calcium (II), magnesium (II) and others, the longer fatty acids, approximately C12 and up, are too insoluble to reach toxic concentrations. The shorter fatty acids, approximately C11 and down, are soluble enough in the presence of metal ions to cause exposure in the water column, but they are not toxic enough to cause adverse effects.

Effects Characterization Summary

Aquatic Organisms

The available toxicity data for soap salts are for mixtures of unknown composition as to chain length. The following discussion identifies tested products as potassium or ammonium salts, but the correspondence to currently registered products is not clear.

Results of the acute toxicity studies tested with soap salts formulation products indicate potassium salts are moderately toxic to freshwater fish, while ammonium salts are slightly toxic. Neither salt caused any effects to estuarine/marine fish up to the solubility limit. Ammonium salts are slightly toxic to freshwater invertebrates while potassium salts are highly toxic to the taxa. Effects of time to first brood release, reproduction, and growth were seen in freshwater invertebrates from chronic exposure as low as 23 mg a.i./L for ammonium salts and 0.5 mg a.i./L for potassium salts. Acute studies with estuarine/marine invertebrates indicate the moderately toxic potassium salts are more toxic than the slightly toxic ammonium salts. While no chronic data were available for estuary invertebrates, potassium salts may be more toxic to estuarine/marine invertebrates than ammonium salts. An acute to chronic ratio was applied to estuary invertebrates. For algaecide uses, aquatic nonvascular plants, algae and diatoms, exhibited equal inhibitions of biomass when exposed to both salts.

No toxicity data were available for sodium salts. The one active sodium salts product registration is a low volume, minor use product intended for homeowner use only, typically hanging bags, which results in low potential for runoff and spray drift; significant concentrations are not expected to reach the receptors. Previously, the Agency waived all aquatic toxicity data for sodium salts. This use pattern is not expected to result in meaningful exposure.

Terrestrial Organisms

Soap salts are practically non-toxic to birds and mammals on an acute exposure basis. No chronic toxicity data for birds and mammals were available since soap salts undergo rapid degradation in less than a day. No effects were seen in bees when exposed to the soap salts formulation products.

As expected with an herbicide, effects on growth were observed in terrestrial plant studies. The vegetative vigor life stage is generally more sensitive than the seedling emergence life stage. Sensitivity varies by species, with dicots generally more sensitive to soap salts than monocots.

As with aquatic organisms, no toxicity data were available for sodium salts.

Contents

II. Problem Formulation

The purpose of this problem formulation is to provide the foundation for the environmental fate and ecological effects for the registration review risk assessment for soap salts (Ammonium (PCCode: 031801), Potassium (PCCode: 079021) and Sodium (PCCode: 079009) Salts of Fatty Acids). Soap salts are used as insecticides, acaricides, herbicides, and algaecides on many food and non-food crops and are also used as a deer and rabbit repellent (ammonium and sodium salts only).

II.1. Nature of the Regulatory Action

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), all pesticides sold or distributed in the United States generally must be registered by the Environmental Protection Agency (EPA). In determining whether a pesticide can be registered in the U.S., EPA evaluates its safety to non-target species based on a wide range of environmental and health effects studies. In 1996, FIFRA was amended by the Food Quality Protection Act (FQPA), and EPA was mandated to implement a new program for the periodic review of pesticides, i.e., registration review (http://www.epa.gov/oppsrrd1/registration_review/). The registration review program is intended to ensure that, as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the statutory standard of no unreasonable adverse effects to human health and the environment. Changes in science, public policy, and pesticide use practices will occur over time. Through the registration review program, the Agency periodically reevaluates pesticides to make sure that as change occurs, products in the marketplace can be used safely.

As part of the implementation of the Registration Review program pursuant to Section 3(g) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Agency is evaluating soap salts to determine whether they continues to meet the FIFRA standard for registration. In addition to non-target species animals and plants, potential effects to listed species (*e.g.,* species on the Federal list of endangered and threatened wildlife and plants) and their designated critical habitat are also considered under the Endangered Species Act (ESA) in order to ensure that the continued registration of soap salts is not likely to jeopardize the continued existence of listed species or adversely modify their critical habitat. In order to meet the requirements of FIFRA and the ESA, this assessment follows EPA guidance on conducting ecological risk assessments (USEPA 1998) and Office of Pesticide Program's Overview Document, which contains guidance for assessing pesticide risks to non-target and listed species (USEPA, 2004). This assessment was prepared to support evaluation of the registration review of soap salts.

II.1.1 History of Soap Salts Regulation

Soap salts were first registered in 1947. In 1982, the Food and Drug Administration (FDA) classified soap salts as Generally Recognized as Safe (GRAS). A national-level ecological assessment was completed as part of the reregistration eligibility decision (RED) for soap salts in 1992 with twenty-four registered soap salts products. The ecological risk assessment included in the soap salts RED was based on basic laboratory fate and acute toxicity data submitted by the registrant in support of registration for soap salts. The primary environmental concern identified in the 1992 RED was associated with risks to freshwater invertebrates. The risks to freshwater invertebrates were not estimated using the risk quotient method at that time; however, the Agency assumed that the uses would not result in serious impact to freshwater invertebrates because soap salts are not applied directly to water and undergo very rapid microbial degradation in soil, from which significant concentrations should not reach waterbodies. Soap salts were reported as practically non-toxic to waterfowl and upland game birds and slightly toxic to both coldwater and warmwater fish species.

No public literature data or incident reports were incorporated in the RED, nor were any risk quotients or modeled exposure concentrations used to determine if the Agency's levels of concerns (LOCs) were exceeded or not. Risks were neither identified nor dismissed. No mitigation measures or potential risks to endangered species were assessed. The only data the Agency required at that time was a honeybee acute contact test to evaluate the toxicity of soap salts to pollinators.

Currently, there are 41 active products containing potassium salts of fatty acids, 7 active products containing ammonium salts of fatty acids and one active product of sodium salts of fatty acids. There are no pending registration actions, including emergency exemptions (Section 18) for soap salts. There is one active Special Local Need (Section 24c) for potassium salts of fatty acids in California. Twenty-two potassium salt products were subjected to reregistration, and these products have been reregistered or cancelled. Two ammonium salt products were subjected to reregistration and have been reregistered.

II.2 Stressor Source and Distribution

II.2.1 Nature of Chemical Stressor

Soap salts (case 4083) comprised of three active ingredients (PC Codes 031801, 079009 and 079021) that are the primary chemical stressors to be considered for registration review. These three active ingredients are: 1) potassium salts of fatty acids ([C_{12}-C_{18} saturated and C_{18} unsaturated]) including potassium laurate, potassium myristate, potassium oleate and potassium ricinoleate combined as a single active ingredient under the PC Code formerly assigned to potassium laurate, PC Code: 079021; 2) ammonium salts of fatty acids ([C_8-C_{18} saturated and C_{18} unsaturated]) including ammonium oleate, PC Code: 031801; and 3) sodium salts of fatty acids including sodium oleate, PC Code 079009. Soap salts belong to the soap chemical family of pesticides. There are at least 100 chemicals of this family and are generally used as insecticides or/and adjuvants.

Potassium salts of fatty acids disrupt the membrane and cellular function in insects, causing cell to dehydrate and die; and also disrupt the photosynthetic process in plants, killing the plant. Ammonium salts of fatty acids affect the olfactory nerves of deer, rabbits, and other mammals, which repel these animals away from the target area and can be formulated as an herbicide to control common annual weeds. Sodium salts of fatty acids are formulated solely as a mammal repellent.

Potassium and ammonium salts are typically applied by ground equipment (hand-held, hose-end, foliar, pump, power, and knapsack sprayer) although some aerial applications are allowed. A mesh bag of sodium salts also can be hung on a branch or staked in the ground. Soap salts may be applied to a wide variety of use sites including both agricultural and non-agricultural sites.

The intended use for these compounds is also varied with both herbicidal and insecticidal modes of action. To date, no information has been provided on the extent of soap salt use, and given the wide ranging use patterns, it is anticipated that soap salts could be used practically anywhere in the United States. Of course, the non-pesticidal use of soap salts is widespread across the U.S.

Potassium salts of fatty acids are used as herbicides (and algaecides) (**Table II.1**), insecticides (and acaricides) (**Table II.2**). They are used to control a variety of insects, mosses, algae, lichens, liverworts and other weeds, in or on many food and feed crops, lawn/turf, ornamental flower beds, house plants, trees, shrubs, greenhouses, automobiles, tires, walks and driveways, as a wood protection treatment, and on dogs, puppies and cats to control flea infestation.

Table II.1. Overview on Herbicide Uses of Potassium Salts of Fatty Acids

Crop Grouping	Representative Use
Terrestrial food and feed	Agricultural crops/soils and vegetables
Terrestrial food	Vegetables
Terrestrial non-food / greenhouse	Agricultural crops/soils
Greenhouse food	Greenhouses-in use
Greenhouse non-food	Greenhouses-in use
Terrestrial non-food	Automobiles, taxis, limousines, recreational vehicles, tires, commercial/industrial outdoor premises/equipments, golf course turf, nonagricultural outdoor building/structures, recreational areas and lawns, commercial/industrial lawns
Terrestrial non-food/outdoor residential	Nursery stock, fencerows/hedgerows, mulch, nonagricultural rights of way/fencerows/hedgerows, ornamental/shade trees, ornamental herbaceous plants, ornamental lawns/turf, ornamental non-flowering plants, ornamental woody shrubs/vines, paths/patios, and paved areas of private driveways/sidewalks
Outdoor residential	Household/domestic dwellings outdoor premises, ornamental/shade trees, ornamental lawns/turf, residential lawns, as a wood protection treatment to outdoor buildings/products, paths/patios, and paved areas of private roads and sidewalks
Indoor non-food	Non-feed/non-food containers-full and ships/boats
Indoor residential	Household/domestic dwellings

Table II.2. Overview on Insecticide Uses of Potassium Salts of Fatty Acids

Crop Grouping	Representative Use
Terrestrial food and feed	Canola/rape, peanuts, eggplant, tomato, cereal grains, seeds, apple, peas, bulb vegetables, wheat, field corn, sweet corn, soybeans, sugar beet, white/irish potato, fiber crops, cole crops, flavoring/spice crops, root and tuber vegetables, deciduous fruit trees, beans, vegetables and fruits, citrus, hops, nut crop/nut trees, pome fruits, pineapple, grapes, small fruits, fruiting vegetables, leafy vegetables, legume vegetables, and cotton.
Terrestrial food	Apple, banana, beans, blackberry, blueberry, broccoli, brussels sprouts, cabbage, cauliflower, citrus, coffee, cole crops, collards, cucumber, cucurbit vegetables, currant, eggplant, grape, kale, loganberry, melons, olive, pear, peas, pepper, pomegranate, potato, pumpkins, raspberry, squash (summer), squash (winter), squash (zucchini), strawberry, tomato, vegetables, and stone fruits.
Terrestrial feed	Alfalfa

Table II.2. Overview on Insecticide Uses of Potassium Salts of Fatty Acids	
Crop Grouping	**Representative Use**
Terrestrial food/greenhouse	Almond, apple, apricot, asparagus, artichoke, avocado, banana, beans, beets, blackberry, brassica (head and stem) vegetables, broccoli, brussel sprouts, cabbage, canola/rape, celery, cherry, citrus, cole crops, corn, cranberry, cucumber, cucurbit vegetables, deciduous fruit trees, eggplant, fig, flavoring and spice crops, fruiting vegetables, grapefruit, grape, herbs, hops, kale, kiwi fruits, leafy vegetables, legume vegetables, lemon, lettuce, lime, loganberry, macadamia nut, melons, nectarine, okra, orange, peach, peanuts, pear, peas, pecan, pepper, pineapple, plum, pome fruits, potato, radish, raspberry, root crop vegetables, small fruits, soybeans, spinach, squash, strawberry, stone fruits, subtropical fruits, tangerines, tomato, tree nuts, vegetables and fruits, watercress, and walnut
Terrestrial non-food / greenhouse	Ornamental/shade trees, ornamental herbaceous plants, ornamental non-flowering plants, and ornamental woody shrubs/vines
Greenhouse food	Greenhouses-in use, alfalfa, cotton, fruits, seeds, and wheat
Greenhouse non-food	Christmas tree plantations, ornamental/shade trees, ornamental herbaceous plants, ornamental non-flowering plants, and ornamental woody shrubs/vines
Terrestrial non-food	Citrus, pome fruits, pomegranate, stone fruits, tree nuts, tobacco, commercial/industrial outdoor premises/equipments, golf course turf, recreational areas, rose, wide area/general outdoor treatment for public health use, Christmas tree plantations, ornamental lawns/turf, eating establishments, ornamental/shade trees, ornamental woody shrubs/vines
Terrestrial non-food/outdoor residential	Ornamental/shade trees and ornamental lawns/turf
Outdoor residential	Fruits, household/domestic dwellings outdoor premises, ornamental/shade trees, ornamental herbaceous plants, ornamental lawns/turf, ornamental non-flowering plants, ornamental woody shrubs/vines, and residential lawns
Indoor food	Beehives/bee colony (diseased/nuisance)
Indoor non-food	Commercial/industrial indoor premises/equipments, ornamental/shade trees, ornamental herbaceous plants, ornamental non-flowering plants, ornamental woody shrubs/vines, and wide area/general indoor treatment
Indoor medical	Hospital/medical institutions premises
Indoor residential	Household/domestic dwellings, ornamental/shade trees, ornamental herbaceous plants, ornamental non-flowering plants, ornamental woody shrubs/vines, adult dogs, puppies and cats.
Indoor residential/non-food	Ornamental/shade trees, ornamental herbaceous plants, ornamental woody shrubs/vines, and ornamental non-flowering plants

Ammonium salts of fatty acids (**Table II.3**) formulated as a rabbit and deer repellent are used on vegetables and fruits, nursery stock, ornamentals, flowers, vines, shrubs and trees. It can also be formulated as a herbicide to control common annual weeds (**Table II.4**) actively growing on agricultural fields, residential gardens and paved areas, empty greenhouses, household dwellings, outdoor buildings, trees, plants, lawns/turf, woody shrubs/vines, and as a wood protection treatment to outdoor buildings/products. It is recommended not to apply any of the products of ammonium salts of fatty acids through any type of irrigation system. In addition, ammonium salt products are not compatible with soluble metallic salts such as zinc, manganese, and iron sulfates. This is presumably because these metal ions cause the fatty acids to precipitate, causing them to be ineffective.

Table II.3. Overview on Repellent Uses of Ammonium Salts of Fatty Acids	
Crop Grouping	**Representative Use**
Terrestrial food and feed crop	Apples, peanuts, and soybeans
Terrestrial food crop	Carrots (including tops), pears, and vegetables

Table II.3. Overview on Repellent Uses of Ammonium Salts of Fatty Acids	
Crop Grouping	**Representative Use**
Outdoor residential	Fruits, ornamental/shade trees, ornamental herbaceous plants, and ornamental woody shrubs/vines
Terrestrial non-food	Nursery stock, ornamental/shade trees, ornamental herbaceous plants, and ornamental woody shrubs/vines

Table II.4. Overview on Herbicide Uses of Ammonium Salts of Fatty Acids	
Crop Grouping	**Representative Use**
Terrestrial food and feed crop	Grapes, cereal grains, vegetables, orchards, field crops, mulch, grass forage/fodder/hay, and non-grass forage/fodder/hay
Terrestrial food crop	Ornamental lawns and turf, ornamental woody shrubs and vines, vegetables, and ornamental shade trees
Greenhouse food crop	Field crops and vegetables
Outdoor residential	Household/domestic dwellings, outdoor premises, mulch, rights-of-way, fencerows, hedgerows, ornamental/shade trees, ornamental herbaceous plants, ornamental lawns/turf, ornamental woody shrubs/vines, paths/patios, paved areas (private roads/sidewalks), and wood protection treatment to buildings/products
Terrestrial non-food	Empty greenhouses, outdoor building and structures, rights-of-way, fencerows, hedgerows, ornamental/shade trees, ornamental herbaceous plants, ornamental lawns/turf, ornamental woody shrubs/vines, mulch, paths/patios, paved areas (private driveways/sidewalks), and wood protection treatment to buildings/products
Greenhouse non-food	Ornamental/shade trees, ornamental herbaceous plants, and ornamental woody shrubs/vines

Sodium salts of fatty acids (**Table II.5**) are used as a deer repellent, which are staked or hung next to shrubs, vines, shade trees, and ornamentals.

Table II.5. Overview on Repellent Uses of Sodium Salts of Fatty Acid	
Crop Grouping	**Representative Use**
Outdoor residential	Ornamental herbaceous plants, ornamental non-flowering plants, ornamental woody shrubs and vines, and ornamental shade trees.

II.2.2. Overview of Pesticide Usage

Together, the soap salt products may be applied at highly variable rates using ground application equipment and less frequently, by aerial applications at lower rates. Terrestrial application rates are as high as 205 lbs/acre and as low as 1 lb/acre and below. Both potassium and ammonium salts uses have rates greater than 100 lbs/acre. The herbicidal products are generally applied as a spot treatment for weed control and as a broadcast spray or spot treatment for moss control, while the insecticidal products are applied broadcast using ground spray equipments. The high application rates for these products are practical only for spot treatments and usually are not applied to an entire acre but to throughly spray all plant (or tree) parts to achieve herbicidal or insecticidal control. Furthermore, the herbicidal products with high rates for moss control are labeled for lawns/turf, exterior building, and paving surfaces; not for agricultural field uses at rates ~10x lower than used for moss control. In addition, the labels are unclear on the number of applications allowed and do not appear to limit the maximum number of applications per year or define a recommended minimum interval between applications; however, do come with label restrictions such as avoiding crop-specific injury from repeated applications, to avoid spraying desirable plants, a buffer size or coarse nozzle settings to reduce spray drift to sensitive plants, or to not spray to water bodies or use in a manner that could cause surface water contamination.

Based on the high variability in the application rates and the inability to categorize uses by application rates, EFED estimated the exposure concentrations of potassium and ammonium salts to non-target terrestrial and aquatic animals and plants using a range of labeled application rates (i.e., 1, 10, 63, 116 lb a.i./A), in addition to the updated BEAD LUIS report (May 12, 2012) on revising the maximum application rates to 205 and 103.8 lb a.i./A for potassium and ammonium salts, respectively. At this time EFED is unable to associate specific use sites with specific application rates (*e.g.* the application rate of 116 lbs/acre is associated with many general use sites including "agricultural crops" and "vegetables"). Therefore, EFED will model aquatic and terrestrial exposures by creating general application rate "bins" (**Table II.6**), in addition to the revised maximum application rates of the salts in order to assess the relative magnitude of exposure and risk across the spectrum of use sites and application rates allowed. Although the dominant application type appears to be broadcast by ground boom and backpack spray, aerial applications (realistically applied at low applications rates) cannot be precluded and thus both aerial and ground applications will be assessed.

Table II.6. Summary of Potassium and Ammonium Salts Application Information

Crop	Rate (lbs a.i./A)	No. of Applications	Minimum Interval (days)
Potassium Salts Maximum Rate – Aerial & Ground Applications	205	1	not applicable
All Potassium Salts Uses – Aerial & Ground Applications	116	1	not applicable
Ammonium Salts Maximum Rate – Aerial & Ground Applications	103.8	1	not applicable
All Uses – Aerial & Ground Application	63	1	not applicable
All Uses – Aerial & Ground Application	10	1	not applicable
All Uses – Aerial & Ground Application	1	1	not applicable

All Uses = Potassium and Ammonium Salts Uses

In addition, only single applications will be modeled; however, multiple applications used at high application rates will be considered whether the total amount of salts applied more than 205 lbs a.i./acre per year would results in additional risks since multiple applications could result in higher longer-term (chronic) average exposure concentrations.

Sodium salts uses as registered through the Agency are not sprayed broadcast using aircraft, ground equipments, or for spot treatment. The product is unique in that it is formulated as a soap bar enclosed in a mesh bag hung or staked in an individual gardener's backyard. Due to how the sodium salt product is formulated for individual gardeners, the application rate is not defined. This use pattern is not expected to result in meaningful exposure to wildlife.

Indoor premises such as greenhouse, households, industrial, commercial, and hospital that are enclosed places where the pesticide does not reach the environment are not expected to result in meaningful exposure to wildlife. Examples of use site groups are greenhouse food, greenhouse nonfood, indoor food, indoor nonfood, indoor medical, indoor residential, and indoor residential/nonfood uses. While potassium salts products can be used to control fleas on pets, it is not expected to produce concentrations as high as on agricultural fields to pose risk to the environment. Thus, indoor and pet uses are not included in this assessment.

In this assessment, the term insecticidal soap refers only to those products whose active insecticidal ingredient is the soap itself. Soap products that contain other kinds of insecticides are excluded in this assessment.

II.3 Ecosystems Potentially at Risk

The terrestrial ecosystems potentially at risk include the treated area and areas immediately adjacent to the treated area that might receive residues of potassium and ammonium salts via drift or runoff. The ecosystems and communities at risk will tend to be those in close proximity to and downwind, downstream, or down gradient from these and other registered use sites. For Tier 1 assessment purposes, risk will be assessed to terrestrial species that are assumed to feed on and otherwise occupy the treated area. Exposure to animals off the treated site is also possible, but exposure and risk estimates are likely to be lower than on the treated site.

Aquatic ecosystems potentially at risk include water bodies adjacent to, or downstream from the treated field and might include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems including estuaries. For Tier 1 assessment purposes, risk will be assessed to species in small ponds receiving runoff and drift from treated areas.

II.3.1 Receptors

Potassium and Ammonium Salts
Terrestrial receptors likely to be exposed to potassium and ammonium salts include birds, mammals, reptiles and terrestrial stages of amphibians that may live and forage in treated fields and terrestrial plants adjacent to, or down slope from treated areas.

The aquatic receptors likely to be exposed to potassium and ammonium salts include fish, invertebrates, aquatic stages of amphibians and plants living in waterways adjacent to or downstream from treated areas.

Sodium Salts
Based on the use pattern (suspended mesh bags), the low use rate (one ounce per bag), and the mode of action (mammal repellency), meaningful exposure of wildlife to the sodium salts is not anticipated.

II.3.2. Assessment Endpoints

Assessment endpoints include reduced survival of individuals, and reproduction and growth impairments within populations and/or adverse effects to communities. Species potentially exposed include terrestrial and aquatic plants and animals. Potential effects are determined through testing of surrogate representatives within those taxonomic groups, or from other related taxonomic groups.

In order to protect threatened and endangered species, all assessment endpoints are measured at the individual level. Measuring endpoints at the individual level also provides insight about risks at higher levels of biological organization (*e.g.* populations and communities). For example, pesticide effects on individual survivorship have important implications for both population growth increase and habitat carrying capacity.

Assessment endpoints and toxicity data used for the risk assessment are identified in **Table II.8**.

II.4. Conceptual Model

In order for a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

The conceptual model depicts the potential pathways for ecological risk associated with soap salts use. The conceptual model provides an overview of the expected exposure routes for animals and plants within the soap salts action area.

II.4.1. Risk Hypothesis

Risk hypotheses are specific assumptions about potential adverse effects (i.e. changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (EPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of soap salts to the environment. The following risk hypothesis was developed for this registration review.

The use of soap salts as an herbicide, insecticide, acaricide, algaecide, and repellent in terrestrial crop and non-crop sites will likely involve situations where terrestrial and aquatic animals and plants will be exposed to the chemicals. Based on the mobility and persistence of soap salts, the mode of action, and the food-web of the target aquatic and terrestrial ecosystems, soap salts have the potential to cause reduced survival, and reproductive and growth impairment for both terrestrial and aquatic animals and plant species.

II.4.2. Conceptual Diagram

The potential exposure pathways and effects of the registered uses of potassium and ammonium salts on crops and non-crops are depicted in **Figure 1**. Solid arrows depict the most likely routes of exposure and effects; dashed lines depict potential routes of exposure that are not considered likely for soap salts.

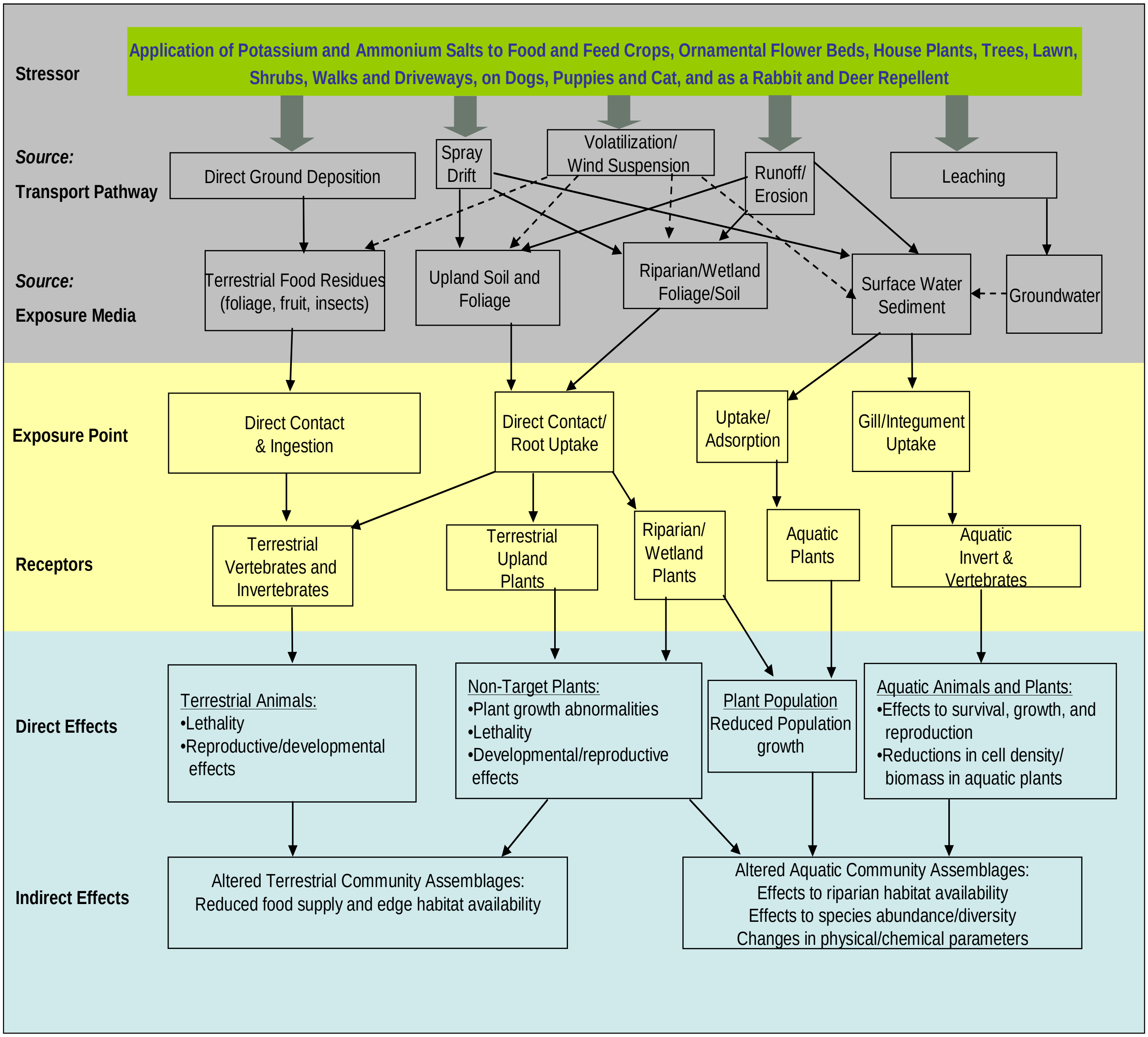


Figure 1 - Conceptual Model Diagram: Potassium and Ammonium Salts Application to Terrestrial Habitats

II.5. Analysis Plan Options

In order to address the risk hypothesis in the soap salts registration review, the potential for adverse effects on non-target aquatic and terrestrial animals and plants will be analyzed in accordance with the Agency's Overview Document (Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, U.S. Environmental Protection Agency, January 2004) and also will be done in accordance with Section 7 of the Endangered Species Act.

During this step, measurements of effect and exposure used to evaluate the risk hypothesis are delineated. The Analysis Plan provides a synopsis of measures that will be used to evaluate the risk hypothesis for salts. There are three categories of measures: exposure, effects, and risk.

Using the screening ecological risk assessment for soap salts, EFED will evaluate the risk hypothesis of whether soap salts may potentially impact, either directly or indirectly, listed species or critical habitat. If the use of soap salts does not support a "not likely to adverse affect" determination, then further refinements will be made. This will involve determining whether use of soap salts "may affect" a particular listed species, and if so, whether it is "likely to adversely affect" the species, or in the case of critical habitat, whether use of the pesticide may destroy or adversely modify any principle constituent elements (PCE) for the critical habitat, and if so, whether the expected impacts are "likely to adversely affect" the critical habitat. The first step in the process is to improve the exposure estimates based on refining the geographic proximity of soap salts' use and the listed species and/or critical habitat. If there is no geographic proximity, this information would support a determination that soap salts use will have no effect on the species or critical habitat. If the Agency determines that a geographic proximity exists, both potential direct effects and any potential indirect effects of soap salts use will be examined. This process is consistent with the Agency's Overview Document. The Agency will consult as necessary with the U.S. Fish and Wildlife Service and National Marine Fisheries Service (Services), consistent with the Services' regulations.

II.5.1 Measures of Exposure

The measures of exposure are estimated using standard EFED models. Aquatic exposure consists of aquatic estimated environmental concentrations (EECs) derived using a waterbody that is vulnerable and representative of static ponds and first order waterways. Because only the shorter-chain fatty acids are soluble in environmental water, aquatic exposures will be modeled as nonanoic (pelargonic) acid, a representative soluble fatty acid.

Terrestrial exposures are estimated using a model that assumes direct application to a variety of avian, mammalian and reptilian food items. Exposure to terrestrial plants are estimated using a model that assume potassium and ammonium salts drift or move with runoff to adjacent habitats, if data are available.

The only potential exposure of the sodium salts mesh bags to the environment would be via direct ingestion of the mesh bags (e.g., there would be minimal surface water runoff, spray drift, or residues expected on potential food items). Direct ingestion is considered to be highly unlikely.

<u>Aquatic Animals and Plants</u>

Tier I simulation model GENEEC2 was used to generate estimated environmental concentrations (EECs) that may occur in surface water bodies adjacent to application sites. The predicted peak, 21-day, and 60-day concentrations are used to estimate risk to aquatic animals and plants inhabiting shallow-water aquatic communities that receive runoff during rainfall events and/or drift from adjacent use sites. More details on GENEEC2 may be found at the following website:

http://www.epa.gov/oppefed1/models/water/index.htm#geneec2

Aquatic Exposure Monitoring and Field Data

No monitoring data are available for soap salts. Even if monitoring data were available, it is unlikely that exposures from pesticidal and non-pesticidal uses could be distinguished.

Terrestrial Animals

The potential exposure pathways for terrestrial plants and animals include deposition from ground and aerial spray applications, runoff/leaching from treated areas, spray drift, direct consumption of mesh bags (considered unlikely), and wind erosion of soil particles resulting in residues on non-target species as well as residues on food items for non-target species. As part of the terrestrial assessment, EFED uses the T-REX and TERRPLANT models to estimate exposure concentrations of potassium and ammonium salts to non-target terrestrial animals and plants, respectively, following single application rates of 1.0, 10, 63, 103.8,116, 205 lb a.i./A.

T-REX estimation of pesticide concentrations in wildlife food items focuses on quantifying possible dietary ingestion of residues on vegetative matter and insects. No field residue data or field study information is available for soap salts; therefore, the residue estimates were based on a nomogram that relates food item residues to pesticide application rate. The residue EECs were generated from a spreadsheet-based model (T-REX version 1.5, an update from the version 1.3.1 that was used in the preliminary problem formulation) that calculates the decay of a chemical applied to foliar surfaces for single or multiple applications on an one-acre field, and is based on the methods of Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. The EECs on terrestrial food items were compared directly with dietary toxicity data or converted to an oral dose, as is the case for small mammals. For mammals, the residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. The risk assessment for potassium and ammonium salts uses upper bound predicted residues as the measure of exposure. Note: T-REX does not differentiate between aerial and ground applications, the method of application is not considered; thus, all aerial and ground applications are considered equivalent. In addition, T-REX assumes 100% of a one-acre agricultural field would be treated using broadcast application equipments.

Brief Description of T-REX Modeling for Birds and Mammals

Formulas presented below in **Table II.7** are used to calculate dose-based and dietary based risk quotients:

Table II.7. Formulas Used to Calculate Dose-Based and Dietary-Based Risk Quotients			
Duration	**Dose or Dietary RQ**	**Surrogate Organism**	**Equation**
Acute	Dose-based	Birds and mammals	Acute Daily Exposure (mg/kg-bw) / adjusted LD_{50} (mg/kg-bw)[1,2]
	Dietary-based	Birds	*Kenaga* EEC (mg/kg-food item) / LC_{50} (mg/kg-diet)
Chronic	Dietary-based	Birds and mammals	EEC (mg/kg-food item) / NOAEC (mg/kg-diet)
	Dose-based	Mammals only	EEC (mg/kg-bw) / Adjusted NOAEL (mg/kg-bw)[2]

[1] Adj. Bird LD_{50} = Bird LD_{50} $(AW/TW)^{(a-1)}$
[2] Adj. Mammal LD_{50} or NOAEL = Mammal LD_{50} or NOAEL $(TW/AW)^{0.25}$

Terrestrial Plants

TerrPlant (v. 1.2.2) was developed to provide screening level estimates of exposure to terrestrial plants from single pesticide applications. The model does not consider exposures to plants from multiple pesticide applications. TerrPlant derives pesticide EECs in runoff and in drift. RQs are developed for non-listed and listed species of monocots and dicots inhabiting dry and semi-aquatic areas that are adjacent to treatment sites receiving runoff and/or drift from applications on sites treated with potassium and ammonium salts.

In addition, the AgDRIFT spray drift model (v. 2.01) will be used to assess exposures of terrestrial plants to potassium and ammonium salts deposited on terrestrial habitats by spray drift. The model consider the amount deposited on a given distance by spray drift to assess the distance (feet) from the edge of field a deposition needs to fall below the terrestrial plant LOC.

Although not used in risk assessment, the Screening Tool for Inhalation Risk (STIR v.1.0) and Screening Imbibition Program (SIP v.1.0) typically are modeled for an upper bound estimate of exposure on inhalation via spray drift and/or vapor and on drinking water to determine whether they are a potential pathway of concern for terrestrial species that warrants for additional studies to further analyze the risks to terrestrial species from exposure to either inhalation or drinking water that are not addressed in the risk assessment. In order to model STIR and SIP, ecological toxicity studies on acute oral and inhalation and chronic reproduction with rat and on acute oral and chronic reproduction with birds, in additional to the physiochemical data on vapor pressure, molecular weight, and solubility for the salts are considered necessary to complete the analyses. However, because the generic mammalian toxicity data requirements have been waived by the Agency's Health Effect Division (HED) for the soap salts due to the lack of effects at high doses in the available studies with other fatty acids, the nature of the chemicals (fatty acids) and their ubiquity in nature, and the limited potential for human exposure via the oral route from established uses; numerous avian toxicity studies show no mortality or sub-lethal effects at high doses as high as 5,000-10,000 mg/kg diet; and the composition of soap salts vary depending on which salt is being assessed, EFED has not attempted to model STIR and SIP due to the nature of the salts and presumes that exposure to inhalation or drinking water were determined not to be a potential pathway of concern for terrestrial species on an acute and chronic exposure basis.

The analysis of the routes in STIR and SIP do not consider that aggregation with other exposure pathways such as dietary, dermal, or drinking water may contribute to a total exposure that has a potential for effects to non-target animals. However, the Agency does consider the relative importance of other routes of exposure in situations where data indicate that pesticide exposures through other routes may be potentially significant contributors to wildlife risk (USEPA, 2004). Detailed information about STIR v.1.0 and SIP v.1.0, as well as the tool, can be found on the EPA's website at:http://www.epa.gov/pesticides/science/models_pg.htm#terrestrial and http://www.epa.gov/pesticides/science/models_pg.htm#terrestrial, respectively.

II.5.2. Measures of Effect

Measures of ecological effects are obtained from submitted guideline studies conducted with a limited number of surrogate species on soap salts. The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions and their standardized use for toxicity studies of a variety of chemicals. As stated above, toxicity testing does not represent all species of birds, mammals, or aquatic animals. Only a few surrogate species for both freshwater fish and birds are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to the laboratory rat. Estuarine/marine testing is usually limited to a crustacean, a mollusk, and a fish. In addition, neither reptiles nor amphibian data are available. The risk assessment assumes that avian, terrestrial-phase amphibian and reptilian toxicities are similar. The same assumption is used for fish and aquatic-phase amphibians.

As noted previously, the correspondence between the products tested in the toxicity studies, and particular currently registered products, is uncertain. The uncertainty is mainly due to unspecified fatty acid chain length compositions.

Where available, sublethal effects observed in acceptable studies will be evaluated qualitatively. Such effects may include behavioral changes (e.g., lethargy and changes in coloration). Quantitative assessments of risks, though, are limited to those endpoints that can be directly linked to the Agency's assessment points of impaired survival, growth and reproduction.

The following table (**Table II.8**) lists the measures of environmental exposure and ecological effects used to assess the potential risks of potassium, ammonium and sodium salts of fatty acids to non-target organisms. The methods used to assess the risk are consistent with those outlined in the document "Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs" (USEPA, 2004).

Table II.8. Measures of Exposure and Measures of Effect Used in Assessing Potential Risks.			
Assessment Endpoint		**Surrogate Species and Measures of Ecological Effect[1]**	**Measures of Exposure**
Birds[2]	Survival	Lowest acute LD_{50} (single oral dose test) and LC_{50} (subacute dietary test)	Upper-bound residues on food items and estimates on concentration of the mesh bag for consumption.
	Reproduction and Growth	Lowest NOAEC (21-week reproduction test)	
Mammals	Survival	Lowest acute LD_{50} (single oral dose test)	
	Reproduction and Growth	Lowest NOAEC (2-generation reproduction test)	
Aquatic Animals (Fish and invertebrates)[3]	Survival	Lowest tested LC_{50} or EC_{50} (acute toxicity test)	Peak EECs[4]
	Reproduction and Growth	Lowest NOAEC (early life-stage or full life-cycle tests)	21-day EECs for invertebrates and 60-day EECs for fish[4]
Terrestrial plants[5]	Survival and growth	Lowest EC_{25} (for non-listed plants) and corresponding NOAEC (for listed plants) (endpoints derived for monocots and dicots from seedling emergence and vegetative vigor studies)	Estimates of runoff and spray drift to non-target areas
Insects[6]	Survival (not quantitatively assessed)	Lowest honeybee LD_{50} (acute contact test)	Maximum application rate for honeybees
Aquatic plants (vascular and non-vascular)	Survival and growth	Lowest EC_{50} (for non-listed plants) and corresponding NOAEC or EC_{05} (for listed plants)	Peak EECs[4]

[1] The most sensitive species tested within taxonomic groups is used for screening-level risk assessments.
[2] Birds represent surrogates for terrestrial-phase amphibians and reptiles.
[3] Freshwater fish represent surrogates for aquatic-phase amphibians.
[4] Aquatic EECs are based on modeling described in **Section III**.
[5] Four species of two families of monocots - one is corn, six species of at least four dicot families, of which one is soybeans.
[6] Risk to terrestrial invertebrates from use is not evaluated, rather the potential hazard to honey bees (i.e. the available data) are qualitatively assessed.

II.5.3. Integration of Exposure and Effects

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from the use of soap salts of fatty acids and the likelihood of direct and indirect effects to non-target animals and plants in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the assessment of risks from exposure to potassium and ammonium salts, the risk quotient (RQ) method is used to compare exposure and measured toxicity values. EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's Levels of Concern (LOCs) (USEPA 2004) (**Table II.9)**. These criteria are used to indicate when salts' uses, as directed on the label, have the potential to cause adverse direct or indirect effects to non-target animals and plants. In addition, incident data from the EIIS and open literature from ECOTOX will be considered as part of the risk characterization.

Table II.9. Agency Risk Quotient (RQ) Metrics and Levels of Concern (LOC) Per Risk Class

RISK CLASS	RISK DESCRIPTION	RQ	LOC
Aquatic Animals (fish and invertebrates)			
Acute	Potential for effects to non-listed animals from acute exposures	Peak EEC/LC_{50}[1]	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	Peak EEC/LC_{50}[1]	0.1
Acute Listed Species	Listed species may be potentially affected by acute exposures	Peak EEC/LC_{50}[1]	0.05
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	60-day EEC/NOAEC (fish)	1
		21-day EEC/NOAEC (invertebrates)	
Aquatic Plants			
Non-Listed	Potential for effects to non-listed plants from exposures	Peak EEC/LC_{50}[1]	1
Listed	Potential for effects to listed plants from exposures	Peak EEC/NOAEC	1
Terrestrial Animals (mammals and birds)			
Acute	Potential for effects to non-listed animals from acute exposures	EEC[2]/LC_{50} (Dietary)	0.5
		EEC/LD_{50} (Dose)	
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	EEC[2]/LC_{50} (Dietary)	0.2
		EEC/LD_{50} (Dose)	
Acute Listed Species	Listed species may be potentially affected by acute exposures	EEC[2]/LC_{50} (Dietary)	0.1
		EEC/LD_{50} (Dose)	
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	EEC/NOAEC	1
Terrestrial and Semi-Aquatic Plants			
Non-Listed	Potential for effects to non-target, non-listed plants from exposures	EEC/ EC_{25}	1
Listed Plant	Potential for effects to non-target, listed plants from exposures	EEC/ NOAEC	1
		EEC/ EC_{05}	

[1] LC_{50} or EC_{50}.
[2] Based on upper bound on feed items

III. Analysis

III.1. Environmental Chemistry of Fatty Acids

The sodium, potassium and ammonium salts of fatty acids across the range C8 to C18 are "soluble" in water, meaning at the maximum completely miscible. The corresponding free acids are less soluble (C8, 789 mg/L and C18, 0.6 mg/L). Thus, formulating the Soap Salt products as sodium, potassium, or ammonium salts aids in the solubilization of the fatty acid moieties in water.

The solubility of fatty acid salts of divalent metal cations (Ca^{2+}, Mg^{2+}, Zn^{2+}) is lower than that of the sodium, potassium, ammonium salts. This is why "ammonium salt products are not compatible with soluble metallic salts such as zinc, manganese, and iron sulfates." The metal ions precipitate the fatty acids as insoluble, high molecular weight salts and make them biologically unavailable. In "hard" water, which is high in Ca and Mg, this is observed as "soap scum" on bathtubs and sinks. The metal ion content of soil provides repeated opportunity for fatty acids to be precipitated out of run-off before reaching an exposure point.

Irani and Callis (1960) reported good correlation between solubility and the number of carbons in saturated fatty acid calcium salts according to the following equations:

$$-\log K_{sp} = -2.63 + 1.24C$$

$$K_{sp} = [Ca^{2+}][\text{fatty acid}]^2$$

where Ksp is the solubility product constant of the salt and C is the number of carbon atoms in the chain. Taking 0.3 mmolar (12 mg/L) as [Ca] for soft water, and 3 mmolar (120 mg/L) as [Ca] for hard water, **Table III.1** gives the solubility limit in mg/L of saturated fatty acid calcium salts, as [fatty acid] in soft and hard water, along with laboratory-measured solubility data given in EPISuite for unknown water hardness conditions.

Table III.1. Solubility Limits of Calcium Fatty acid salts, as mg/L [fatty acid]

Carbon#	MW acid	logKsp	Ksp(1)	Soft water(2)	Hard water(3)	Acid sol (4)
8	144.22	7.29	5.13E-08	1886	596	789
9	158.24	8.53	2.95E-09	496	157	284
10	172.27	9.77	1.699E-10	130	41	61.8
11	186.3	11.01	9.77E-12	34	11	52
12	200.32	12.25	5.623-13	8.7	2.7	4.8
13	214.35	13.49	3.24E-14	2.2	0.70	33
14	228.38	14.73	1.86-15	0.57	0.18	1.07
15	242.41	15.97	1.07E-16	0.14	0.046	
16	256.43	17.21	6.17E-18	0.037	0.012	0.04
17	270.46	18.45	3.55E-19	0.0093	0.0029	
18	284.49	19.69	2.04E-20	0.0023	0.00074	0.597

(1) solubility product constant. (2) fatty acid solubility in soft water. (3) fatty acid solubility in hard water. (4) laboratory-measured solubility literature values from EPISuite in water of unknown hardness.

The lowest toxicity endpoint for potassium and ammonium soap salts (**Tables III.9 and III.10**) is higher (0.39 mg/L for algae NOAEC) than the solubilities for C15 and above, indicating that fatty acids above C15 are too insoluble to reach toxicity thresholds. Thus the fatty acids contributing to the exposure are generally the more soluble C8 to C12 acids.

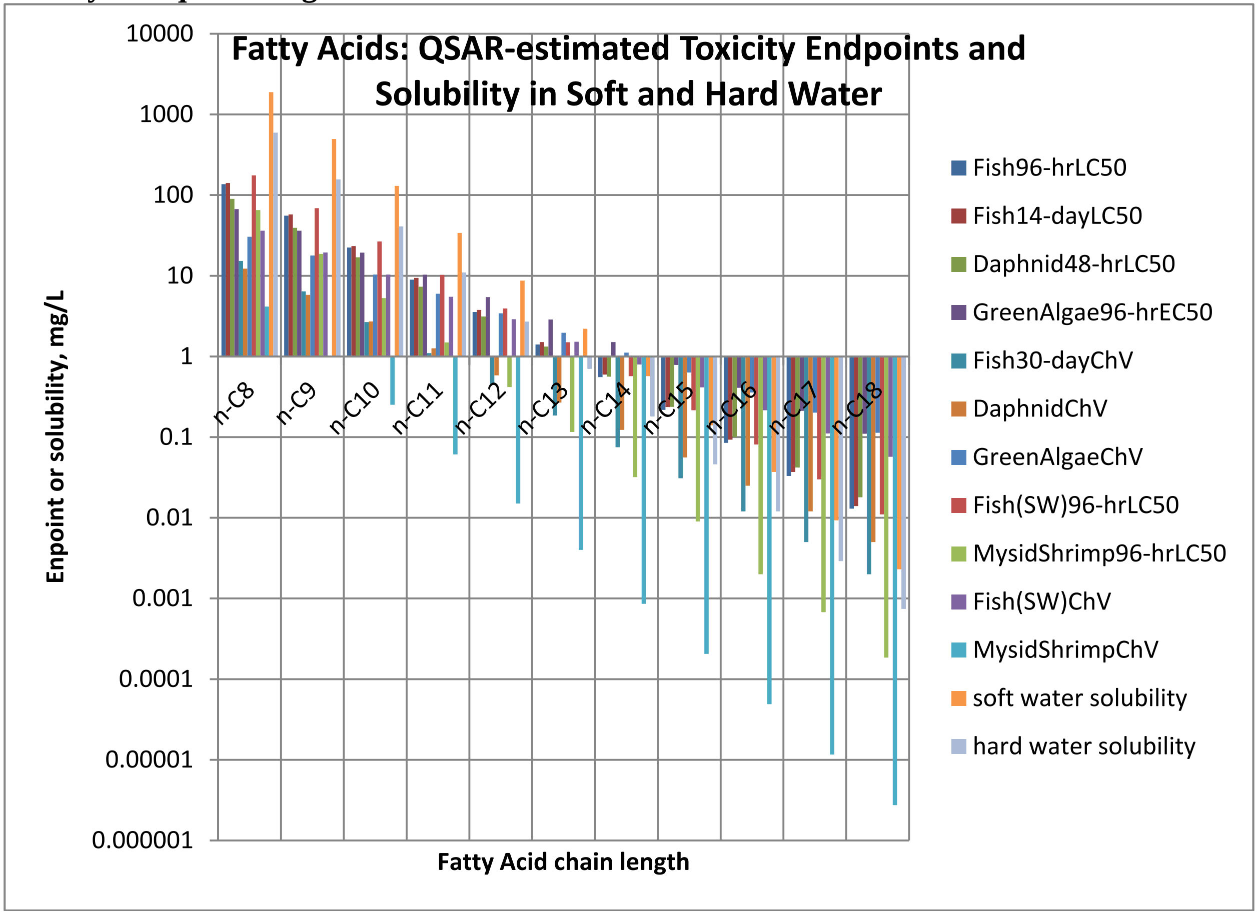
Data for dodecanoic acid (MRID 43465501) indicate that its calcium salt is not soluble enough to reach the measured LC_{50} for fish (36 mg/L), and that the EC_{50} for Daphnids (16.9 mg/L) is over the solubility limit (8.7 mg/L in soft water and 2.7 mg/L in hard water). Above C12, the fatty acids may be too insoluble in environmental water to reach these acute toxicity thresholds.

The environmental fate models used by OPP to estimate fatty acid concentrations in water do not account for interaction with metal ions. Thus, it can be expected that fatty acid concentrations will be lower in waters with relatively high metal ion content than the models predict. Also, in some agricultural situations, lime, which is rich in Ca, is added to raise the pH of the soil. The presence of added Ca in agricultural fields should also serve to limit the solubility and mobility, and thus the environmental water concentration, of fatty acids.

Figure 2 presents a plot of the ECOSAR estimations of the toxicities of normal fatty acids from n-C8 to n-C18, along with the solubilities in soft and hard water. For the shorter chain lengths, solubilities are high enough for the toxicity endpoints to be reached, but at higher chain lengths, the acids are too insoluble for toxic levels to be reached.

The exception to this conclusion appears to be for the mysid shrimp, however it is a salt water organism, and fatty acid solubilities in salt water will be even less than shown in **Figure 2**. Compared to “hard” fresh water (calcium concentration 120 mg/L), calcium concentrations in seawater are even higher (400 mg/L) with high concentrations of fatty-acid precipitating magnesium as well (1,350 mg/L) [CRC Handbook of Chemistry and Physics, 69^{th} ed., 1988-89, p. F-146]. Thus, the higher fatty acids above about n-C13 will not be sufficiently soluble in salt water to be toxic.

Figure 2. Comparison of Calcium-limited Solubilities of Fatty acids and their Estimated toxicity of Aquatic Organisms



Environmental Fate Summary

A typical commercial soap is made by saponification of fats with a strong base to produce a salt of a fatty acid (C_{12} –C_{18} saturated). These fatty acids in soap are an excellent energy source in soil and are among the most efficient energy sources available to living cells. Fatty acids constitute a significant portion of the normal daily diet of mammals (including humans), birds, and invertebrates since they are found in large amounts in the form of lipids in all living tissues (including seeds). Potassium salts of fatty acids are naturally occurring.

Hydrolysis of potassium salts of fatty acids did not occur over a period of 43 days (MRID 470307006). This is consistent with open literature data on fatty acids, which indicates that the primary environmental degradation route of fatty acids is by micro-floral action (the cleavage of the carbon chain of fatty acids requires oxidative chemistry) as opposed to hydrolysis. Aqueous photolysis of two formulated products of fatty acids (Safer's Weed and Grass Killer Concentrate and Safer's Sapestain) was tested (MRID 470307007). The active ingredient in this study was free fatty acids which showed no degradation during the 32 day course of the study. Due to the similarity of chemical structure, it is expected that hydrolysis of the ammonium salts of fatty acid would be similar to that of the potassium salts of fatty acids.

An aerobic soil metabolism study (MRID 470168026) submitted to the Agency indicated that the half-life of these fatty acids is less than one day. The study was conducted using soil collected below turf, and analytical results were reported over a three week period. Both sterilized and non-sterilized soils were treated and the results indicate that the natural fatty acid content of the soil was lower than the fatty acid content of the treated soil. The results also indicated that the concentration of fatty acids in the treated soils had declined to natural levels within 10 days of treatment and that the primary mechanism of degradation was via microbial processes. Extraction for individual degradates was not done because microbial metabolism of fatty acids has the effect of either converting the degradates to CO, and ester (if used as an energy source) or converting the carbon content of the fatty acid to any of the thousands of naturally occurring organic substances produced by the soil micro flora (if used as a carbon source).

Finally, an adsorption/desorption study (MRID 470306008) was submitted for two fatty acids including Capric and Pelargonic fatty acids. Both of these fatty acids are naturally occurring. As with the aerobic soil metabolism study, soil was collected from beneath a turf site and treated with both compounds. Leaching was evaluated by extracting with distilled water, $CHCL_3$, and CH_3OH using a sepratory funnel. Leachate was extracted using H_2SO_4, hexane and distilled water. Extracts were analysis using a gas chromatograph in duplicate with 3 runs per replicate. The study suggests that leaching of Capric and Pelargonic fatty acids would be minimal, although no Kd or Koc estimates were provided nor could they be calculated using the data provided in the study.

In order to address the need for adsorption data (either Kd or Koc) for modeling purposes EFED estimated Koc and log Kow values for a variety of fatty acids using EpiSuite. EpiSuite is modeling software that relies on a database of physical/chemical property data and a suite of environmental fate estimation models developed by EPA's Office of Pollution Prevention & Toxics (OPPTS). Estimates of Koc were generated for nonanoic acid, because this fatty acid represents an average chain length for soap salt products that are soluble enough in environmental water to cause exposure. Estimates of Koc for nonanoic acid ranged from 53 mL/g (molecular connectivity index method) to 111 mL/g (Kow method). A value of 100 mL/g was taken to be representative of soap salt mixtures of length C8 to C11.

http://www.epa.gov/opptintr/exposure/pubs/episuite.htm

In addition, EPA's OPPTS maintains a database of physical/chemical property data under the High Production Volume (HPV) Challenge Program. The HPV program makes human health and environmental effects data available to the public and includes information on Tall Oil Fatty Acids and Related Substances. This database includes limited information on these fatty acids but does include several compounds specifically included in this assessment including potassium salts of fatty acids, fatty acids, tall oil, and sodium salts of fatty acids. The environmental fate data set for these fatty acids is limited but does include some information on log K_{ow} and persistence as measured by biodegradation. In general, these data are consistent with the environmental fate data summarized above and suggests that these fatty acids have the potential to bioaccumulate but are not likely to be persistent. More information on the HPV program in general and the specific data for tall oils may be found at the following website:

http://www.epa.gov/hpvis/

III.2. Aquatic Exposure Modeling

Because the longer-chain fatty acids present in soap salts are not expected to be soluble enough for toxicity to be expressed, the exposure modeling needs to be based on the short-chain acids (generally C8 to C12). It was therefore assumed that only the portion of the product up to C12 contributes to the exposure. Maximum application rates were used. Because the maximum rates include an insoluble portion, modeling the exposure as only soluble fatty acid overstates the actual exposure. For this range (C8 to C12), an overall solubility of 100 mg/L, limited by metal ion concentrations, was judged to be representative based on the data in **Table III.1**. This is roughly equivalent to the solubility of C10 acid in soft water (130 mg/L).

Model input parameters (**Table III.2**) were selected based on laboratory fate data in accordance with EFED's input parameter guidance. Tier I modeling was conducted based on a single application at the maximum application rate. The screening risk assessment has been revised to include the maximum label application rates of 205 and 103.8 lb a.i./A for potassium and ammonium salts, respectively, based on the updated BEAD LUIS report to the previously discussed 'bin' rates of 1.0, 10, 63 and 116 lb a.i./A in the preliminary problem formulation (based on assumptions about the volume of pesticide that may be sprayed per unit area) as described in **Section II.2**. More information on selection of input parameters for GENEEC2 may be found at the following website:

http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm

Table III.2. GENEEC2 Input Parameters for Soap Salts for Aquatic Ecological Exposure Assessment

Model Parameter	Value	Comments	Source
Spray Drift by Scenario	aerial –13% ground -6.6 %	Default Assumption [1]	
Aerobic Soil Metabolism (t ½)	1 day		MRID 470168026
Aerobic Aquatic Degradation (t ½)	2 days	2x aerobic soil metabolism value due to lack of data [1]	
Aqueous Photolysis (t ½)	Stable		MRID 470304007
Hydrolysis	Stable		MRID 470307006
K_{oc}	100	Estimate is representative of mixtures dominated by nonanoic acid (C9)	EpiSuite Estimates
Water Solubility	100 mg/l		EpiSuite Estimates

1- From "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides*"

Modeling Results

Aquatic EECs calculations generated from GENEEC2 for the registered uses of soap salts on outdoor sites based on maximum application rates have been updated for risk estimations in this screening-level assessment (**Table III.3**). The highest application rates for potassium and ammonium salts (205 and 103.8 lbs/acre, respectively) coupled with the representative K_{oc} for lower chain length products (100) yield the EECs in **Table III.3**. Application rates for modeling purposes were selected in accordance with a range of application rates (i.e., 1, 10, 63, 116 lb a.i./A) and the maximum labeled application rates for potassium and ammonium salts (205 and 103.8 lb a.i./A, respectively) in order to assess the relative magnitude of exposure across the spectrum of use sites and application rates allowed.

Table III.3. Exposure Estimates (ppm) for Soap Salts modeled as Nonanoic Acid

Application Rate lb a.i./A	Peak	21-Day Avg	60-Day Avg
Aerial Application			
205	3.2	0.89	0.32
116	1.8	0.50	0.18
103.8	1.60	0.45	0.16
63	0.97	0.27	0.098
10	0.16	0.043	0.016
1	0.016	0.0043	0.0016
Ground Application			
205	2.9	0.79	0.28
116	1.6	0.45	0.16
103.8	1.44	0.40	0.14
63	0.88	0.24	0.086
10	0.14	0.038	0.014
1	0.014	0.0038	0.0014

Terrestrial Organisms

Modeling Results

The predicted upper bound residues of potassium and ammonium salts that may be expected to occur on selected avian or mammalian food items immediately following application (at the maximum label rates for the salts and general ‘bin’ application rates) are presented in **Table III.4** (dietary-based EECs for birds and mammals), **Table III.5** (dose-based EECs for various sizes of birds), and **Table III.6** (dose-based EECs for various sizes of mammals).

Table III.4. Terrestrial Dietary-Based EECs (Birds and Mammals) Following Potassium and Ammonium Salts Spray Application.			
Uses	**Maximum Labeled and General 'Bin' Application Rates**	**Food Items**	**Upper Bound Dietary-Based EEC[1] (mg a.i./kg)**
Max potassium use	205 lb a.i./A x 1 application	Short Grass	49200
		Tall Grass	22550
		Broadleaf Plants	27675
		Fruits, Pods, Seeds	3075
		Arthropods	19270
All potassium uses	116 lb a.i./A x 1 application	Short Grass	27840
		Tall Grass	12760
		Broadleaf Plants	15660
		Fruits, Pods, Seeds	1740
		Arthropods	10904
Max ammonium use	103.8 lb a.i./A x 1 application	Short Grass	24912
		Tall Grass	11418
		Broadleaf Plants	14013
		Fruits, Pods, Seeds	1557
		Arthropods	9757
All registered uses	63 lb a.i./A x 1 application	Short Grass	15120
		Tall Grass	6930
		Broadleaf Plants	8505
		Fruits, Pods, Seeds	945
		Arthropods	5922
All registered uses	10 lb a.i./A x 1 application	Short Grass	2400
		Tall Grass	1100
		Broadleaf Plants	1350
		Fruits, Pods, Seeds	150
		Arthropods	940
All registered uses	1.00 lb a.i./A x 1 application	Short Grass	240
		Tall Grass	110
		Broadleaf Plants	135
		Fruits, Pods, Seeds	15
		Arthropods	94

[1] Used to determine the potential risk to non-target wildlife and plants and the need to consider regulatory action.
All registered uses = Potassium and Ammonium Salts uses

Table III.5. Terrestrial Dose-Based EECs (Birds) Following Potassium and Ammonium Salts Spray Application.					
Uses	**Maximum Labeled and General 'Bin' Application Rates**	**Food items**	**Avian Classes and Body Weights**		
			small	**mid**	**large**
			20 g	**100 g**	**1000 g**
Upper Bound Dose-based EEC (mg a.i./kg bw)[1]					
Max potassium use	205 lb a.i./A x 1 application	Short Grass	56033.87	31952.89	14305.73
		Tall Grass	25682.19	14645.07	6556.79
		Broadleaf Plants	31519.05	17973.50	8046.97
		Fruits, Pods	3502.12	1997.06	894.11
		Arthropods	21946.60	12514.88	5603.08
		Seeds	778.25	443.79	198.69
All potassium uses	116 lb a.i./A x 1 application	Short Grass	31706.97	18080.66	8094.95
		Tall Grass	14532.36	8286.97	3710.19
		Broadleaf Plants	17835.17	10170.37	4553.41
		Fruits, Pods	1981.69	1130.04	505.93
		Arthropods	12418.56	7081.59	3170.52
		Seeds	440.37	251.12	112.43
Max ammonium use	103.8 lb a.i./A x 1 application	Short Grass	28372.27	16179.07	7243.59
		Tall Grass	13003.96	7415.41	3319.98
		Broadleaf Plants	15959.40	9100.73	4074.52
		Fruits, Pods	1773.27	1011.19	452.72
		Arthropods	11112.47	6336.80	2837.07
		Seeds	394.06	224.71	100.61
All registered uses	63 lb a.i./A x 1 application	Short Grass	17220.17	9819.67	4396.40
		Tall Grass	7892.58	4500.68	2015.01
		Broadleaf Plants	9686.34	5523.56	2472.97
		Fruits, Pods	1076.26	613.73	274.77
		Arthropods	6744.57	3846.04	1721.92
		Seeds	239.17	136.38	61.06
All registered uses	10 lb a.i./A x 1 application	Short Grass	2733.36	1558.68	697.84
		Tall Grass	1252.79	714.39	319.84
		Broadleaf Plants	1537.51	876.76	392.54
		Fruits, Pods	170.83	97.42	43.62
		Arthropods	1070.57	610.48	273.32
		Seeds	37.96	21.65	9.69
All registered uses	1.00 lb a.i./A x 1 application	Short Grass	273.34	155.87	69.78
		Tall Grass	125.28	71.44	31.98
		Broadleaf Plants	153.75	87.68	39.25
		Fruits, Pods	17.08	9.74	4.36
		Arthropods	107.06	61.05	27.33
		Seeds	3.80	2.16	0.97

[1] Used to determine the potential risk to non-target wildlife and the need to consider regulatory action.
All registered uses = Potassium and Ammonium Salts uses

Table III.6. Terrestrial Dose-Based EECs (Mammals) Following Potassium and Ammonium Salts Spray Application.					
Uses	Maximum Labeled and General 'Bin' Application Rates	Food items	Mammalian Classes and Body Weights		
			small	mid	large
			20 g	100 g	1000 g
Upper Bound Dose-based EEC (mg a.i./kg bw)[1]					
Max potassium use	205 lb a.i./A x 1 application	Short Grass	46908.43	32420.00	7516.69
		Tall Grass	21499.70	14859.17	3445.15
		Broadleaf Plants	26385.99	18236.25	4228.14
		Fruits, Pods	2931.78	2026.25	469.79
		Arthropods	18372.47	12697.83	2944.04
		Seeds	651.51	450.28	104.40
All potassium uses	116 lb a.i./A x 1 application	Short Grass	26543.31	18344.98	4253.35
		Tall Grass	12165.68	8408.11	1949.45
		Broadleaf Plants	14930.61	10319.05	2392.51
		Fruits, Pods	1658.96	1146.56	265.83
		Arthropods	10396.13	7185.12	1665.89
		Seeds	368.66	254.79	59.07
Max ammonium use	103.8 lb a.i./A x 1 application	Short Grass	23751.68	16415.59	3806.01
		Tall Grass	10886.19	7523.81	1744.42
		Broadleaf Plants	13360.32	9233.77	2140.88
		Fruits, Pods	1484.48	1025.97	237.88
		Arthropods	9302.74	6429.44	1490.69
		Seeds	329.88	227.99	52.86
All registered uses	63 lb a.i./A x 1 application	Short Grass	14415.76	9963.22	2310.01
		Tall Grass	6607.22	4566.48	1058.75
		Broadleaf Plants	8108.87	5604.31	1299.38
		Fruits, Pods	900.99	622.70	144.38
		Arthropods	5646.17	3902.26	904.75
		Seeds	200.22	138.38	32.08
All registered uses	10 lb a.i./A x 1 application	Short Grass	2288.22	1581.46	366.67
		Tall Grass	1048.77	724.84	168.06
		Broadleaf Plants	1287.12	889.57	206.25
		Fruits, Pods	143.01	98.84	22.92
		Arthropods	896.22	619.41	143.61
		Seeds	31.78	21.96	5.09
All registered uses	1.00 lb a.i./A x 1 application	Short Grass	228.82	158.15	36.67
		Tall Grass	104.88	72.48	16.81
		Broadleaf Plants	128.71	88.96	20.63
		Fruits, Pods	14.30	9.88	2.29
		Arthropods	89.62	61.94	14.36
		Seeds	3.18	2.20	0.51

[1] Used to determine the potential risk to non-target wildlife and the need to consider regulatory action.
All registered uses = Potassium and Ammonium Salts uses

Terrestrial Plants

Modeling Results

EFED's exposure scenario for off-site plants is based on the application rate, application method (ground or air), and the water solubility of the pesticide. The amount of pesticide that runs off is a proportion of the application rate and is assumed to be 1%, 2%, or 5% for water solubility values of <10 mg/L, 10-100 mg/L, and >100 mg/L, respectively. For soap salts, a runoff value of 2% is presumed, based on its solubility of 100 mg/L in water. Drift from ground-spray and aerial applications are assumed to be 1% and 5%, respectively, of the application rate. The previous EECs in the preliminary problem formulation were incorrect because a runoff value of 5% was used in the calculations and has been revised. The revised EECs are tabulated below in **Table III.8**.

Table III.8. EECs for Terrestrial Plants Located Adjacent to Potassium and Ammonium Salts Treated Sites.				
Application Rate (lb a.i./A)	**Application Method**	**EECs (lbs a.i./A)**		
		Total Loading to Areas Adjacent to Treated Areas[1]	**Total Loading to Semi-Aquatic Areas Adjacent to Treated Areas[2]**	**Drift to Adjacent Areas[3]**
205	Ground Unincorp. Spray	6.2	43.1	2.1
	Aerial Spray	14.4	51.3	10.3
116	Ground Unincorp. Spray	3.5	24.4	1.2
	Aerial Spray	8.1	29.0	5.8
103.8	Ground Unincorp. Spray	3.1	21.8	1.0
	Aerial Spray	7.3	26.0	5.2
63	Ground Unincorp. Spray	1.9	13.2	0.6
	Aerial Spray	4.4	15.6	3.2
10	Ground Unincorp. Spray	0.3	2.1	0.1
	Aerial Spray	0.7	2.5	0.5
1.00	Ground Unincorp. Spray	0.03	0.21	0.01
	Aerial Spray	0.07	0.25	0.05

[1] EEC = Sheet Runoff + Drift (1% for ground; 5% for aerial)
[2] EEC = Channelized Runoff + Drift (1% for ground; 5% for aerial)
[3] EEC for ground (appl. rate x 1% drift); for aerial (appl. rate x 5% drift)

III.3. Ecological Effects Characterization

In screening-level ecological risk assessments, effects characterization describes the types of effects a pesticide can have on aquatic and terrestrial organisms. This characterization is based on the registrant-submitted toxicity data for birds, mammals, fish, invertebrates, and plants for the active ingredients selected for this ecological risk assessment phase of soap salts registration review. Effect data were available for potassium and ammonium salts; however, none were available for sodium salts. Because the one active sodium salts product registration is a low volume, minor use product intended for homeowner use only and the only potential exposure to the environment is via direct ingestion of the bar (e.g. there would be no runoff, spray drift, or residues expected on potential food items), toxicity data were waived.

This assessment evaluates the potential for salts to directly or indirectly affect listed species or modify designated critical habitat. As previously discussed in **Section II.5**, assessment endpoints include direct toxic effects on the survival, reproduction, and growth of listed entities, as well as indirect effects, such as reduction of the prey base or modification of habitat. In addition, potential modification of critical habitat is assessed by evaluating effects to the critical elements principle constituent elements (PCEs), which are components of the critical habitat areas that provide essential life cycle needs of listed entities.

As described in the Agency's Overview Document (USEPA 2004), the most sensitive endpoint for each taxon is used for risk estimation. For this assessment, evaluated taxa include freshwater fish, freshwater invertebrates, aquatic plants, birds (also surrogate for terrestrial-phase amphibians and reptiles), terrestrial invertebrates, and terrestrial plants. Mammalian endpoints were not available for risk estimation as the Agency's Health Effects Division (HED) has waived all mammalian endpoints due to available data for related products of known composition that show lack of effects at high rates to mammals.

Toxicity endpoints are established based on data generated from guideline studies submitted by the registrant, and from open literature studies that meet the criteria for inclusion into the ECOTOX database maintained by EPA/Office of Research and Development (ORD) (U.S. EPA, 2004). Open literature data searched for this screening assessment were obtained from ECOTOX information obtained in June 2008. In order to be included in the ECOTOX database, papers must meet the following minimum criteria:

(1) the toxic effects are related to single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) there is a biological effect on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) there is an explicit duration of exposure.

Data that pass the ECOTOX screen are evaluated along with the registrant-submitted data, and may be incorporated qualitatively or quantitatively into this endangered species assessment. In general, effects data in the open literature that indicates effects at lower concentrations than the registrant-submitted data are considered. The degree to which open literature data are quantitatively or qualitatively characterized is dependent on whether the information is relevant to the assessment endpoints (survival, reproduction, and growth) identified in **Section II.5**. For example, endpoints such as behavior modifications are likely to be qualitatively evaluated, because quantitative relationships between modifications and reduction in species survival, reproduction, and/or growth are not available. To date, none of the open literature that passed the ECOTOX screen obtained effects at lower concentrations than the submitted studies and thus are not used in this risk assessment.

Ecological effect studies are typically performed using the technical grade active ingredient (TGAI); however, because the salts are formed through an integrated manufacturing process, there is no technical product. To resolve these issues, the Agency requested studies with the formulated products. However, an uncertainty on the toxicity values of the active ingredients used in the assessment exists because the particular fatty acid chain length composition of the tested products is unknown.

In addition to registrant-submitted and open literature toxicity information, other sources of information, including use of the acute probit dose-response relationship to establish the probability of an individual effect and reviews of the Ecological Incident Information System (EIIS), are conducted to further refine the characterization of potential ecological effects associated with exposure to salts. A summary of the available aquatic and terrestrial ecotoxicity information and use of the probit dose-response relationship for salts are provided in **Sections III and V**, respectively.

A review of the Ecological Incident Information System (EIIS) maintained by the Agency's Office of Pesticide Programs (OPP) indicates a total of 2 reported ecological incidents associated with the use of potassium salt formulated products. The reported incidents involved phytotoxicity damage to cherry trees (terrestrial plants) that occurred in two counties of Washington State in 1989 and 1999. Both incidents were associated with registered uses of salts and classified as "probable" that the incidents were associated with salts exposure. In addition, there are 29 aggregate plant incidents reported for potassium salt formulated products between 1997 and 2012 that were reported by the pesticide registrants.

Similarly, a search of the Avian Incident Monitoring System (AIMS; http://www.abcbirds.org/abcprograms/policy/toxins/aims/aims/index.cfm) was conducted on October 10, 2012. AIMS is a database administered by the American Bird Conservancy that contains publicly available data on reported avian incidents involving pesticides. No incidents involving soap salts were found.

III.3.1. Aquatic Effects Characterization

The most sensitive acute and chronic effects measurement endpoints associated with salts exposure to freshwater and estuarine/marine species are summarized in **Table III.9** for potassium and in **Table III.10** for ammonium**.** Selected effects endpoints for the risk assessment are from acceptable and supplemental studies for salts and are described below.

Laboratory studies examining the effects of salts of fatty acids to aquatic organisms indicated potassium salt is generally more toxic than ammonium salt. Based on the most sensitive toxicity data, potassium is acutely classified as moderately toxic to freshwater fish and estuarine/marine invertebrates; highly toxic to freshwater invertebrates; and no effects were seen in estuarine/marine fish at doses up to 4.4 mg a.i./L. Ammonium is classified as slightly toxic to freshwater fish and both freshwater and estuarine/marine invertebrates; and practically nontoxic to estuarine/marine fish on an acute basis. In addition, freshwater fish also act as surrogates for aquatic-phase amphibians in the absence of data; therefore, acute toxicity data with freshwater fish indicates potassium and ammonium salts are moderately and slightly toxic to aquatic-phase amphibians, respectively. With chronic toxicity data limited to the daphnid life cycle studies, reproductive and growth effects in the time release of first brood, offspring per adult, and length were observed; however, daphnids' life cycle was more sensitive to potassium than ammonium. Acute-to-Chronic Ratio calculations were used to estimate the NOAEC for chronic effects to freshwater fish, estuarine/marine fish, and estuarine/marine invertebrates, using data from the daphnid and mysid studies.

No aquatic organism toxicity data are available for sodium salts; however, sodium salt mesh bags are hung on branches or stakes, which results in low potential for runoff and spray drift to aquatic organisms/plants. In addressing the lack of toxicity data, the required exposure for adverse effects on aquatic organisms/plants exposed to sodium salts are discussed further in **Section IV.2**.

It is not clear from the available data (**Tables III.11 thru III.16**) for potassium, and ammonium salts whether the tested substance represented a long-chain (C14 – C18) or short-chain (C8 – C12) mixture. For comparison, toxicity testing was conducted on a product whose composition is known (96.7% pelargonic, or nonanoic acid, C9, and 2.5% 2-methyloctanoic acid, a C9 isomer). This fatty acid is representative of shorter-chain fatty acids that are appreciably soluble even in the presence of metal ions. The results of acute toxicity studies with nonanoic acid indicate that the LC_{50} in bluegill sunfish is greater than 105 mg/L (MRID 430653-01), the LC_{50} in rainbow trout is 91 mg/L (MRID 430653-02), and the EC_{50} in daphnia magna is 96 mg/L (MRID 430653-03).

These results indicate that a fatty acid of defined composition (99.2% C9 and isomer) is less toxic than would be indicated by the toxicity data for potassium and ammonium salts of unknown fatty acid composition. This introduces an uncertainty in the risk quotient calculations, since with the available data (**Tables III.11 thru III.16**), we are not certain which substance or substances is represented.

Table III.9. Most Sensitive Acute and Chronic Toxicity Data for Aquatic Organisms Exposed to Potassium Salts of Fatty Acids.				
Exposure Scenario	**Species**	**Affected Endpoint**	**Toxicity Measurement**	**MRID (Classification)**
Freshwater Fish				
Acute	Rainbow trout (*Onchorhynchus mykiss*)	Mortality	96-hr LC_{50} = 9.19 mg a.i./L	40053304
Chronic		No data available	Estimated NOAEC = 8.06 mg a.i./L	ACR[1]
Freshwater Invertebrates				
Acute	Water flea (*Daphnia* spp.)	Immobility	48 hr EC_{50} = 0.57 mg a.i./L	40053305
Chronic		Reproduction and Growth	NOAEC = 0.5 mg a.i./L (offspring/adult and length)	48664201
Estuarine/Marine Fish				
Acute	Sheepshead minnow (*Cyprinodon variegates)*	Mortality	96-hr LC_{50}>4.4 mg a.i./L	48469802
Chronic		No studies available	Estimated NOAEC >3.9 mg a.i./L	ACR[1]
Estuarine/Marine Invertebrates				
Acute	Mysid shrimp (*Americamysis bahia*)	Mortality	96-hr LC_{50} = 1.2 mg a.i./L	48608707
Chronic		No data available	Estimated NOAEC = 1.05 mg a.i./L	ACR[1]
Aquatic Plants				
7-day exposure	Duckweed (*Lemna gibba*)	Frond count	7-day EC_{50}: >5.0 mg a.i./L NOAEC = 5.0 mg a.i./L	48608702
96-hour exposure	Green algae (*P. subcapitata*)	Cell density	96-hr EC_{50}: 0.59 mg a.i./L NOAEC = 0.39 mg a.i./L	48608701

[1] Estimated value based on Acute to Chronic Ratio (ACR) method using daphnid data; ACR = 1.14. Trout NOAEC = (LC50 of 9.19 mg/L ÷ 1.14) = 8.06 mg/L; Minnow NOAEC = (LC50 of >4.4 mg/L ÷ 1.14) = >3.9 mg/L; Mysid NOAEC = (EC50 of 1.2 mg/L ÷ 1.14) = 1.05 mg/L

Table III.10. Most Sensitive Acute and Chronic Toxicity Data for Aquatic Organisms Exposed to Ammonium Salts of Fatty Acids.				
Exposure Scenario	**Species**	**Affected Endpoint**	**Toxicity Measurement**	**MRID**
Freshwater Fish				
Acute	Rainbow trout (*Onchorhynchus mykiss*)	Mortality	96-hr LC_{50} = 12 mg a.i./L	42806405
Chronic		No studies available	Estimated NOAEC = 10.3 mg a.i./L	ACR[1]
Freshwater Invertebrates				
Acute	Water flea (*Daphnia* spp.)	Immobility	48 hr EC_{50} = 27 mg a.i./L	42806406
Chronic		Reproduction and Growth	NOAEC = 23 mg a.i./L (time to first brood release)	48402203
Estuarine/Marine Fish				
Acute	Sheepshead minnow (*Cyprinodon variegates)*	None	96-hr LC_{50}>105 mg a.i./L	48402202
Chronic		No studies available	Estimated NOAEC = >90 mg a.i./L	ACR[1]
Estuarine/Marine Invertebrates				
Acute	Mysid shrimp (*Americamysis bahia*)	Mortality	96-hr LC_{50} = 67 mg a.i./L	48402201
Chronic		No data available	Estimated NOAEC = 57 mg a.i./L	ACR[1]
Aquatic Plants				
7-day exposure	Duckweed (*Lemna gibba*)	Frond count	7-day EC_{50}= 200 mg a.i./L NOAEC = 15 mg a.i./L	48402206
96-hour exposure	Green algae (*P. subcapitata*)	Cell density	96-hr EC_{50}: 6.6 mg a.i./L NOAEC = 2.9 mg a.i./L	48402207

[1] Estimated value based on Acute to Chronic Ratio (ACR) method using daphnid data; ACR = 1.17. Trout NOAEC = (LC50 of 12 mg/L ÷ 1.17) = 10.3 mg/L; Minnow NOAEC = (LC50 of >105 mg/L ÷ 1.17) = >90 mg/L; Mysid NOAEC = (EC50 of 66.5 mg/L ÷ 1.17) = 57 mg/L

Freshwater Fish, Acute Effects

Fish toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to fish. Results of the acute studies with the ammonium and potassium salts formulated products to freshwater fish indicate the trout LC_{50} value of 12 mg a.i./L and 9.19 mg a.i./L, respectively, (**Table III.11**) are used to evaluate potential acute effects of the salts to freshwater fish.

Table III.11. Freshwater Fish Acute Toxicity with Soap Salts (Ammonium and Potassium).					
Species	**% a.i.**	**96-hour LC_{50} (mg a.i./L)**	**Toxicity Category**	**MRID No. Author/Year**	**Study Classification**
AMMONIUM SALTS OF FATTY ACIDS					
Rainbow trout (*Oncorhynchus mykiss*)	13.1	12[A]	Slightly toxic	42806405 Ward *et al.* (1993)	Supplemental[1]
POTASSIUM SALTS OF FATTY ACIDS					
Rainbow trout (*Oncorhynchus mykiss*)	51	131.3[B]	Practically nontoxic	00090936 Janssen. (1979)	Supplemental[2]
	49	17[C]	Slightly toxic	44980313 Nedvidek. (1996)	Acceptable
	25	9.19[D]	Moderately toxic	40053304 Obenchain. (1986)	Supplemental[3]
	Not reported	18.1 mg formulation/L[E]	N/A[4]	00096636 Berlin. (1981)	Supplemental[5]
Bluegill sunfish (*Lepomis macrochirus*)	25	23[F]	Slightly toxic	40053304 Obenchain. (1986)	Supplemental[6]

[A] Trout 95% Confidence Interval (C.I.) = 11-14 mg a.i./L; slope = N/A (moving average)
[B] Trout 95% C.I. = 85-151 mg a.i./L; slope = N/A (binomial)
[C] Trout 95% C.I. = 7.67-28.64 mg a.i./L; slope = N/A (binomial)
[D] Trout 95% C.I. = 7.28-11.5 mg a.i./L; slope (95% C.I) = 3.88 (2.53-5.22)
[E] Trout 95% C.I. = 16.8-19.3 mg formulation/L; slope (95% C.I.) = 18.15 (9.42-26.88)
[F] Sunfish 95% C.I. = 19.2-27.5 mg a.i./L; slope (95% C.I.) = 4.97 (3.27-6.66)
[1] No chemical analyses were performed on the test concentrations at the beginning and end of the test as well as before and after each renewal.
[2] Each concentration was less than 60% of the next higher concentration, there were not enough concentrations at which between 0% and 100% of the fish died in 96 hours.
[3] Aeration was applied within 24 hours of the test in order to maintain dissolved oxygen levels since levels fell below 40% saturation between 24- and 48-hours.
[4] The purity of the active ingredient in the formulation was not reported, it was not possible to determine the toxicity category for the active ingredient when corrected for purity.
[5] No chemical analyses of the test solutions for the presence of the formulation or active ingredient.
[6]Aeration was used.

AMMONIUM SALTS OF FATTY ACIDS

A 96h static-renewal acute exposure study (MRID 42806405; Supplemental) with rainbow trout (*Onchorhynchus mykiss*) is available for a 13.1% ammonium salts of fatty acids formulation. Twenty trout per level were exposed to nominal concentrations of 0 (control), 3, 5, 8, 13 and 20 mg a.i./L (corrected for purity). 10, 40 and 100% mortalities occurred at the 8, 13 and 20 mg a.i./L concentrations. The LC_{50} was determined to be 12 mg a.i./L (adjusted for purity). Dark coloration and lethargy were observed in the 13 and 20 mg a.i./L concentrations, the EC_{50} could not be calculated; the visual-observed NOAEC is 8 mg a.i./L.

POTASSIUM SALTS OF FATTY ACIDS

A 96h static acute exposure study (MRID 90936; Supplemental) with rainbow trout (*Onchorhynchus mykiss*) is available for a 51% potassium salts of fatty acids formulation. Ten trout per level were exposed to nominal concentrations of 0 (control), 24, 43, 77, 135 and 240 mg a.i./L (corrected for purity). No mortality occurred in the control or in concentrations up to 43 mg a.i./L. 100% mortality occurred in the 135 mg a.i./L and 240 mg a.i./L, the two highest concentrations tested. While the formulated product was used, the 96-hour LC_{50} and NOAEC for the active ingredient was determined to be 131 and 87 mg a.i./L, respectively.

A 96h static acute exposure study (MRID 96636; Supplemental) with rainbow trout (*Onchorhynchus mykiss*) is available for a potassium salts of fatty acids formulation. Twenty trout per level were exposed to nominal concentrations of 0 (control), 10, 15, 17, 20 and 22 mg formulation/L. The purity of the active ingredient was not reported; the reviewer could not correct the concentrations for purity. 10, 30, 70 and 100% mortalities occurred at the 15, 17, 20 and 22 mg formulation/L concentrations. The LC_{50} was determined to be 18 mg formulation/L. Data on sub-lethal effects were not available to evaluate whether there were other effects than mortality. The statistical output calculated an NOAEC of 17 mg/L for mortality; however, the reviewer felt that the observed mortality at this level (30%) was biologically significant and therefore, visually determined the NOAEC to be 15 mg formulation/L based on the single mortality at this level.

A 96h static acute exposure study (MRID 40053304; Supplemental) with bluegill sunfish *(Lepomis macrochirus)* is available for a 25% potassium salts of fatty acids formulation. Twenty sunfish per level were exposed to nominal concentrations of 0 (control), 10, 18, 32, 56 and 100 mg a.i./L. 5, 30, 70, 100 and 100% mortalities occurred at the 10, 18, 32, 56 and 100 mg a.i./L test levels. While the formulated product was used, the 96-hour LC_{50} for the active ingredient based on 25% of product by volume was determined to be 23 mg a.i./L.

A 96h static acute exposure study (MRID 40053304; Supplemental) with rainbow trout *(Onchorhynchus mykiss)* is available for a 25% potassium salts of fatty acids formulation. Twenty trout per level were exposed to nominal concentrations of 0 (control), 3.7, 7.5, 15.2, 32 and 65 mg a.i./L. 10, 30, 80, 100 and 100% mortalities occurred at the 3.7, 7.5, 15.2, 32 and 65 mg a.i./L test levels. While the formulated product was used, the 96-hour LC_{50} for the active ingredient based on 25% of product by volume was determined to be 9.19 mg a.i./L.

A 96h static acute exposure study (MRID 44980313; Acceptable) with rainbow trout *(Onchorhynchus mykiss)* is available for a 49% potassium salts of fatty acids formulation. Twenty trout per level were exposed to initial-measured concentrations of 0 (control), 4.48, 7.67, 28.64, 41.42, 260.1 and 404.9 mg a.i./L (adjusted for purity). 90, 100, 100 and 100% mortalities occurred at the 28.64, 41.42, 260.1 and 404.9 mg a.i./L test levels. The LC_{50} was determined to be 17 mg a.i./L. The NOAEC, based on sublethal effects of lying at the bottom, floating vertically and swimming slowly, is 4.48 mg a.i./L based on initial-measured concentrations.

Freshwater Fish, Chronic Effects

AMMONIUM and POTASSIUM SALTS OF FATTY ACIDS

No chronic ecological effects studies of ammonium and potassium salts using freshwater fish were submitted.

Freshwater Invertebrates, Acute Effects

Toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to freshwater invertebrates. Results of the acute studies with the ammonium and potassium salts formulated products to freshwater invertebrates indicate the EC_{50} value of 27.1 mg a.i./L and 0.57 mg a.i./L, respectively, (**Table III.12**) is used to evaluate potential acute effects of the salts to freshwater invertebrates.

Table III.12. Freshwater Invertebrate Acute Toxicity with Soap Salts (Ammonium and Potassium).

Species	% a.i.	48-hour EC_{50} (mg a.i./L)	Toxicity Category	MRID No. Author/Year	Study Classification
AMMONIUM SALTS OF FATTY ACIDS					
Water flea (*Daphnia magna*)	13.1	27.1 [A]	Slightly toxic	42806406 Ward *et al*. (1993)	Supplemental[1]
	22	30.9 [B]	Slightly toxic	44760402 Kleiner (1998)	Acceptable
POTASSIUM SALTS OF FATTY ACIDS					
Water flea (*Daphnia pulex*)	51	106 [C]	Practically non-toxic	00096638 Condrashoft. (1979)	Supplemental[2]
Water flea (*Daphnia magna*)	25	0.57 [D]	Highly toxic	40053305 Harrison. (1986)	Acceptable
Water flea (*Daphnia magna*)	49	17.3 [E]	Slightly toxic	44980315 Grunert. (1996)	Supplemental[1]

[A] D. magna 95% Confidence Interval = 20-33 mg a.i./L; slope = N/A (binomial)

[B] D. magna 95% Confidence Interval = 24-40.9 mg a.i./L; slope = N/A (moving average)

[C] D. pulex 95% Confidence Interval = N/A; slope = N/A

[D] D. magna 95% Confidence Interval = 0.44-0.75 mg a.i./L; slope and its 95% C.I. = 3.18 (2.13-4.23)

[E] D. magna 95% Confidence Interval = 14.1-21.3 mg a.i./L; slope and its 95% C.I. = 4.46 (2.9-6.0)

[1] No chemical analyses were performed on the test concentrations for the presence of the active ingredient or formulation especially when mortality/immobility were observed.

[2] The test solutions were aerated after the test material was added; the dissolved oxygen data was not reported to verify the need to aerate the test solutions.

AMMONIUM SALTS OF FATTY ACIDS

A 48h static-renewal acute exposure study (MRID 42806406; Supplemental) with daphnids (*Daphnia magna*) is available for a 13.1% ammonium salts of fatty acids formulation. Twenty daphnids per level were exposed to nominal concentrations of 0 (control), 12, 20, 33, 52, 79 and 131 mg a.i./L (corrected for purity). 90, 100, 100 and 100% mortalities occurred at the 33, 52, 79 and 131 mg a.i./L concentrations. The immobility EC_{50} was determined to be 27.1 mg a.i./L; the NOAEC was 20 mg a.i./L (adjusted for purity). 100% lethargy was observed in the 33 mg a.i./L concentration; in higher concentrations, complete immobility/mortality precluded the observations of sublethal effects, the EC_{50} could not be calculated; the visual-observed NOAEC for sub-lethal effects is 20 mg a.i./L.

A 48h static-renewal acute exposure study (MRID 44760402; Acceptable) with daphnid

(*Daphnia magna*) is available for a 22% ammonium salts of fatty acids formulation. Twenty daphnids per level were exposed to initial-measured concentrations of 0 (control), 0.5, 0.9, 1.4, 4.7, 6.6, 22.6, 34.4, 82.3 and 203.7 mg a.i./L (corrected for purity). 5, 10, 55, 100 and 100% immobility occurred at the 6.6, 22.6, 34.4, 82.3 and 203.7 mg a.i./L concentrations. The EC_{50} and NOAEC for immobility was determined to be 30.9 and 22.6 mg a.i./L, respectively (adjusted for purity). The sub-lethal effects were not reported since immobility was considered a sub-lethal effect by the study authors.

POTASSIUM SALTS OF FATTY ACIDS

A 48h static acute exposure study (MRID 96638; Supplemental) with daphnids (*Daphnia pulex*) is available for a 50.5% potassium salts of fatty acids formulation. Thirty daphnids per level were exposed to nominal concentrations of 0 (control), 50, 100, 150 and 200 mg a.i./L. 33.3, 40, 73.3 and 100% mortality occurred in the first test and 20, 40, 66.7 and 100% mortality occurred in the second test. The study author based its conclusion on dead daphnids; no data on immobilized daphnids were available and were not included in the count; it is possible the actual EC_{50} value could be lower if immobilized daphnids had been included in the count. The reviewer calculated the LC_{50} for the first and second tests separately and was 84.7 and 97.6 mg a.i./L, respectively; however, the study author reported a LC_{50} of 106 mg a.i./L by combining the data of the tests together. The immobility EC_{50} is not available since data on immobilization were not available.

A 48h static acute exposure study (MRID 40053305; Acceptable) with daphnids (*Daphnia pulex*) is available for a 25% potassium salts of fatty acids formulation. Twenty daphnids per level were exposed to nominal concentrations of 0 (control), 0.25, 0.5, 1.25, 2.5 and 3.75 mg a.i./L. 5, 55, 85, 95 and 100% effect occurred at the 0.25, 0.5, 1.25, 2.5 and 3.75 mg a.i./L concentrations. It appears that the study author based its conclusion on dead daphnids rather than the total of daphnids dead and immobilized; it is possible the actual EC_{50} value could be lower if immobilized daphnids had been included in the count. The LC_{50} based on mortality was determined to be 0.57 mg a.i./L. The NOAEC was not determined since >5% effects were observed in all levels. The immobility EC_{50} is not available since data on immobilization were not available.

A 48h static acute exposure study (MRID 44980315; Supplemental) with daphnids (*Daphnia magna*) is available for a 49% potassium salts of fatty acids formulation. Twenty daphnids per level were exposed to nominal concentrations of 0 (control), 0.38, 0.76, 1.53, 3.06, 6.13, 12.25, 24.5, 49 and 98 mg a.i./L (corrected for purity). 35, 65, 100 and 100% immobility occurred at the 12.25, 24.5, 49 and 98 mg a.i./L concentrations. The EC_{50} and NOAEC for immobility was determined to be 17.2 and 6.13 mg a.i./L, respectively (adjusted for purity).

Freshwater Invertebrates, Chronic Effects

Laboratory toxicity studies using the typical end-use products were submitted to establish the chronic toxicity of salts to freshwater invertebrates. Results of the reproduction studies with the ammonium and potassium salts formulated products to freshwater invertebrates indicate the NOAEC value of 23 mg a.i./L and 0.5 mg a.i./L, respectively, (**Table III.13**) is used to evaluate potential reproductive effects of the salts to freshwater fish.

Table III.13. Freshwater Invertebrate Chronic Toxicity with Soap Salts (Ammonium and Potassium).					
Species	**% a.i.**	**21-day NOAEC (mg a.i./L)**	**Endpoint affected**	**MRID No. Author/Year**	**Study Classification**
AMMONIUM SALTS OF FATTY ACIDS					
Water flea *(Daphnia magna)*	21.85	23	Time to first brood release, offspring per adult, length and dry weight	48402203 Fournier. (2011)	Acceptable
POTASSIUM SALTS OF FATTY ACIDS					
Water flea *(Daphnia magna)*	50.1	0.5	Offspring per adult, length and parental survival	48664201 Sayers. (2011)	Acceptable
Water flea *(Daphnia magna)*	46.8	0.52	Time to first brood release, offspring per adult and length	48668601 Fournier. (2011)	Acceptable

AMMONIUM SALTS OF FATTY ACIDS

A 21d freshwater invertebrate life-cycle study (MRID 48402203; Acceptable) with daphnids (*Daphnia magna*) is available for a 21.85% ammonium salts of fatty acids formulation. Mean-measured test concentrations were 0 (control), 4.8, 12, 23, 48 and 100 mg a.i./L. Survival averaged 70 to 100% for all levels. The mean day of first brood release averaged 8.3, 8.9, 9.1, 8.6, 10.2 and 18.1 days for the control and 4.8, 12, 23, 48 and 100 mg a.i./L levels, respectively. There was a significant ($p < 0.05$) treatment-related delay in first brood release at the two highest treatment levels. The cumulative number of offspring release per female averaged 128 for the control, compared to 132, 113, 155, 148 and 14 for the test levels. The difference was statistically significant compared to the control ($p < 0.05$) at the 100 mg a.i./L level. At study termination, surviving daphnia from the control and test levels measured 4.6, 4.67, 4.66, 4.71, 4.72 and 4.02 mm in length and 0.66, 0.76, 0.77, 0.74, 0.8 and 0.55 mg in dry weight with the difference statistically-reduced compared to the control at the 100 mg a.i./L level. Offspring per adult female, length and weight were affected; however, the time of the first brood releases was most affected, the NOAEC is 23 mg a.i./L.

POTASSIUM SALTS OF FATTY ACIDS

A 21d freshwater invertebrate life-cycle study (MRID 48664201; Acceptable) with daphnids (*Daphnia* magna) is available for a 50.1% potassium salts of fatty acid formulation. Mean-measured test concentrations were 0 (control), 0.16, 0.31, 0.63, 1.3 and 2.5 mg a.i./L, 46-80% of nominal levels. Survival averaged 15 to 100% for all levels, with a statistically-significant difference at 1.9 mg a.i./L, the highest test level, when compared to control. The day of first brood release was recorded on Day 7 or 8 for the control group and all treatment levels except the highest level where no offspring were produced. The day of the first brood release recorded was consistent with the control performance. The cumulative number of offspring released per female average 149 for the negative control, compared to 182, 182, 178, 65 and 0 for the mean-measured 0.087, 0.14, 0.5, 0.9 and 1.9 mg a.i./L levels, respectively. The difference was statistically-significant compared to the control ($p<0.05$) at the 0.9 and 1.9 mg a.i./L levels. Surviving daphnia from the control group and treatment levels measured 4.8, 4.9, 4.9, 5.0, 4.1 and 2.7 mm in length and 0.99, 0.98, 1.05, 1.3, 1.04 and 0.59 mg in weight; the difference in length was statistically-reduced ($p<0.05$) compared to the control at the 0.9 and 1.9 mg a.i./L levels. No treatment-related reductions were observed for dry weight. Time of first brood release and parental survival were affected; however, offspring per adult and length were most affected, the NOAEC is 0.5 mg a.i./L.

A 21d freshwater invertebrate life-cycle study (MRID 48668601; Acceptable) with daphnids (*Daphnia* magna) is available for a 46.8% potassium salts of fatty acid formulation. Mean-measured test concentrations were 0 (control), 0.091, 0.21, 0.33, 0.52 and 1.4 mg a.i./L, 52-85% of nominal levels. Survival averaged 90 – 98% for all levels, with no statistically-significant differences from the control. The day of first brood release was recorded on Day 8 for the control group and levels up to the 0.52 mg a.i./L treatment level. The day of the first brood release recorded for the 1.4 mg a.i./L treatment level was on Day 10. The reviewer interpreted this to be a treatment-related delay in first brood release at the highest test level. The cumulative number of offspring released per female averaged 115 for the control, compared to 136, 153, 170, 174 and 85 for the mean-measured 0.091, 0.21, 0.33, 0.52 and 1.4 mg a.i./L levels, respectively. The difference was statistically-significant compared to the control ($p<0.05$) at the highest test level. Surviving daphnia from the control and treatment levels measured 4.43, 4.46, 4.53, 4.63, 4.7 and 4.06 mm in length and 0.93, 1.00, 0.99, 1.02, 1.08 and 0.96 mg in dry weight. The difference in length was statistically-reduced ($p<0.05$) compared to the control at the 1.4 mg a.i./L level. Time to first brood releases, offspring per adult and length were equally affected, the NOAEC is 0.52 mg a.i./L.

Estuarine/Marine Fish, Acute Effects

Estuarine/marine fish toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to fish. Results of the acute studies with the ammonium and potassium salts formulated products to estuarine/marine fish indicate the minnow LC_{50} value of >105 mg a.i./L and >4.4 mg a.i./L, respectively, (**Table III.14**) is used to evaluate potential acute effects of the salts to freshwater fish.

Table III.14. Estuarine/Marine Fish Acute Toxicity with Soap Salts (Ammonium and Potassium).

Species	% a.i.	96-hour LC_{50} (mg a.i./L)	Toxicity Category	MRID No. Author/Year	Study Classification
AMMONIUM SALTS OF FATTY ACIDS					
Sheepshead minnow *(Cyprinodon variegates)*	21.9	>105	Practically nontoxic	48402202 Fournier. (2011)	Acceptable
POTASSIUM SALTS OF FATTY ACIDS					
Sheepshead minnow	46.8	>2.1	No effects	48469802	Acceptable

(Cyprinodon variegates)			up to 2.1 mg/L	Fournier. (2011)	
	50.8	>4.4	No effects up to 4.4 mg/L	48636502 Sayers. (2011)	Acceptable

AMMONIUM SALTS OF FATTY ACIDS

A 96h static-renewal acute exposure study (MRID 48402202; Acceptable) with sheepshead minnow (*Cyprinodon variegatus*) is available for a 21.9% ammonium salts of fatty acids formulation. Twenty minnows per level were exposed to Time Weighted Average (TWA) concentrations of 0 (control), 6.3, 13, 25, 50 and 100 mg a.i./L. There were no mortality in the control and levels up to 50 mg a.i./L; 5% mortality occurred at the 100 mg a.i./L test level, the highest level tested. The TWA LC_{50} is determined to be >105 mg a.i./L. The 5% mortality was not statistically-significant, the TWA NOAEC is 105 mg a.i./L. No sub-lethal effects were observed in the control or any of the treatment levels.

POTASSIUM SALTS OF FATTY ACIDS

A 96h flow-through acute exposure study (MRID 48469802; Acceptable) with sheepshead minnow (*Cyprinodon variegatus*) is available for a 46.8% potassium salts of fatty acids formulation. Twenty minnows per level were exposed to mean-measured concentrations of 0 (control), <LOD, 0.017, 0.35, 1.0 and 2.1 mg a.i./L, 0 to 42% of nominal levels due to rapid degradation in seawater. No mortality or sub-lethal effects occurred in the control or in treatment levels up to the solubility limit. While the formulated product was used, the 96-hour LC_{50} and NOAEC for the active ingredient is determined to be >2.1 and 2.1 mg a.i./L, respectively.

A 96h flow-through acute exposure study (MRID 48636502; Acceptable) with sheepshead minnow (*Cyprinodon variegatus*) is available for a 50.8% potassium salts of fatty acids formulation. Twenty minnows per level were exposed to mean-measured concentrations of 0 (control), <LOD, 0.12, 0.76, 2.9 and 4.4 mg a.i./L, 9.4 to 85% of nominal levels due to rapid degradation in seawater. No mortality or sub-lethal effects occurred in the control or in treatment levels up to the solubility limit. The 96-hour LC_{50} and NOAEC for the active ingredient is determined to be >4.4 and 4.4 mg a.i./L, respectively.

Estuarine/Marine Fish, Chronic Effects

AMMONIUM and POTASSIUM SALTS OF FATTY ACIDS

No chronic ecological effects studies of ammonium and potassium salts using estuarine/marine fish were submitted.

Estuarine/Marine Invertebrates, Acute Effects

Toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to estuarine/marine invertebrates. Results of the acute studies with the ammonium and potassium salts formulated products to estuarine/marine invertebrates indicate the mysid shrimp LC_{50} value of 66.5 mg a.i./L and 1.2 mg a.i./L, respectively, (**Table III.15**) is used to evaluate potential acute effects of the salts to estuarine/marine invertebrates. No data on Eastern oysters were available, this is a data gap and the value is discussed further in the risk description section.

Table III.15. Estuarine/Marine Invertebrate Acute Toxicity with Soap Salts (Ammonium and Potassium).

Species	% a.i.	96-hour LC_{50}/EC_{50} (mg a.i./L)	Toxicity Category	MRID No. Author/Year	Study Classification
AMMONIUM SALTS OF FATTY ACIDS					
Mysid shrimp *(Americamysis bahia)*	21.85	66.5 [A]	Slightly toxic	48402201 Fournier. (2011)	Acceptable
Eastern oyster (*Crassostrea virginica*)	--	--	--	No data	--
POTASSIUM SALTS OF FATTY ACIDS					
Mysid shrimp *(Americamysis bahia)*	46.8	>2.2	No effects up to 2.2 mg a.i./L	48469801 Fournier. (2011)	Acceptable
	50.8	1.2 [B]	Moderately toxic	48608707 Sayers. (2011)	Acceptable
Eastern oyster (*Crassostrea virginica*)	--	--	--	No data	--

[A] Mysid 95% Confidence Interval = 54.1-85.7 mg a.i./L; slope = N/A (moving average)
[B] Mysid 95% Confidence Interval = 0.9 – 1.6 mg a.i./L; slope = N/A (binominal)

AMMONIMUM SALTS OF FATTY ACIDS

A 96h static-renewal acute exposure study (MRID 48402201; Acceptable) with mysid shrimp (*Americamysis bahia*) is available for a 21.85% ammonium salts of fatty acids formulation. Twenty mysids per level were exposed to time-weighted average concentrations of 0 (control), 3.3, 8, 20, 45 and 125 mg a.i./L. All mysids in the control group and TWA-measured 8.0 mg a.i./L were normal throughout the test. At test termination, 10, 5, and 5% mortality was observed in the lowest test level (3.3 mg a.i./L), 20 and 45 mg a.i./L. Complete mortality was observed in the highest test level. The LC_{50} is determined to be 66.5 mg a.i./L; the NOAEC via Fisher's Exact Test is 45 mg a.i./L. Data on the sublethal effects observations were not available for analysis.

No acute ecological effects studies of ammonium salts using mollusks were submitted.

POTASSIUM SALTS OF FATTY ACIDS

A 96h flow-through acute exposure study (MRID 48469801; Acceptable) with juvenile mysids

(*Americamysis bahia*) is available for a 46.8% potassium salts of fatty acids formulation. Twenty mysids per level were exposed to mean-measured concentrations of 0 (control), 0.081, <0.034, 0.31, 1.1 and 2.2 mg a.i./L. Two and three mysids died in the control group and the lowest test level, respectively, and two died at the third highest test level, considering the naturally occurring variability in mortality, the reviewer agrees the mysids that died were not treatment-related. Mysids were normal in all other test levels. The LC_{50} is >2.2 mg a.i./L. The NOAEC is 2.2 mg a.i./L, the highest test level tested. The EC_{50} is not available since data on sublethal effects were not available.

A 96h flow-through acute exposure study (MRID 48608707; Acceptable) with young adult mysids (*Americamysis bahia*) is available for a 50.8% potassium salts of fatty acids formulation. Twenty mysids per level were exposed to mean-measured concentrations of 0 (control), <0.059, 0.17, 0.9, 1.6 and 5.0 mg a.i./L. One mysid died at the lowest level and 100% mortality was observed in the two highest test levels at test termination. The reviewer felt that the mysid that died in the lowest level is considered naturally occurring variability and not an adverse response. The LC_{50} is 1.2 mg a.i./L; the NOAEC is 0.9 mg a.i./L. The EC_{50} on sublethal effects is not available since data were not available for analysis.

No acute ecological effects studies of potassium salts using mollusks were submitted.

Estuarine/Marine Invertebrates, Chronic Effects

AMMONIUM and POTASSIUM SALTS OF FATTY ACIDS

No chronic ecological effects studies of ammonium and potassium salts using estuarine/marine invertebrates were submitted.

Effects to Aquatic Vascular and Non-vascular Plants

Potassium salts studies were submitted for a freshwater vascular plant (duckweed, *Lemna gibba*) and four phytoplanktonic nonvascular plants: a green algae (*Pseudokirchneriella subcapitata*), a cyanobacteria (*Anabaena flos-aquae*), a freshwater diatom (*Navicula pelliculosa*) and a marine alga (*Skeletonema costatum*). Duckweed and *P. subcapitata* were the only plants tested for ammonium salts, the effects to the three other phytoplanktonic nonvascular plants listed above exposed to ammonium salts are unknown. In each of these studies, because the salts rapidly degrade by metabolism, no salts were detected at the end of the studies. However, based on the Pesticide Reregistration Rejection Rate Analysis (USEPA 1994), under such a circumstance, analysis is based on the initial measured concentrations.

Aquatic plant toxicity studies using the typical end-use products were submitted to establish the toxicity of potassium and ammonium salts to vascular and non-vascular species. Results of the studies with the ammonium and potassium salts formulated products to aquatic plants indicate nonvascular plants were more sensitive than vascular plants to salts. EC_{50} values of 200 and 6.6 for ammonium salts and of >5.0 and 0.59 mg a.i./L for potassium salts (**Table III.16**) were used to evaluate potential effects of the salts to non-listed aquatic vascular and non-vascular plants, respectively. Corresponding NOAEC values of 15 and 2.9 mg a.i./L for ammonium salts and of 0.3 and 0.39 mg a.i./L for potassium salts were used to evaluate potential effects of the salts to listed aquatic vascular and nonvascular plants, respectively.

Table III.16. Aquatic Plant Toxicity with Soap Salts (Ammonium and Potassium).					
Species	**% a.i.**	**EC_{50} (mg a.i./L)**	**NOAEC (mg a.i./L)**	**MRID No. Author/Year**	**Study Classification**
AMMONIUM SALTS OF FATTY ACIDS					
Vascular Plants					
Duckweed *Lemna gibba*	21.9	200 [A]	30	48402206 Softcheck. (2011)	Acceptable
Non-Vascular Plants					
Marine diatom *Skeletonema costatum*	--	--	--	No data	--
Freshwater blue-green algae *Anabaena flos-aquae*	--	--	--	No data	--
Freshwater diatom *Navicula pelliculosa*	--	--	--	No data	--
Freshwater green algae *Pseudokirchneriella subcapitata*	21.9	6.6[B]	2.9	48402207 Softcheck. (2011)	Acceptable
POTASSIUM SALTS OF FATTY ACIDS					
Vascular Plants					
Duckweed *Lemna gibba*	46.8	>19	19	48469803 Softcheck. (2011)	Acceptable
	50.8	>5.0	5.0	48608702 Softcheck. (2011)	Acceptable
Non-Vascular Plants					
Marine diatom *Skeletonema costatum*	50.8	8.1 [C]	1.2	48608705 Softcheck. (2011)	Acceptable
Freshwater blue-green algae *Anabaena flos-aquae*	50.8	5.4 [D]	2.6	48636501 Softcheck. (2011)	Acceptable
Freshwater diatom *Navicula pelliculosa*	50.8	0.59 [E]	0.39	48608701 Softcheck. (2011)	Acceptable
Freshwater green algae *Pseudokirchneriella subcapitata*	50.8	0.86 [F]	0.63	48608706 Softcheck. (2011)	Acceptable
	46.8	2.9 [G]	1.2	48402303 Softcheck. (2011)	Acceptable

[A] Duckweed 95% Confidence Interval (C.I.) = 170-240 mg a.i./L

[B] Freshwater green algae 95% C.I. = 5.3-8.2 mg a.i./L

[C] Marine diatom 95% C.I. = 6.4-10 mg a.i./L

[D] Blue-green algae 95% C.I. = 4.8-5.9 mg a.i./L

[E] Freshwater diatom 95% C.I. = 0.43-0.82 mg a.i./L

[F] Green algae 95% C.I. = 0.46-1.6 mg a.i./L

[G] Green algae 95% C.I. = 1.2-3.2 mg a.i./L

AMMONIUM SALTS OF FATTY ACIDS

In a 7-day static-renewal toxicity study, the aquatic vascular plant duckweed (*Lemna gibba*) was exposed to a 21.9% ammonium salts of fatty acids formulation (MRID 48402206; Acceptable). Measured concentrations at Day 0 ranged from 110 to 120% of nominal and by Day 3 dropped below the level of quantitation in the three lowest levels; thus, the initial-measured concentrations of 0 (control), 4.3, 11, 30, 68, 170, 430 and 1100 mg a.i./L were used in the calculations. All endpoints were affected with frond density the most sensitive endpoint, with EC_{50} and NOAEC values of 200 and 30 mg a.i./L, respectively. The % growth inhibition of frond density in the treated culture as compared to the control ranged from -6 to 96%. Smaller frond size, less root formation, curled and chlorotic fronds were observed in the ≥170 mg a.i./L treatment levels.

In a 96-hour static toxicity study, the green algae *Pseudokirchneriella subcapitata* was exposed to a 21.9% ammonium salts of fatty acids formulation (MRID 48402207; Acceptable). Measured concentrations at Day 0 ranged from 100 – 123% of nominal and by test termination dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 1.6, 2.9, 5.3, 10 and 20 mg a.i./L were used in the calculations. Cell density was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 6.6 and 2.9 mg a.i./L, respectively. The % growth inhibition of cell density in the treated culture as compared to the control ranged from -1 to 87%. No signs of injury occurred and the cells were observed to be normal throughout the test.

No ecological effects studies of ammonium salts using the three remaining phytoplanktonic nonvascular plants (freshwater and marine diatom and blue-green algae) were submitted.

POTASSIUM SALTS OF FATTY ACIDS

In a 7-day static-renewal toxicity study, the aquatic vascular plant duckweed (*Lemna gibba*) was exposed to a 46.8% potassium salts of fatty acids formulation (MRID 48469803; Acceptable). Measured concentrations at Day 0 ranged from 90 to 100% of nominal and by Day 7 dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 1.2, 2.5, 4.5, 9.7 and 19 mg a.i./L were used in the calculations. None of the endpoints inhibited 50% or more, with EC_{50} and NOAEC values all >19 and 19 mg a.i./L, respectively. The % growth inhibition of frond density in the treated culture as compared to the control ranged from -2 to 6%. Fronds were observed to be normal in all test levels.

In a 7-day static-renewal toxicity study, the aquatic vascular plant duckweed (*Lemna gibba*) was exposed to a 50.8% potassium salts of fatty acids formulation (MRID 48608702; Acceptable). Measured concentrations at Day 0 ranged from 98-100% of nominal and by Day 7 dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 0.3, 0.63, 1.2, 2.5 and 5.0 mg a.i./L were used in the calculations. None of the frond density, biomass or growth rate were inhibited 50% or more in the test, with an EC_{50} value of >5.0 mg a.i./L for all endpoints. A statistically significance difference in frond density and dry frond weight was observed in all test levels when compared to the control group, making the NOAEC below the lowest test concentration tested (<0.3 mg a.i./L). However, a closer look at the statistical results indicated the control group outperformed the data of all treatment groups when compared which explains why the NOAEC could not be determined with significant differences at all test levels, while results within the treatment groups were not statistically significant among treatment levels when compared. If a graph was plotted with inhibition the highest in the middle and lowest at the lowest and highest test concentrations, a shallow bell-shaped dose-response curve would be observed rather than a monotonically decreasing dose response curve. Therefore, it was determined by the reviewer that the statistically significance differences were not biologically significant and that none of the endpoints were affected. Fronds were observed to be normal in all test levels.

In a 96-hour static toxicity study, the marine diatom *Skeletonema costatum* was exposed to a 50.8% potassium salts of fatty acids formulation (MRID 48608705; Acceptable). Measured concentrations at Day 0 ranged from 76-99% of nominal and by test termination dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 0.62, 1.2, 1.9, 4.4 and 8.8 mg a.i./L were used in the calculations. Biomass was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 8.1 and 1.2 mg a.i./L, respectively. The % growth inhibition of biomass in the treated culture as compared to the control ranged from 3 to 53%. No signs of injury occurred and the cells were observed to be normal throughout the test.

In a 96-hour static toxicity study, the freshwater blue-green algae *Anabaena flos-aquae* was exposed to a 50.8% potassium salts of fatty acids formulation (MRID 48636501; Acceptable). Measured concentrations at Day 0 ranged from 100-104% of nominal and by test termination dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 0.63, 1.3, 2.6, 5.0 and 10 mg a.i./L were used in the calculations. Biomass was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 5.4 and 2.6 mg a.i./L, respectively. The % growth inhibition of biomass in the treated culture as compared to the control ranged from -4 to 93%. No signs of injury occurred and the cells were observed to be normal throughout the test.

In a 96-hour static toxicity study, the freshwater diatom *Navicula pelliculosa* was exposed to a 50.8% potassium salts of fatty acids formulation (MRID 48608701; Acceptable). Measured concentrations at Day 0 ranged from 84-100% of nominal and by test termination dropped below the level of quantitation in all test levels; thus, the initial-measured concentrations of 0 (control), 0.084, 0.18, 0.39, 0.79 and 1.6 mg a.i./L were used in the calculations. Cell density was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 0.59 and 0.39 mg a.i./L, respectively. The % growth inhibition of cell density in the treated culture as compared to the control ranged from -27 to 98%. No signs of injury occurred and the cells were observed to be normal throughout the test.

In a 96-hour static toxicity study, the freshwater green algae *Pseudokirchneriella subcapitata* was exposed to a 50.8% potassium salts of fatty acids formulation (MRID 48608706; Acceptable). Measured concentrations at Day 0 ranged from 93.8-100% of nominal and by test termination dropped below the level of quantitation in all test levels except the highest concentration; thus, the initial-measured concentrations of 0 (control), 0.1, 0.26, 0.63, 1.5, 3.8 and 9.5 mg a.i./L were used in the calculations. Cell density was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 0.86 and 0.63 mg a.i./L, respectively. The % growth inhibition of cell density in the treated culture as compared to the control ranged from -4 to 98%. No signs of injury occurred and the cells were observed to be normal throughout the test.

In a 96-hour static toxicity study, the freshwater green algae *Pseudokirchneriella subcapitata* was exposed to a 46.8% potassium salts of fatty acids formulation (MRID 48402303; Acceptable). Measured concentrations at Day 0 ranged from 92.3-100% of nominal and by test termination dropped below the level of quantitation in the lowest test level while the remaining test levels were 1.5 – 5.8% of nominal; thus, the initial-measured concentrations of 0 (control), 0.6, 1.2, 2.4, 4.7 and 10 mg a.i./L were used in the calculations. Biomass was the most sensitive endpoint, with 96-hour EC_{50} and NOAEC values of 2.0 and 0.6 mg a.i./L, respectively. The % growth inhibition of biomass in the treated culture as compared to the control ranged from 27 to 98%. No signs of injury occurred and the cells were observed to be normal throughout the test.

III.3.2. Terrestrial Effects Characterization

The most sensitive acute and chronic effects measurement endpoints associated with salts exposure to terrestrial species are summarized in **Table III.17** for potassium and in **Table III.18** for ammonium**.** Selected effects endpoints for the risk assessment are from acceptable and supplemental studies for salts and are described below.

Overall, soap salts are practically nontoxic to birds on an acute basis. After adjusting for purity, potassium and ammonium salts caused no mortality or sub-lethal effects up to and including 2,450 mg a.i./kg bw and 5620 mg a.i./kg diet to upland game birds and waterfowl via oral and dietary routes, respectively. In addition, while limited, the 1981 studies with these species also indicated no effect to birds in the diet as high as 10,000 mg TEP/kg diet. No acute avian toxicity data is available for sodium salts. In addition, birds also act as surrogates for reptiles and terrestrial-phase amphibians in the absence of data; therefore, acute toxicity data with birds indicates potassium and ammonium salts are practically nontoxic to reptiles and terrestrial-phase amphibians. Avian reproduction data for soap salts were not available, the chronic toxicity to birds, reptiles, and terrestrial-phase amphibians is unknown; however, the Agency is not asking for reproduction data since it is anticipated that the ecological effects to birds are minimal with the salts undergoing rapid degradation in less than a day and the lack of effects at high rates in the acute studies.

HED has waived all generic mammalian toxicity data requirements for soap salts due to the lack of effects at high doses in the available studies of other fatty acid salts, the nature of the chemicals (fatty acids) and their ubiquity in nature, and the limited potential for human exposure via the oral route from established uses. With no systemic toxicity observed, HED did not select endpoints for human health risk assessment. Thus, for the ecological risk assessment, the ecological effects to mammals are anticipated to be minimal.

Results of the acute contact tests with honeybees indicate that formulation products of soap salts are practically non-toxic to honeybees.

Table III.17. Most Sensitive Acute and Chronic Toxicity Data for Terrestrial Animals Exposed to Potassium Salts of Fatty Acids.				
Exposure Scenario	**Species**	**Exposure Duration**	**Toxicity Reference Value**	**MRID**
Mammals				
Acute (Dose-based)	No mammalian endpoints selected from HED due to lack of effects at high doses in available studies of other acid salts, the ecological effects to mammals are anticipated to be minimal.			
Chronic (Dietary-based)				
Birds				
Acute (Dose-based)	Bobwhite quail *Colinus virginianus*	14-day single oral dose	LD_{50} > 2450 mg a.i./kg bw	44980310
	Passerine bird		No data available	
Acute (Dietary-based)	Bobwhite quail *Colinus virginianus*	8-day dietary	LC_{50}: >5620 mg a.i./kg-diet	40066204
Chronic (Dietary-based)	No studies available, surrogate data from other salts are used.			
Terrestrial Plants				
Seedling emergence	Ryegrass (monocot)	14 days	EC_{25} = >62.34 lbs a.i./A NOAEC = 31.17 lbs a.i./A	48608704
	Radish (dicot)		EC_{25} = 53.9 lbs a.i./A NOAEC = 3.865 lbs a.i./A	
Vegetative Vigor	Corn (monocot)		EC_{25} = 5.91 lbs a.i./A NOAEC = 4.239 lbs a.i./A	48402302
	Oilseed rape (dicot)		EC_{25} = 18.5 lbs a.i./A EC_{05} = 4.38 lbs a.i./A	
Beneficial Insects				
Contact	Honey bee	48-hours	LD_{50} >100 µg a.i./bee	42806001

Table III.18. Most Sensitive Acute and Chronic Toxicity Data for Terrestrial Animals and Plants Exposed to Ammonium Salts of Fatty Acids.				
Exposure Scenario	**Species**	**Exposure Duration**	**Toxicity Reference Value**	**MRID**
Mammals				
Acute (Dose-based)	No mammalian endpoints selected from HED due to lack of effects at high doses in available studies of other acid salts, the ecological effects to mammals are anticipated to be minimal.			
Chronic (Dietary-based)				
Birds				
Acute (Dose-based)	No data available, surrogate data from other salts are used.			
Acute (Dietary-based)	Japanese quail *(Cortunix japonica)*	8-day dietary	LC_{50}: >5000 mg/kg diet or 1100 mg a.i./kg diet	46206301
Chronic (Dietary-based)	No data available, surrogate data from other salts are used.			
Terrestrial Plants				
Seedling emergence	All 4 monocots and 6 dicots	14 days	EC_{25} >100 lbs a.i./A NOAEC = 100 lbs a.i./A	48402204
Vegetative Vigor	Corn (monocot)		EC_{25} = 6.2 lbs a.i./A NOAEC = 1.5 lbs a.i./A	48402205
	Tomato (dicot)		EC_{25} = 2.2 lbs a.i./A EC_{05} = 1.1 lbs a.i./A	
Beneficial Insects				
Contact	Honey bee	48-hours	LD_{50} >100 µg/bee	44766401

Birds, Acute Oral

Acute avian oral toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to birds via the oral route (**Table III.19**). No acute oral data on passerine birds for potassium salts and on any bird species for ammonium salts were available, bridging data from other salts are used as a surrogate.

Table III.19. Avian Acute Oral Toxicity with Soap Salts (Ammonium and Potassium).					
Species	**% a.i.**	**Nominal LD_{50} (mg a.i./kg bw)**	**Toxicity Category**	**MRID No. Author/Year**	**Study Classification**
AMMONIUM SALTS OF FATTY ACIDS					
Passerine bird	n/a	n/a	n/a	No data	n/a
Northern bobwhite quail or mallard duck	n/a	n/a	n/a	No data	n/a
POTASSIUM SALTS OF FATTY ACIDS					
Passerine bird	n/a	n/a	n/a	No data	n/a
Mallard duck (*Anas platyrhynchos*)	50	>2500 [A]	Practically nontoxic	00030861 Hunsaker. 1979.	Supplemental[1]
	50.5	>2000 [A]	Practically nontoxic	00096639 Fink *et al.* 1981.	Acceptable
Northern bobwhite quail *(Colinus virginianus)*	Not reported	>2250 mg formulation/ kg bw	Could not be determined	40053301 Grimes & Jaber. 1987.	Supplemental[2]
	25	>2000 [A]	Practically nontoxic	40066202 Hiken & Jaber. 1987.	Acceptable
	60	>1350	No effects up to 1350 mg a.i./kg bw	0157471 Beavers. 1986.	Supplemental[3]
	49	>2450 [A]	Practically nontoxic	44980310 Stadens-peek & Leopold 1996.	Acceptable

[A] The LD_{50} was greater than the highest concentration; therefore, it was not possible to calculate a probit slope and 95% confidence intervals.

[1] Not enough of the birds tested at the 5000 mg/kg bw dose level were the proper age. There was no mention of the pre-test condition of the ducks or the climatic conditions of the test chamber if indoors or the atmospheric conditions if outdoors.

[2] The purity of the active ingredient in the formulation was not reported; it was not possible to convert to mg active ingredient/kg bw.

[3] The concentrations used (when adjusted for active ingredient) did not produce a precise LD50 and the highest concentration was below 2000 mg a.i./kg bw.

AMMONIUM SALTS OF FATTY ACIDS

No ecological effects studies of ammonium salts using an upland game bird or waterfowl and a passerine bird were submitted.

POTASSIUM SALTS OF FATTY ACIDS

The acute oral toxicity of a 50.5% potassium salts of fatty acids formulation (MRID 00030861; Supplemental) to juvenile and young mallard ducks (*Anas platyrhynchos*) was assessed over 48 hours and held for an additional 5 days for post-observation. The formulation was administered in corn oil to a total of 31 ducks comprising two groups of differing ages per treatment level by gavage at nominal concentrations of 0 (control) and 500 mg a.i./kg bw. No mortality was observed in the controls or at the limit dose. Following the completion of the study, an additional dose at 2500 mg a.i./kg bw using ducks from the previous study were subsequently added to observe for any mortality at the higher dose. As a result, none of the juvenile or young ducks died at 500 or 2500 mg a.i./kg bw. Raw data were not available to verify the author's conclusions on sublethal effects; however, the author reported there were no externally observable effects on the behavior or physiology of ducks, including no decline in vigor or in food and water intake. The young ducks were able to reproduce, lay eggs, and engage in normal adult preening behavior. The 48-hours acute oral LD_{50} is >2500 mg a.i/kg bw based on a lack of mortality and sub-lethal effects.

The acute oral toxicity of a 50.5% potassium salts of fatty acids formulation (MRID 00096639; Supplemental) to 6-month old mallard ducks (*Anas platyrhynchos*) was assessed over 14 days. The formulation was administered to ducks per treatment level by gavage at nominal concentrations of 0 (control), 201, 319, 505, 803 and 1268 mg a.i./kg bw (corrected for purity) and a second trail conducted at 2000 mg a.i./kg bw. No mortality was observed in the controls or in the treatment groups. Overall percent body weight change during the 14-day exposure period averaged 1.9% in the control and 2.4, 1.0, 1.8, 4.5 and 6% in the nominal 201, 319, 505, 803 and 1268 mg a.i./kg bw treatment groups, respectively. In the 2^{nd} study with the nominal 2,000 mg a.i./kg bw treatment group, overall % body weight change averaged 0% as compared to 3% in the vehicle control. The mean food consumption in the control and nominal 201, 319, 505, 803 and 1268 mg a.i./kg bw treatment groups during 1-7 day period was 91 g in the control and 101, 81, 94, 112 and 100 g in the treatment groups, respectively, yielding inhibitions of -10, 11, -3, -23 and -10%, respectively. During the 8-14 day period, mean food consumption in the control was 96 g and 88, 104, 105, 106 and 103 g in the treatment groups, yielding inhibitions of 8, -8, -9, -10 and -7%. In the 2^{nd} study with the nominal 2,000 mg a.i./kg bw treatment group, mean food consumption was inhibited 24% during the 1-7 day period and -12% during the 8-14 day period when compared to control. The 14-day acute oral LD_{50} is >2000 mg a.i./kg bw based on a lack of mortality and sub-lethal effects.

The acute oral toxicity of a potassium salts of fatty acids formulation (MRID 40053301; Supplemental) to 26-week old bobwhite quails (*Colinus virginianus*) was assessed over 14 days. The formulation was administered to birds per treatment level by gavage at nominal concentrations of 0 (control) 292, 486, 810, 1350 and 2250 mg formulation/kg bw (% a.i. not reported, values not corrected for purity). No mortality was observed in the controls or in the treatment groups. Overall percent body weight change for both males and females during the 14-day test period average 7% in the control and 6, 5, 5, 6 and 6% in the nominal 292, 486, 810, 1350 and 2250 mg formulation/kg bw treatment groups, respectively. The mean food consumption in the control and nominal 292, 486, 810, 1350 and 2250 mg formulation/kg bw treatment groups during the1-7 day period was 45 g in the control and 67, 55, 50, 43 and 35 g in the treatment groups, respectively, yielding inhibitions of -33, -22, -11, 4 and 22%, respectively. During the 8-14 day test period, mean food consumption in the control and nominal 292, 486, 810, 1350 and 2250 mg formulation/kg bw treatment groups was 45 g in the control and 51, 46, 47, 37 and 33 g in the treatment groups, respectively, yielding inhibitions of -13, -2, -4, 18 and 27%. The 14-day acute oral LD_{50} is >2250 mg formulation/kg bw (not corrected for purity) based on a lack of mortality and sub-lethal effects.

The acute oral toxicity of a 25% potassium salts of fatty acids formulation (MRID 40066202; Acceptable) to 31-week old bobwhite quails (*Colinus virginianus*) was assessed over 14 days. The formulation was administered to birds per treatment level by gavage at nominal concentrations of 0 (control), 500, 1000 and 2000 mg a.i./kg bw. No mortality was observed in the controls or in the treatment groups. Overall percent body weight change for both males and females during the 14-day test period average 10% in the control and 8, 9 and 8% in the nominal 500, 1000 and 2000 mg a.i./kg bw treatment groups, respectively. The mean food consumption in the control and nominal 500, 1000 and 2000 mg a.i./kg bw treatment groups during the1-7 day period was 42 g in the control and 43, 37 and 45 g in the treatment groups, respectively, yielding inhibitions of -2, 12 and -7%, respectively. During the 8-14 day test period, mean food consumption in the control and nominal 500, 1000 and 2000 mg a.i./kg bw treatment groups was 33 g in the control and 38, 30 and 46 g in the treatment groups, respectively, yielding inhibitions of -15, 9 and -40%. The 14-day acute oral LD_{50} is >2000 mg a.i./kg bw based on a lack of mortality and sub-lethal effects.

The acute oral toxicity of a 60% potassium salts of fatty acids formulation (MRID 00157471; Supplemental) to 22-week old bobwhite quails (*Colinus virginianus*) was assessed over 14 days. The formulation was administered to birds per treatment level by gavage at nominal concentrations of 0 (control), 175, 292, 486, 810 and 1350 mg a.i./kg bw (corrected for purity). No mortality was observed in the controls or in the treatment groups. Overall percent body weight change for both males and females during the 14-day test period average 7% in the control and 7, 8, 7, 9 and 5% in the nominal 175, 292, 486, 810 and 1350 mg a.i./kg bw treatment groups, respectively. The mean food consumption in the control and nominal 175, 292, 486, 810 and 1350 mg a.i./kg bw treatment groups during the1-7 day period was 58 g in the control and 59, 60, 52, 57 and 56 g in the treatment groups, respectively, yielding inhibitions of -2, -3, 10, 2 and 3%, respectively. During the 8-14 day test period, mean food consumption in the control and nominal 175, 292, 486, 810 and 1350 mg a.i./kg bw treatment groups was 48 g in the control and 47, 49, 43, 51 and 49 g in the treatment groups, respectively, yielding inhibitions of 2, 8, 10, -6 and -2%. The 14-day acute oral LD_{50} is >1350 mg a.i./kg bw based on a lack of mortality and sub-lethal effects.

The acute oral toxicity of a 49% potassium salts of fatty acids formulation (MRID 44980310; Acceptable) to 21-week old bobwhite quail (*Colinus virginianus*) was assessed over 15 days. The formulation was administered to birds per the limit dose by gavage at a nominal concentration of 2450 mg a.i./kg bw (corrected for purity). No mortality was observed in the controls or in the limit dose. Overall percent body weight change for both males and females during the 15-day test period average 3% in the control and 4% in the nominal 2450 mg a.i./kg bw treatment group. The mean food consumption in the control and nominal 2450 mg a.i./kg bw treatment group during the1-8 day period was 15 g in the control and 15 g in the treatment group, yielding an inhibition of 0%. During the 8-15 day test period, mean food consumption in the control and nominal 2450 mg a.i./kg bw treatment group was 14 g in the control and 15 g in the treatment group, yielding an increase of 7%. The 15-day acute oral LD_{50} is >2450 mg a.i./kg bw based on a lack of mortality and sub-lethal effects.

No ecological effects studies of potassium salts using a passerine bird were submitted.

Birds, Subacute Dietary

Subacute avian dietary toxicity studies using the typical end-use products were submitted to establish the acute toxicity of salts to birds via the dietary route (**Table III.20**). No acute dietary data on a waterfowl for ammonium salts were available, bridging data from other salts are used as a surrogate.

Table III.20. Avian Acute Dietary Toxicity with Soap Salts (Ammonium and Potassium).					
Species	**% a.i.**	**Nominal LC_{50} (mg a.i./kg diet)**	**Toxicity Category**	**MRID No. Author/Year**	**Study Classification**
AMMONIUM SALTS OF FATTY ACIDS					
Mallard duck (*Anas platyrhynchos*)	n/a	n/a	n/a	No data	n/a
Japanese quail (*Coturnix japonica)*	22	>1,100	No effects up to 1,100 mg a.i./kg diet	46206301 Bien. 2003.	Acceptable
POTASSIUM SALTS OF FATTY ACIDS					
Mallard duck (*Anas platyrhynchos*)	Not report ed	>10,000 mg formulation/kg diet	Could not be determined	00105040 Beavers & Fink. 1981.	Supplemental[1]
	60	>3,372	No effects up to 3,372 mg a.i./kg diet	40385601 Johnson & Jaber. 1987.	Acceptable
	49	>2,450	No effects up to 2,450 mg a.i./kg diet	44980312 Leopold. 1997.	Acceptable
	25	>1,405	No effects up to 1,405 mg a.i./kg diet	40053303 Grimes & Jaber. 1986.	Supplemental
	25	>5620	Practically nontoxic	40066204 Grimes & Jaber. 1987.	Acceptable
	50	>2,642	No effects up to 2,642 mg a.i./kg diet	00030862 Condrashoff. 1979.	Supplemental
Northern bobwhite quail *(Colinus virginianus)*	60	>3372	No effects up to 3372 mg a.i./kg diet	00157472 Beavers. 1986.	Acceptable
	25	>1,405	No effects up to 1,405 mg a.i./kg diet	40053302 Grimes & Jaber. 1986.	Supplemental
	Not report ed	>10,000 mg formulation/kg diet	Could not be determined	00096640 Beavers & Fink. 1981.	Supplemental[1]
	25	>5620	Practically nontoxic	40066203 Grimes *et al.* 1987.	Acceptable
	50	>2,642	No effects up to 2,642 mg a.i./kg diet	00030863 Condrashoff. 1979.	Supplemental
	49	>2450 [A]	No effects up to 2,450 mg a.i./kg diet	44980311 Leopold. 1997.	Acceptable

[A] The LD_{50} was greater than the highest concentration; therefore, it was not possible to calculate a probit slope and 95% confidence intervals.

[1] The % of the active ingredient in the formulation was not reported; thus, it was not possible to correct the toxicity value to the active ingredient.

AMMONIUM SALTS OF FATTY ACIDS

In an 8-day acute dietary toxicity study, the 8-day old Japanese quail (*Coturnix japonica*) was exposed to a 22% ammonium salts of fatty acids formulation (MRID 46206301; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (control) and 1,100 mg a.i./L (corrected for purity). No mortalities were observed. Percent body weight change during the 5-day exposure period averaged 40.7% in the control and 38.3% in the 1,100 mg a.i./kg diet treatment group yielding an inhibition of 5.8%. Percent body weight gain during the 3-day observation period (days 6-8) averaged 15.9% in the control and 18.6% in the treatment group yielding an increase of 17%. The overall % body weight gain was 50.2% in the control and 49.8% in the treatment group. The mean food consumption in the control and treatment group during the exposure period (days 0-5) was 134 and 123 g, respectively, yielding an inhibition of 8.2% and mean food consumption in the control and treatment group during the observation period was 178 and 169 g, respectively, yielding an inhibition of 5.1%. The 8-day LC_{50} is >1,100 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

POTASSIUM SALTS OF FATTY ACIDS

In an 8-day acute dietary toxicity study, the 14-day old mallard duck (*Anas platyrhynchos*) was exposed to a potassium salts of fatty acids formulation (MRID 00105040; Supplemental). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 562, 1000, 1780, 3160 and 5620 mg formulation/kg diet and a second trail conducted at 10,000 mg formulation/kg diet (% a.i. not reported, values not corrected for purity). No mortalities or behavioral abnormalities were observed. Percent body weight change during the 5-day exposure period averaged 46% in the control and 47.1, 46.7, 48.1, 49.4 and 43.2% in the nominal 562, 1000, 1780, 3160 and 5620 mg/kg diet treatment groups, respectively, yielding inhibitions of -2.3, -1.5, -4.5, -7.3 and 6%. In the 2nd study with the nominal 10,000 mg/kg treatment group, % body weight gain averaged 47.4% as compared to the 44.8% gain in the vehicle control, yielding an inhibition of -5.8%. The mean food consumption in the control and nominal 562, 1000, 1780, 3160 and 5620 mg/kg diet treatment groups during the exposure period (days 0-5) was 3965 g in the control and 4370, 3740, 4279, 3696 and 3882 g in the treatment groups, respectively, yielding inhibitions of -10.2, 5.7, -7.9, 6.8 and 2.1%, respectively. In the 2nd study with the nominal 10,000 mg/kg diet treatment group, mean food consumption was 3814 g as compared to 3827 g in the vehicle control, yielding an inhibition of 0.3% The 8-day LC_{50} is >10,000 mg formulation/kg diet (not corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old mallard duck (*Anas platyrhynchos*) was exposed to a 60% potassium salts of fatty acids formulation (MRID 40385601; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 337.2, 600, 1068, 1896 and 3372 mg a.i./kg diet (corrected for purity). No mortality or behavioral abnormalities were observed. Percent body weight change during the exposure period averaged 43.2% in the control and 42.1, 42.9, 40.9, 43.3 and 40.5% in the nominal 337.2, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups, respectively, yielding inhibitions of 2.5, 0.7, 5.3, -0.2 and 6.3%. Percent body weight gain during the observation period averaged 22.7% in the control and 22.7, 20.3, 20.0, 22.1 and 22.6% in the 337.2, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups, respectively, yielding increases of 0, -10.6, -11.9, -2.6 and -0.4%.

The overall % body weight gain was 55.1% in the control and 55.2, 54.5, 52.8, 55.8 and 54.0% in the 337.2, 600, 1068, 1896 and 3372 mg a.i./kg diet groups, respectively. The mean food consumption in the control and nominal 337.2, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups during the exposure period was 64 g in the control and 61, 56, 62, 60 and 53 g, respectively, yielding inhibitions of 5, 12, 3, 6 and 17%. Mean food consumption in the control and treatment groups during the observation period was 66.2 g in the control and 67, 61, 61, 71 and 65 g, respectively, yielding inhibitions of -2, 8, 8, -8 and 2%. The 8-day LC_{50} is >3,372 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old mallard duck (*Anas platyrhynchos*) was exposed to a 49% potassium salts of fatty acids formulation (MRID 44980312; Acceptable). The formulation was administered in the diet to 20 ducks at 2450 mg a.i./kg diet (corrected for purity), 10 ducks were exposed to a diet without a vehicle and 10 ducks to a diet mixed with acetone. Twenty ducks were exposed to a control diet without a vehicle and twenty ducks to a diet mixed with acetone in case inhomogeneity occurred in the diets prepared without a vehicle. No mortality or behavioral abnormalities were observed. Percent body weight change during the exposure period averaged 42.6% in the control and 41.7% in the nominal 2450 mg a.i./kg diet treatment group, yielding an inhibition of 2.1%. For the groups mixed with acetone, the % body weight gain averaged 46.2% in the control and 46.3% in the limit dose level, resulting in an inhibition of -0.2%. The overall % body weight gain was 52.1% in the control and 51.7% in the treatment group without acetone; for the groups mixed with acetone, the gain was 53.9% in the control and 58.5% in the treatment group. The mean food consumption in the control and nominal 2450 mg a.i./kg diet treatment group during the exposure period was 35 g in the control and 38 g, yielding an inhibition of -8.6% and mean food consumption in the control and treatment groups during the observation period was 42 g in the control and 43 g, yielding an inhibition of -2.4%. The mean food consumption for the groups mixed with acetone during the exposure period was 40 g in the control and 37 g in the limit dose, yielding an inhibition of 7.5% and mean food consumption during the observation period was 43 g in the control and 47 g in the limit dose, yielding an inhibition of -9.3%. The 8-day LC_{50} is >2450 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old mallard duck (*Anas platyrhynchos*) was exposed to a 25% potassium salts of fatty acids formulation (MRID 40053303; Supplemental). The formulation was administered to the ducks in the diet at nominal concentrations of 0 (vehicle control), 140.5, 250, 445, 790 and 1405 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 52% in the control and 53.6, 52.7, 51.5, 51.9 and 51.5% in the nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, yielding inhibitions of -3.0, -1.3, 1.0, 0.2, 1.0%. The overall % body weight gain was 63.4% in the control and 65, 63.2, 63.5, 63.8 and 62.7% in the treatment groups, respectively. The mean food consumption in the control and nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, respectively, during the exposure period was 58.6 g in the control and 61, 56, 58, 61 and 54 g, respectively, yielding inhibitions of -4.0, 4.4, 1.0, -4.0 and 7.8% and mean food consumption in the control and treatment groups during the observation period was 70 g in the control and 72, 65, 65, 75 and 73 g, respectively, yielding inhibitions of -2.9, 7.1, 7.1, -7.1 and -4.3%. The 8-day LC_{50} is >1405 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old mallard duck (*Anas platyrhynchos*) was exposed to a 25% potassium salts of fatty acids formulation (MRID 40066204; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 562, 1000, 1780, 3160 and 5620 mg a.i./kg diet. No mortality or behavioral abnormalities were observed. Percent body weight change during the exposure period averaged 45% in the control and 45, 45, 47, 47 and 44% in the nominal 562, 1000, 1780, 3160 and 5620 mg a.i./kg diet treatment groups, respectively, yielding inhibitions of -4, -2, 5, -4 and 4%. Percent body weight gain during the observation period averaged 23% in the control and 23, 26, 22, 22 and 24% in the 562, 1000, 1780, 3160 and 5620 mg a.i./kg diet treatment groups, respectively, yielding increases of 4, 5, -3, 3 and -4%. The overall % body weight gain was 60% in the control and 57, 59, 60, 59 and 57% in the 562, 1000, 1780, 3160 and 5620 mg a.i./kg diet groups, respectively. The mean food consumption in the control and nominal 562, 1000, 1780, 3160 and 5620 mg a.i./kg diet treatment groups during the exposure period was 69 g in the control and 63, 64, 62, 68 and 62 g, respectively, yielding inhibitions of 9, 7, 10, 1 and 10%. Mean food consumption in the control and treatment groups during the observation period was 83 g in the control and 82, 87, 82, 79 and 78 g, respectively, yielding inhibitions of 1, -5, 1, 5 and 6%. The 8-day LC_{50} is >5620 mg a.i./kg diet based on a lack of mortality and sub-lethal effects.

In a 5-day acute dietary toxicity study, the 14-day old mallard duck (*Anas platyrhynchos*) was exposed to a 50% potassium salts of fatty acids formulation (MRID 00030862; Supplemental). The formulation was administered to the ducks in the diet at nominal concentrations of 0 (vehicle control) and 2,642 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 42.7% in the control and 48.2% in the nominal 2642 mg a.i./kg diet treatment groups, yielding an inhibition of -13%. The overall % body weight gain could not be assessed since an observation period was not included in the test. The mean food consumption in the control and nominal 2642 mg a.i./kg diet treatment group during the exposure period was 724.9 g in the control and 781.6 g, yielding an inhibition of -7.8%. The mean food consumption in the control and treatment group during the observation period could not be assessed since an observation period was not included in the test. The 8-day LC_{50} is >2642 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old bobwhite quail (*Colinus virginianus*) was exposed to a 60% potassium salts of fatty acids formulation (MRID 00157472; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 337, 600, 1068, 1896 and 3372 mg a.i./kg diet (corrected for purity). No mortality or behavioral abnormalities were observed. Percent body weight change during the exposure period averaged 40.4% in the control and 46.9, 45.2, 45.5, 44.8 and 45.2% in the nominal 337, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups, respectively, yielding inhibitions of 2.4, 5.5, -0.6, 11.6 and 5.5%. Percent body weight gain during the observation period averaged 19.6% in the control and 20, 20.5, 23.3, 21.6 and 20.5% in the 337, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups, respectively, yielding increases of 2.4, 4.9, -4.9, 9.8 and 4.9%. The overall % body weight gain was 52.1% in the control and 57.5, 56.4, 58.1, 56.8 and 56.4% in the 337, 600, 1068, 1896 and 3372 mg a.i./kg diet groups, respectively. The mean food consumption in the control and nominal 337, 600, 1068, 1896 and 3372 mg a.i./kg diet treatment groups during the exposure period was 9 g in the control and 13, 10, 11, 11 and 13 g, respectively, yielding inhibitions of -44, -11, -22, -22 and -44%. Mean food consumption in the control and treatment groups during the observation period was 16 g in the control and 14, 10, 11, 10 and 13 g, respectively, yielding inhibitions of 12.5, 37.5, 31.3, 37.5 and 18.8%. The 8-day LC_{50} is >3,372 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old bobwhite quail (*Colinus virginianus*) was exposed to a 25% potassium salts of fatty acids formulation (MRID 40053302; Supplemental). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 140.5, 250, 445, 790 and 1405 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 40.7% in the control and 37.9, 37, 37, 37.9 and 39.3% in the nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, yielding inhibitions of -7.4, 0, 0, -7.4 and -3.7%. Percent body weight gain during the observation period averaged 22.9% in the control and 21.6, 25, 20.6, 19.4 and 24.3% in the 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, respectively, yielding increases of 5.4, 2.7, -2.9, 2.7 and 5.4%. The overall % body weight gain was 54.3% in the control and 51.4, 52.8, 50, 50 and 54.1% in the treatment groups, respectively. The mean food consumption in the control and nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, respectively, during the exposure period was 12 g in the control and 10, 11, 8, 13 and 9 g, respectively, yielding increases of -20, -9, -50, 7.7 and -33% and mean food consumption in the control and treatment groups during the observation period was 12 g in the control and 12, 18, 11, 20 and 12 g, respectively, yielding increases of 0, 33, -9, 40 and 0%. The 8-day LC_{50} is >1,405 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 14-day old bobwhite quail (*Colinus virginianus*) was exposed to a potassium salts of fatty acids formulation (MRID 00096640; Supplemental). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 562, 1000, 1780, 3160 and 5620 mg formulation/kg diet and a second trail conducted at 10,000 mg formulation/kg diet (% a.i. not reported, values not corrected for purity). No mortalities or behavioral abnormalities were observed. Overall percent body weight change during the test averaged 43.2% in the control and 40.6, 39.4, 42.9, 38.7 and 36.1% in the nominal 562, 1000, 1780, 3160 and 5620 mg/kg diet treatment groups, respectively, yielding inhibitions of 13.5, 10.8, 5.4, 16.2 and 2.7%. In the 2nd study with the nominal 10,000 mg/kg treatment group, overall % body weight gain averaged 44.9% as compared to the 47% gain in the vehicle control, yielding an increase of 2%. The mean food consumption in the control and nominal 562, 1000, 1780, 3160 and 5620 mg/kg diet treatment groups during the exposure period (days 0-5) was 396 g in the control and 357, 409, 361, 345 and 356 g in the treatment groups, respectively, yielding inhibitions of 10.1, -3.0, 9.1, 13.1 and 10.3%, respectively. In the 2nd study with the nominal 10,000 mg/kg diet treatment group, mean food consumption was 406 g as compared to 376 g in the vehicle control, yielding an inhibition of -7.9% The 8-day LC_{50} is >10,000 mg formulation/kg diet (not corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 10-day old bobwhite quail (*Colinus virginianus*) was exposed to a 25% potassium salts of fatty acids formulation (MRID 40066203; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control), 140.5, 250, 445, 790 and 1405 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 36.1% in the control and 33.3, 36.4, 36.7, 36.4, 34.4% in the nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, yielding inhibitions of 3.2, -6.5, 3.2, -6.5, and -3.2%. Percent body weight gain during the observation period averaged 21.3% in the control and 25, 21.4, 23.1, 21.4 and 22% in the 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups, respectively, yielding increases of 1.5, 6.2, -1.0, 6.2 and 3.9%. The overall % body weight gain was 49.7% in the control and 50, 50, 51.3, 50 and 48.8% in the treatment groups, respectively. The mean food consumption in the control and nominal 140.5, 250, 445, 790 and 1405 mg a.i./kg diet treatment groups during the exposure period was 9.4 g in the control and 9, 10, 10, 10 and 11 g, respectively, yielding inhibitions of 4.3, -6.4, -6.4, -6.4 and -17% and mean food consumption in the control and treatment groups during the observation period was 15 g in the control and 12, 12, 16, 15 and 14 g, respectively, yielding inhibitions of 20, 20, -6.7, 0.0 and 6.7%. The 8-day LC_{50} is >1405 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In a 5-day acute dietary toxicity study, the 14-day old bobwhite quail (*Colinus virginianus*) was exposed to a 50% potassium salts of fatty acids formulation (MRID 00030863; Supplemental). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control) and 2,642 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 37% in the control and 23% in the nominal 2642 mg a.i./kg diet treatment groups, yielding an inhibition of 25%. The overall % body weight gain could not be assessed since an observation period was not included in the test. The mean food consumption in the control and nominal 2642 mg a.i./kg diet treatment group during the exposure period was 317.2 g in the control and 263.3 g, yielding an inhibition of 17%. The mean food consumption in the control and treatment group during the observation period could not be assessed since an observation period was not included in the test. The 8-day LC_{50} is >2642 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

In an 8-day acute dietary toxicity study, the 14-day old bobwhite quail (*Colinus virginianus*) was exposed to a 50% potassium salts of fatty acids formulation (MRID 44980311; Acceptable). The formulation was administered to the birds in the diet at nominal concentrations of 0 (vehicle control) and 2,450 mg a.i./kg diet (corrected for purity). Percent body weight change during the exposure period averaged 33.8% in the control and 33% in the nominal 2450 mg a.i./kg diet treatment group, yielding an inhibition of 2.6%. Percent body weight gain during the observation period averaged 16.5% in the control and 20.8% in the limit dose, yielding an increase of 1.4%. The overall % body weight gain was 44.7% in the control and 46.9% in the limit dose. The mean food consumption in the control and nominal 2450 mg a.i./kg diet treatment group during the exposure period was 8 g in the control and 8 g in the treatment group, yielding an inhibition of 0%. The mean food consumption in the control and treatment group during the observation period was 9 g in the control and 9 g in the treatment group, yielding an inhibition of 0%. The 8-day LC_{50} is >2450 mg a.i./kg diet (corrected for purity) based on a lack of mortality and sub-lethal effects.

Birds, Reproduction

AMMONIUM and POTASSIUM SALTS OF FATTY ACIDS

No chronic ecological effects studies of ammonium and potassium salts using birds were submitted. The Agency is not asking for the ecological studies due to the lack of effects at high rates in acute avian studies and the salts undergo rapid degradation via metabolism in less than a day.

Mammals, Acute Oral and Reproduction

In most cases, rat or mouse toxicity values are obtained from the Agency's Health Effects Division (HED) for EFED's ecological risk assessment to evaluate the potential risk to mammalians. In an August 29, 2012 memorandum (D399690), HED has reported the toxicology database for soap salts is adequate to support reregistration eligibility. HED has waived all generic mammalian toxicity data requirements for soap salts due to the lack of effects at high doses in the available studies of other fatty acid salts, the nature of the chemicals (fatty acids) and their ubiquity in nature, and the limited potential for human exposure via the oral route from established uses. With no systemic toxicity observed, HED did not select endpoints for human health risk assessment and waived all mammalian toxicity data; thus, the ecological effects to mammals are anticipated to be minimal.

Beneficial Insects, Acute

Honeybee acute contact studies were submitted for soap salts because of its wide-ranging uses that will result in honeybee exposure (**Table III.21**). The acute contact LD_{50}, using the honey bee, *Apis mellifera*, is derived from a laboratory study designed to estimate the quantity of toxicant required to cause 50% mortality in a test population of bees. Results of the acute contact studies with honeybees indicate the formulated products of soap salts are practically non-toxic to bees on a contact exposure basis. The available honeybee acute contact and oral studies are summarized in **Table III.21**.

Table III.21. Acute Contact and Oral Toxicity of Ammonium and Potassium Salts to Honeybees

Species	% a.i.	Nominal LD_{50}/LC_{50}* (µg a.i./bee)	Toxicity Category	MRID No.	Study Classification
AMMONIUM SALTS OF FATTY ACIDS					
Honey bee (*Apis mellifera*)	13.1	>262 (contact)	Practically nontoxic	42806407 Ward *et al*. 1993.	Acceptable
	22	>100 (contact)	Practically nontoxic	44766401 Nengel. 1998.	Acceptable
		>108.94 (oral)	Not categorized		Supplemental[†]
POTASSIUM SALTS OF FATTY ACIDS					
Honey bee	52.8	>13 (contact)	Practically nontoxic	42806001 Hoxter and Bernard. 1993.	Acceptable
	19.9	>5 (contact)	No significant effects up to 5 µg a.i./bee	43042801 Palmer and Beavers. 1993.	Acceptable
	40	>10 (contact)	No significant effects up to 10 µg a.i./bee	43173604 Palmer and Beavers. 1993.	Acceptable

Table III.21. Acute Contact and Oral Toxicity of Ammonium and Potassium Salts to Honeybees

	50.5	>100 (contact)	Practically nontoxic	45060901 Schur. 1999.	Acceptable
		>96.04 (oral)	Not categorized		Supplemental†

† Acute oral - a non-guideline study

* The LD_{50}s/LC_{50}s were greater than the highest concentration; therefore, it was not possible to calculate a probit slope and 95% confidence intervals.

AMMONIUM SALTS OF FATTY ACIDS

The acute contact toxicity of a 13.1% ammonium salt formulated product (MRID 42806407; Acceptable) to honey bees (*Apis mellifera*) was tested in the laboratory. In the 48-hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (control), 16.4, 32.8, 65.5, 131 and 262 µg a.i./bee. Lethargy was the only reported sub-lethal effect and was only observed in the two highest doses. At 48 hours, 10.4% of surviving bees in the 131 µg a.i./bee treatment group were lethargic. At 4 hours, one bee of the surviving 49 bees in the 262 µg a.i./bee treatment group was lethargic, and at 48 hours the number of lethargic bees increased to 14%. Mortality was 2, 6, 6, 4 and 30% in the 16.4, 32.8, 65.5, 131 and 262 µg a.i./bee treatment groups, respectively. The 48-hour acute contact LD_{50} was >262 µg a.i./bee and the NOAEL was 65.5 µg a.i./bee, based on sub-lethal effects.

The acute contact and oral toxicity of a 22% ammonium salt formulated product (MRID 44766401; Acceptable (contact), Supplemental (oral)) to honey bees were tested in the laboratory. In the 48- hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (control), 6.25, 12.5, 25, 50 and 100 µg a.i./bee, while in the oral test, bees were exposed to the formulation by feeding at an intake rate of 7.36, 13.56, 29.11, 59.21 and 108.94 µg a.i./bee. In the contact test, no sub-lethal effects were observed in the control or in the treatment groups. Mortality was 0% in the control and nominal 6.25, 12.5 and 25 µg a.i./bee treatment groups and 8 and 14% in the nominal 50 and 100 µg a.i./bee treatment groups, respectively. The resulting contact NOAEL and LD_{50} values were 50 and >100 µg a.i./bee, respectively. In the oral test, no sub-lethal effects were observed in the control or treatment groups. At the highest dose of 108.94 µg a.i./bee, only 4% of the bee died. The resulting oral NOAEC and LC_{50} values were 108.94 and >108.94 µg a.i./bee, respectively.

POTASSIUM SALTS OF FATTY ACIDS

The acute contact toxicity of a 52.8% potassium salt formulated product (MRID 42806001; Acceptable) to honey bees (*Apis mellifera*) was tested in the laboratory. In the 48-hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (negative and solvent controls), 0.8, 1.6, 3.3, 6.6 and 13 µg a.i./bee. Immobility was observed in one bee in the nominal 0.8 µg a.i./bee treatment group and in two bees in each of the 1.6 and 13 µg a.i./bee treatment groups the first 2 hours following application of the formulation. No sub-lethal effects were observed. Mortality was 0% in the controls and nominal 0.8, 3.3 and 6.6 µg a.i./bee treatment groups and 4% in the nominal 1.6 ad 13 µg a.i./bee treatment groups, yielding 48-hour acute contact LD_{50} and NOAEL values of >13 and 13 µg a.i./bee, respectively.

The acute contact toxicity of a 19.9% potassium salt formulated product (MRID 43042801; Acceptable) to honey bees (*Apis mellifera*) was tested in the laboratory. In the 48-hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (negative and solvent controls), 0.3, 0.6, 1.3, 2.5 and 5 µg a.i./bee. No mortality was observed in the negative control and solvent control groups. Four bees appeared lethargic on day 0 in the negative control group, all other control bees appeared normal throughout the test. Mortality in the treatment groups ranged between 0 and 4%. On day 0, one bee was lethargic in the highest dose. All surviving bees were normal in appearance and behavior throughout the test. The 48-hour acute contact LD_{50} and NOAEL values were >5 and 5 µg a.i./bee, respectively, based on lack of mortality and sub-lethal effects.

The acute contact toxicity of a 40% potassium salt formulated product (MRID 43173604; Acceptable) to honey bees (*Apis mellifera*) was tested in the laboratory. In the 48-hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (negative and solvent controls), 0.6, 1.2, 2.5, 5 and 10 µg a.i./bee. None of the bees died in the negative control group; however, 6% mortality was observed in the solvent control group. Mortality in the treatment groups ranged between 0 and 4%. The 48-hour acute contact LD_{50} and NOAEL values were >10 and 10 µg a.i./bee, respectively, based on lack of mortality and sub-lethal effects.

The acute contact and oral toxicity of a 50.5% potassium salt formulated product (MRID 45060901; Acceptable (contact), Supplemental (oral)) to honey bees were tested in the laboratory. In the 48- hour acute contact test, bees were exposed to the formulation administered topically to the thorax, at an application rate of 0 (control), 6.25, 12.5, 25, 50 and 100 µg a.i./bee, while in the oral test, bees were exposed to the formulation by feeding at an intake rate of 6.15, 10.7, 24.32, 48.72 and 96.04 µg a.i./bee. In the contact test, mortality was 0% in the control and nominal 6.25, 12.5, 25 and 50 µg a.i./bee treatment groups and 10% in the nominal 100 µg a.i./bee treatment group. The resulting contact NOAEL and LD_{50} values were 50 and >100 µg a.i./bee, respectively. In the oral test, mortality was 8% in the control and 6, 18, 8, 14 and 20% in the nominal 6.15, 10.7, 24.32, 48.72 and 96.04 µg a.i./bee treatment groups, respectively. The resulting oral NOAEC and LC_{50} values were 25 and >96.04 µg a.i./bee, respectively.

Terrestrial Plants, Seedling Emergence and Vegetative Vigor

Terrestrial plant studies are required for all terrestrial outdoor pesticides. Tier II terrestrial plant toxicity studies were conducted to establish the toxicity of the ammonium (**Table III.22**) and potassium salt formulated products (**Tables III.23 and III.24**) to non-target terrestrial plants which was tested at doses lower than the maximum labeled application rates of 103.8 and 205 lb a.i./A for ammonium and potassium salts respectively. The recommendations for seedling emergence and vegetative vigor studies are for testing of (1) six species of at least four dicotyledonous families, one species of which is soybean (*Glycine max*), and the second of which is a root crop, and (2) four species of at least two monocotyledonous families, one of which is corn (*Zea mays*).

AMMONIUM SALTS OF FATTY ACIDS

For seedlings and young plants exposed to ammonium salt formulated products (**Table III.22**), seedlings at 100 lb a.i./A were not affected while active-growing monocotyledonous and dicotyledonous species were mostly affected. The seedling emergence EC_{25}s were >100 lbs a.i./A for all monocotyledonous and dicotyledonous species tested and would be used as a screening-level endpoint to assess risk to non-listed seedling, as well as it corresponding NOAEC of 100 lb a.i./A to assess risk to listed plants.

In the vigor studies, dry weight was most affected in corn, oat, bean, oilseed rape and soybeans, while shoot length was most affected in cucumber, radish and tomato. No effects were seen in active-growing onion and ryegrass when exposed to ammonium salt formulated products. The most sensitive monocotyledonous species was corn, based on dry weight, with EC_{25} and NOAEC values of 6.2 and 1.5 lb a.i./A and would be used to assess risk to non-listed and listed monocotyledonous plants, respectively. The most sensitive dicotyledonous species was tomato, based on shoot length, with EC_{25} and EC_{05} values of 2.2 and 1.1 lb a.i./A and would be used to assess risk to non-listed and listed dicotyledonous plants, respectively.

Table III.22. Summary of Tier II Seedling Emergence and Vegetative Vigor Results for an Ammonium Salt Formulated Product

	Vegetative Vigor*			Seedling Emergence**		
Species	**Endpoint**	**NOAEC/[EC05]**	**EC_{25}**	**Endpoint**	**NOAEC**	**EC_{25}**
Corn	Dry weight	1.5	6.2	None	100	>100
Oat	Dry weight	6.3	9.8	None	100	>100
Onion	None	6.3	>6.3	None	100	>100
Ryegrass	None	6.3	>6.3	None	100	>100
Bean	Dry weight	6.3	27	None	100	>100
Cucumber	Shoot length	[1.3]	6.6	None	100	>100
Oilseed Rape	Dry weight	1.5	2.9	None	100	>100
Radish	Shoot length	0.094	5.8	None	100	>100
Soybean	Dry weight	1.5	4.4	None	100	>100
Tomato	Shoot length	[1.1]	2.2	None	100	>100

* 21.85% a.i ammonium salts of fatty acids; MRID 48402205, Martin. 2011. Measured concentrations for tomato were <LOQ (<0.0015, control), 0.023, 0.094, 0.36, 1.5, and 6.3 lb a.i./A. For corn, oilseed rape, cucumber, onion, ryegrass, and radish, measured concentrations were <LOQ (<0.0015, control), 0.094, 0.36, 1.5, 6.3, and 22 lb a.i./A. For bean, oat, and soybean, measured concentrations were <LOQ (<0.0015, control), 0.36, 1.5, 6.3, 22, and 94 lb a.i./A.
** 21.85% a.i ammonium salts of fatty acids; MRID 48402204, Martin. 2011.

POTASSIUM SALTS OF FATTY ACIDS

Results indicate the plants at the 3-leaf stage (young plants) exposed to potassium salts were more sensitive to potassium salt formulated products than seedlings (**Tables III.23** and **III.24**). Monocotyledonous and dicotyledonous seedlings and active-growing monocotyledonous species were generally not inhibited 25% or more to potassium salt formulated products at the maximum doses (62 or 68 lb a.i./A). The only reliable dicotyledonous seedling was radish, the EC_{25} and NOAEC values were 53.9 and 3.9 lb a.i./A based on reduced height and would be used as screening-level endpoints to assess risk to non-listed and listed dicotyledonous seedlings, respectively. For monocotyledonous seedlings, the most sensitive species was ryegrass based on significant reductions in survival and emergence, the EC_{25} and NOAEC values were >62.34 and 31.17 lb a.i./A and would be used to assess risk to non-listed and listed monocotyledonous seedlings, respectively.

Dry weight was the most sensitive endpoint in the vegetative vigor studies exposed to potassium salt formulated products. The most sensitive monocotyledonous species was corn, based on dry weight, with EC_{25} and NOAEC values of 5.91 and 4.24 lb a.i./A and would be used to assess risk to non-listed and listed monocotyledonous plants, respectively. The most sensitive dicotyledonous species was oilseed rape, based on dry weight, with EC_{25} and EC_{05} values of 18.5 and 4.38 lb a.i./A and would be used to assess risk to non-listed and listed dicotyledonous plants, respectively.

Table III.23. Summary of Tier II Seedling Emergence and Vegetative Vigor Results for a Potassium Salt Formulated Product

	Vegetative Vigor*			Seedling Emergence**		
Species	**Endpoint**	**NOAEC/[EC05]**	**EC_{25}**	**Endpoint**	**NOAEC/[EC05]**	**EC_{25}**
Corn	Dry weight	4.24	5.91	None	68.57	>68.57
Onion	None	68.08	>68.08	None	68.57	>68.57
Ryegrass	None	68.08	>68.08	None	68.57	>68.57
Oat	None	68.08	>68.08	None	68.57	>68.57
Bean	Dry weight	8.104	20.72	None	68.57	>68.57
Cucumber	Dry weight	16.21	23.05	Emergence and Survival	16.83	23.8[A]
Oilseed Rape	Dry weight	[4.38]	18.50	None	68.57	>68.57
Radish	Dry weight	16.21	57.27	None	68.57	>68.57
Soybean	Dry weight	16.21	30.55	Emergence and Survival	[4.1]	43.79 [A]
Tomato	Dry weight	16.21	21.73	None	[0.0000021]	>68.57

* 46.8% a.i potassium salts of fatty acids; MRID 48402302, Martin. 2011.
** 46.8% a.i potassium salts of fatty acids; MRID 48402301, Martin. 2011.
[A] Toxicity value should be interpreted with caution as the 95% confidence intervals appear unreliable.

Table III.24. Summary of Tier II Seedling Emergence and Vegetative Vigor Results for a Potassium Salt Formulated Product

	Vegetative Vigor*			Seedling Emergence**		
Species	**Endpoint**	**NOAEC/[EC05]**	**EC_{25}**	**Endpoint**	**NOAEC**	**EC_{25}**
Corn	None	68.57	>68.57	None	62.34	>62.34
Onion	None	68.57	>68.57	None	62.34	>62.34
Ryegrass	Shoot length	31.79	NC	Emergence and Survival	31.17	>62.34
Oat	Dry weight	16.21	>68.57	None	62.34	>62.34
Bean	Shoot length	[39.3]	49.8	Height	31.17	>62.34
Cucumber	Shoot length	[2.3][A]	47.7	None	62.34	>62.34
Oilseed Rape	None	[NC]	NC	Weight	15.58	>62.34
Radish	None	68.57	>68.57	Height	3.9	53.9
Soybean	None	68.57	>68.57	None	62.34	>62.34
Tomato	Dry weight	31.79	32.6	None	62.34	>62.34

* 50.8% a.i potassium salts of fatty acids; MRID 48608703, Martin. 2006.
** 50.8% a.i potassium salts of fatty acids; MRID 48608704, Martin. 2011.
NC – The ECx or/and 95% confidence intervals appear unreliable.
[A] Toxicity value should be interpreted with caution as the 95% confidence intervals appear unreliable.

IV. Risk Characterization

IV.1. Risk Estimation

Toxicity data and exposure estimates are used to evaluate the potential for adverse ecological effects on non-target species. This assessment for soap salts relies on the deterministic RQ method to provide a metric of potential risks. The RQ provides a comparison of exposure estimates to toxicity endpoints (*i.e.*, the estimated exposure concentrations are divided by acute and chronic toxicity values). The resulting RQs are compared to the Agency's LOCs, as shown in **Table II.12**. LOCs are used by the Agency to indicate when the use of a pesticide, as directed by the label, has the potential to cause adverse effects to non-target organisms.

IV.1.1 Risk Quotient Calculations for Aquatic Organisms

There is a potential for exposure of the active ingredients to aquatic organisms, toxicity information on the percentage of the active ingredient in the formulations are used to estimate the risks to aquatic organisms as a result of surface runoff and spray drift from aerial or ground applications. The LD_{50} and EC_{50} is used to estimate acute risk for adverse effects on survival to fish and invertebrates, respectively, and the NOAEC is used to estimate chronic risk for adverse effects on reproduction and growth to both fish and invertebrates.

Freshwater Fish and Invertebrates

Tables IV.1 and IV.2 list acute and chronic RQs calculated for freshwater fish (also surrogates for aquatic-phase amphibians) and invertebrates exposed to potassium and ammonium salts, respectively, based on the peak EECs generated from GENEEC modeling. A single application is modeled. Results of the assessment on freshwater organisms indicate the acute RQs for freshwater fish exceeded the acute listed species LOC of 0.05 and restricted use LOC of 0.1 when applying at and greater than the application rate of 63 lb a.i./A of potassium salts via air or ground. The acute RQs for freshwater invertebrates exceeded the acute listed species and restricted use LOCs when applying at and greater than the application rate of 10 lb a.i./A using aerial or ground equipments and exceeded the acute non-listed species LOC of 0.5 when applying at and greater than 63 lb a.i./A.

For uses of ammonium salts, acute RQs were above the Agency's acute LOCs for freshwater fish at and greater than 63 lb a.i./A and for freshwater invertebrates at the maximum application rate via aerial or ground applications.

When compared to toxicity data for 99.2% nonanoic acid, however, the acute risk quotients are below Agency levels of concern. The acute freshwater fish RQ is 3.2/91 = 0.04, and the Daphnia acute RQ is 3.2/96= 0.03.

Chronic RQs for freshwater invertebrates exposed to potassium salts are above the Agency's LOC for chronic risk when applied aerially at and greater than 116 lb a.i./A and at and greater than 205 lb a.i./A when using broadcast ground equipment.

No chronic toxicity data were available for freshwater fish. The acute to chronic ratio method was used to estimate the chronic toxicity value for freshwater fish using data from rainbow trout and daphnid studies. Chronic RQs for freshwater fish exposed to potassium and ammonium salts were below the chronic LOC at maximum applications rates. The data gap is discussed further in **Section IV.2**.

The potential risks to freshwater organisms are discussed further in **Section IV.2**.

Table IV.1. Risk Quotients for Freshwater Organisms for Potassium Salts of Fatty Acids

Use (Aerial or ground/ # apps/ lb a.i./A)	Peak EEC	21D EEC	60D EEC	Freshwater Fish (LC_{50} = 9.19 mg a.i./L; NOAEC = No data, ACR = 8.06 mg a.i./L)		Freshwater Invertebrate (EC_{50} = 0.57 mg a.i./L; NOAEC = 0.5 mg a.i./L)	
	(mg a.i./L)			Acute	Chronic	Acute	Chronic
1 aerial app @ 205	3.2	0.89	0.32	**0.35***	0.04	**5.6****	**1.8*****
1 ground app @ 205	2.9	0.79	0.28	**0.32***	0.04	**5.1****	**1.6*****
1 aerial app @ 116	1.8	0.50	0.18	**0.20***	0.02	**3.2****	**1.0*****
1 ground app @ 116	1.6	0.45	0.16	**0.17***	0.02	**2.8****	0.90
1 aerial app @ 63	0.97	0.27	0.098	**0.11***	0.01	**1.7****	0.54
1 ground app @ 63	0.88	0.24	0.086	**0.10***	0.01	**1.5****	0.48
1 aerial app @ 10	0.16	0.043	0.016	0.02	<0.01	**0.28***	0.09
1 ground app @ 10	0.14	0.038	0.014	0.02	<0.01	**0.25***	0.08
1 aerial app @ 1.0	0.016	0.0044	0.0016	0.0017	<0.01	0.03	0.01
1 ground app @ 1.0	0.014	0.0038	0.0014	0.0015	<0.01	0.02	0.01

* Exceeds the listed species LOC of 0.05; ** Exceeds the nonlisted species LOC of 0.5 and the listed species LOC of 0.05; and *** Exceeds the chronic LOC of 1.0 for nonlisted and listed species.

Table IV.2. Risk Quotients for Freshwater Organisms for Ammonium Salts of Fatty Acids							
Use (Aerial or ground/ # apps/ lb a.i./A)	**Peak EEC**	**21D EEC**	**60D EEC**	**Freshwater Fish (LC_{50} = 12 mg a.i./L; NOAEC = No data, ACR = 10.3 mg a.i./L)**		**Freshwater Invertebrate (EC_{50} = 27 mg a.i./L ; NOAEC = 23 mg a.i./L)**	
	(mg a.i./L)			**Acute**	**Chronic**	**Acute**	**Chronic**
1 aerial app @ 103.8	1.6	0.45	0.16	**0.13***	0.02	**0.06***	0.02
1 ground app @ 103.8	1.4	0.40	0.14	**0.12***	0.01	**0.05***	0.02
1 aerial app @ 63	0.97	0.27	0.098	**0.08***	<0.01	0.04	0.01
1 ground app @ 63	0.88	0.24	0.086	**0.07***	<0.01	0.03	0.01
1 aerial app @ 10	0.16	0.043	0.016	0.01	<0.01	<0.01	<0.01
1 ground app @ 10	0.14	0.038	0.014	0.01	<0.01	<0.01	<0.01
1 aerial app @ 1.0	0.016	0.0044	0.0016	0.001	<0.01	<0.01	<0.01
1 ground app @ 1.0	0.014	0.0038	0.0014	0.001	<0.01	<0.01	<0.01

* Exceeds the listed species LOC of 0.05; ** Exceeds the nonlisted species LOC of 0.5 and the listed species LOC of 0.05; and *** Exceeds the chronic LOC of 1.0 for nonlisted and listed species.

Estuarine/Marine Fish and Invertebrates

Tables IV.3 and IV.4 list acute and chronic RQs calculated for estuarine/marine fish and invertebrates exposed to potassium and ammonium salts based on the peak EECs generated from GENEEC modeling.

The acute RQs for estuarine/marine fish exposed to potassium salts were not calculated since no effects were observed at the maximum dose tested in the toxicity studies with sheepshead minnows. Exposed to potassium salts, the acute RQ for estuarine/marine invertebrates exceeded the acute listed species LOC of 0.05 when applying at and greater than 10 lb a.i./A by air or ground. None of the chronic RQs exceeded the chronic LOC of 1.0 for estuarine/marine invertebrates. At the maximum rate, the highest acute and chronic RQs are 2.7 and 0.8, respectively.

Acute and chronic RQs for uses of ammonium salts at the maximum label rate of 103.8 lb a.i./A were below the Agency's acute LOCs for estuarine/marine organisms exposed to ammonium salts via aerial or ground applications; therefore, RQs based on other uses with lower application rates of ammonium salts are also less than the LOC.

No chronic toxicity data were available for estuarine/marine organisms. The acute to chronic ratio method was used to estimate the chronic toxicity value for estuarine/marine fish and invertebrates using data from sheepshead minnow, daphnid, and mysid studies.

The potential risks to estuarine/marine organisms are discussed further in **Section IV.2**.

Table IV.3. Risk Quotients for Estuarine/Marine Organisms for Potassium Salts of Fatty Acids							
Use (Aerial or ground/ # apps/ lb a.i./A)	**Peak EEC**	**21D EEC**	**60D EEC**	**Estuarine/marine Fish (LC_{50} >4.4 mg a.i./L; NOAEC = no data, ACR >3.9 mg a.i./L)**		**Estuarine/marine Invertebrates (EC_{50} = 1.2 mg a.i./L; NOAEC = no data, ACR = 1.05 mg a.i./L)**	
	(mg a.i./L)			**Acute**	**Chronic**	**Acute**	**Chronic**
1 aerial app @ 205	3.2	0.89	0.32	RQs not calculated due to no effects at the solubility limit	RQs were not derived due to a non-definitive NOAEC using ACR method	**2.7****	0.8
1 ground app @ 205	2.9	0.79	0.28			**2.4****	0.8
1 aerial app @ 116	1.8	0.50	0.18			**1.5****	0.5
1 ground app @ 116	1.6	0.45	0.16			**1.3****	0.4
1 aerial app @ 63	0.97	0.27	0.098			**0.8****	0.3
1 ground app @ 63	0.88	0.24	0.086			**0.7****	0.2
1 aerial app @ 10	0.16	0.043	0.016			**0.1***	0.04
1 ground app @ 10	0.14	0.038	0.014			**0.1***	0.04
1 aerial app @ 1.0	0.016	0.0044	0.0016			0.01	0.04
1 ground app @ 1.0	0.014	0.0038	0.0014			0.01	0.04

* Exceeds the listed species LOC of 0.05; ** Exceeds the nonlisted species LOC of 0.5 and the listed species LOC of 0.05; and *** Exceeds the chronic LOC of 1.0 for nonlisted and listed species.

Table IV.4. Risk Quotients for Estuarine/marine Organisms for Ammonium Salts of Fatty Acids							
Use (Aerial or ground/ # apps/ lb a.i./A)	**Peak EEC**	**21D EEC**	**60D EEC**	**Estuary Fish (LC_{50} >105 mg a.i./L; NOAEC = no data, ACR >90 mg a.i./L)**		**Estuary Invertebrate (EC_{50} = 67 mg a.i./L; NOAEC = no data, ACR = 57 mg a.i./L)**	
	(mg a.i./L)			**Acute**	**Chronic**	**Acute**	**Chronic**
1 aerial app @ 103.8	1.6	0.45	0.16	RQs not calculated due to no effects at the maximum dose	RQs were not derived due to a non-definitive NOAEC using ACR method	0.02	<0.01
1 ground app @ 103.8	1.44	0.4	0.14			0.02	<0.01

IV.1.2 Risk Quotient Calculations for Aquatic Plants

There is a potential for exposure of the active ingredients to aquatic vascular and nonvascular plant species, toxicity information on the percentage of the active ingredient in the TEP are used to estimate the risks to aquatic plants as a result of surface runoff and spray drift from aerial and ground applications. The EC_{50} is used to estimate risk for adverse effects on growth to *non-listed* aquatic plants and the NOAEC (or EC_{05} when a NOAEC is not available) is used to estimate risk for adverse effects on growth to *listed* aquatic plants.

Non-listed and Listed Aquatic Plants

According to peak GENEEC EECs of various application rates and toxicity values of the salts, assuming 100% of the acre is treated using broadcast applications, the *listed* RQs for aquatic vascular plants is below Agency's plant LOC of 1.0 when applying at the maximum label rate of 205 lb a.i./A for aerial and ground applications; and the *listed* RQs for aquatic non-vascular plants is above Agency's LOC when applying via air or ground at and greater than 63 lb a.i./A (**Table IV.5**). RQs were not derived for *non-listed* aquatic vascular plants because only non-definitive EC_{50}s are available and the risks to these species are discussed in the Risk Description section. There was an LOC exceedance for *non-listed* aquatic non-vascular plants exposed to potassium salts following aerial or ground applications at and greater than 63 lb a.i./A.

RQs for uses of ammonium salts at the maximum label rate of 103.8 lb a.i./A fall below the Agency's plant LOCs for aquatic plants (both vascular and nonvascular) exposed to ammonium salts via aerial or ground applications (**Table IV.6**); therefore, RQs based on other uses with lower application rates of ammonium salts are also less than the LOC.

The potential risks to aquatic plants are discussed further in **Section IV.2**.

Table IV.5. Risk Quotients for Aquatic Plants for Potassium Salts of Fatty Acids

Use (Aerial or ground/ # apps/lb a.i./A) Mobility	Peak EEC	Vascular Aquatic Plant (EC_{50} >5.0 mg a.i./L NOAEC = 5.0 mg a.i./L)		Non-Vascular Aquatic Plant (EC_{50} = 0.59 mg a.i./L; NOAEC = 0.39 mg a.i./L)	
	(mg a.i./L)	Non-Listed	Listed	Non-Listed	Listed
1 aerial app @ 205	3.2	RQs not calculated due to no effects at the solubility limit	0.6	**5***	**8****
1 ground app @ 205	2.9		0.6	**5***	**7****
1 aerial app @ 116	1.8		0.4	**3***	**5****
1 ground app @ 116	1.6		0.3	**3***	**4****
1 aerial app @ 63	0.97		0.2	**2***	**3****
1 ground app @ 63	0.88		0.2	**2***	**2****
1 aerial app @ 10	0.16		0.03	0.3	0.4
1 ground app @ 10	0.14		0.03	0.2	0.4
1 aerial app @ 1.0	0.016		0.003	0.03	0.04
1 ground app @ 1.0	0.014		0.003	0.02	0.04

* Exceeds the nonlisted species LOC of 1.0 for plants; ** Exceeds the listed species LOC of 1.0 for plants.

Table IV.6. Tier II Risk Quotients for Aquatic Plants for Ammonium Salts of Fatty Acids					
Use (Aerial or ground/ # apps/lb a.i./A)	**Peak EEC**	**Vascular Aquatic Plant (EC_{50} = 200 mg a.i./L NOAEC = 15 mg a.i./L)**		**Non-Vascular Aquatic Plant (EC_{50} = 6.6 mg a.i./L; NOAEC = 2.9 mg a.i./L)**	
	(mg a.i./L)	**Non-Listed**	**Listed**	**Non-Listed**	**Listed**
1 aerial app @ 103.8	1.6	0.01	0.1	0.24	0.55
1 ground app @ 103.8	1.44	0.01	0.1	0.22	0.50

IV.1.3. Risk Quotient Calculations for Terrestrial Animals

For this screening-level risk assessment with birds and mammals, acute and chronic RQs are derived based on ecological toxicity data for formulations of soap salts (e.g. potassium, ammonium and sodium salts of fatty acids), and then directly compared to the dietary-based EECs generated from T-REX. For dose-based RQs, the EECs and toxicity values are first adjusted based on food intake and body weight differences of the terrestrial animals prior to the assessment. The LD_{50} and LC_{50} are used to estimate acute risk for adverse effects on survival to both birds and mammals; the NOAEC is used to estimate chronic risk for adverse effects on reproduction and growth to both birds and mammals.

Birds

There is a potential for acute exposure to birds via the oral and dietary routes, but acute RQs were not calculated because toxicity information on the potassium and ammonium salt TEPs were not established (potassium: acute oral LD_{50s} >2450 mg a.i./kg-bw (quail); acute dietary LC_{50}s were >2450 mg a.i./kg-diet to >10,000 mg TEP/kg-diet (quail and duck); ammonium: acute dietary LC_{50} >5,000 mg/kg diet).

No chronic reproduction data were available to assess the toxicity of the active ingredients to birds; thus, chronic RQs were not calculated. Back calculating for the chronic toxicity value using highest T-REX EEC and LOC of 1.0 for chronic risk to birds calculates a toxicity value (NOAEC) of >49,200 and >24,912 mg/kg-diet based on the maximum application potassium and ammonium salts rate, respectively, is needed for the RQ to not exceed the LOC. The potential risk for acute and chronic exposure to birds is discussed in the Risk Description section.

Terrestrial-phase Amphibians and Reptiles

EFED currently uses surrogate data (birds) for terrestrial amphibians and reptiles when data are not available. Risks are discussed in the Risk Description section.

Mammals

Acute and chronic RQs were not calculated because no mammalian toxicity data are available for the soap salts. The potential risk for acute and chronic exposure to mammals is discussed in the Risk Description section.

Beneficial Insects

Potassium and ammonium salts are classified as practically nontoxic to honeybees on an acute exposure basis. Only non-definitive endpoints are available and RQs were not calculated. More discussion on the ratio between the highest concentration tested and the expected exposure is presented in the Risk Description section.

IV.1.4. Risk Quotient Calculations for Terrestrial Plants in Terrestrial and Semi-aquatic Environments

For this risk assessment with terrestrial monocots and dicots, *Non-listed and listed* plant species RQs are derived based on ecological toxicity data for the active ingredients and then compared to the TERRPLANT EECs for plants in non-target area receiving surface runoff combined with spray drift adjacent to the target area. Details of the TERRPLANT model and EECs are presented in **Table II.11**.

There is a potential for exposure of the active ingredients to terrestrial plants, toxicity information on the formulations are used to estimate the risks to non-target (*non-listed*) terrestrial plants inhabiting dry or semi-aquatic areas adjacent to a treated field as a result of surface runoff and/or spray drift. The EC_{25} was used to estimate risk for adverse effects on growth to *non-listed* plant species while the NOAEC (or EC_{05} when a NOAEC is not available) was used to estimate risk for adverse effects on growth to *listed* plant species. Note: TerrPlant does not consider exposures to plants from multiple pesticide applications; thus, results are based on single pesticide applications.

Non-listed and Listed Terrestrial Plants

Tables IV.8 and IV.9 present RQs for the formulated products of potassium and ammonium salts, respectively, to terrestrial plants via ground and aerial spray applications. Of the registered uses, the RQs exceeded (RQ = 1.73 (potassium salts at 205 lb a.i./A) and RQs of 1.43 – 2.36 (ammonium salts at 63 and up to 103.8 lb a.i./A)) the LOC of 1.0 for risk to *non-listed* terrestrial plants and the RQs exceeded (RQs = 1.37 – 2.42 (potassium salts at 116 and up to 205 lb a.i./A) and RQs of 2.1 – 4.72 (ammonium salts at 63 and up to 103.8 lb a.i./A) the LOC of 1.0 for risk to *listed* terrestrial plants located anyplace adjacent to treated areas as a result of offsite spray drift alone using aerial equipments. However, there was no LOC exceedance for *non-listed* terrestrial plants exposed to soap salts as a result of spray drift alone using ground equipments or from surface water runoff via aerial or ground applications.

RQs (1.14-13.26) for *listed* dicots exposed to potassium salts through a combination of surface water runoff and spray drift exceeded the plant LOC of 1.0 for plants inhabiting dry and semi-aquatic areas adjacent to an use site treated with aerial applications; for those inhabiting semi-aquatic areas adjacent to a site treated with ground applications at a rate of 63 lb a.i./A and higher; and for those inhabiting dry areas exposed to ground applications at the maximum potassium salt rate. For *listed* monocots inhabiting semi-aquatic areas adjacent to a treated site exposed to a combination of runoff and spray drift of potassium salts, the exceedances (RQs = 1.38 – 1.64) were observed at the maximum-labeled rate. No exceedances for *listed* monocots inhabiting dry areas. No exceedances for *listed* monocots and dicots inhabiting dry or semi-aquatic areas adjacent to a treated site exposed to ammonium salts as a combination of runoff and drift.

The potential risks to terrestrial plants are discussed further in the Risk Description section.

Table IV.8. Terrestrial Plant Risk Quotient Summary for Potassium [1, 2, 3, 4]

Scenario	Non-listed RQs			Listed RQs		
	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift
Maximum Labeled Rate for Potassium Salt Uses (205 lb a.i./A)						
Ground spray						
Monocot	<0.1	<0.69	0.35	0.2	**1.38**	0.48
Dicot	0.11	0.8	0.11	**1.59**	**11.14**	0.47
Aerial spray						
Monocot	0.23	0.82	**1.73**	0.46	**1.64**	**2.42**
Dicot	0.27	0.95	0.55	**3.71**	**13.26**	**2.34**
General Bin Rate for Potassium Salt Uses (116 lb a.i./A)						
Ground spray						
Monocot	<0.1	0.39	0.2	0.11	0.78	0.27
Dicot	<0.1	0.45	<0.1	0.9	**6.3**	0.26
Aerial spray						
Monocot	0.13	0.47	0.98	0.26	0.93	**1.37**
Dicot	0.15	0.54	0.31	**2.10**	**7.50**	**1.32**
General Bin Rate for Potassium Salt Uses (63 lb a.i./A)						
Ground spray						
Monocot	<0.1	0.21	0.11	<0.1	0.42	0.15
Dicot	<0.1	0.25	<0.1	0.49	**3.42**	0.14
Aerial spray						
Monocot	<0.1	0.25	0.53	0.14	0.51	0.74
Dicot	<0.1	0.29	0.17	**1.14**	**4.08**	0.72
General Bin Rate for Potassium Salt Uses (10 lb a.i./A)						
Ground spray						
Monocot	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dicot	<0.1	<0.1	<0.1	<0.1	0.54	<0.1
Aerial spray						
Monocot	<0.1	<0.1	<0.1	<0.1	<0.1	0.12
Dicot	<0.1	<0.1	<0.1	0.18	0.65	0.11

[1] RQs for ground and aerial spray applications in this table were calculated using the maximum application rates for potassium (205 lb a.i./A) salt uses and the general "bins" rates created in the problem formulation.
[2] Non-listed potassium salt toxicity thresholds (EC_{25}) were 62.34, 53.9, 5.91, and 18.5 lb a.i./A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot.
[3] Listed potassium salt toxicity thresholds (NOAEC) were 31.17, 3.865, 4.239, and 4.38 lb a.i./A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot.
[4] Values in bold are LOC exceedances.

Table IV.9. Terrestrial Plant Risk Quotient Summary for Ammonium Salts [1, 2, 3, 4]

Scenario	Non-listed RQs			Listed RQs		
	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift
Maximum Labeled Rate for Ammonium Salt Uses (103.8 lb a.i./A)						
Ground spray						

Monocot	<0.1	<0.22	0.17	<0.1	0.22	0.69
Dicot	<0.1	<0.22	0.47	<0.1	0.22	0.94
Aerial spray						
Monocot	<0.1	<0.26	0.84	<0.1	0.26	**3.46**
Dicot	<0.1	<0.26	**2.36**	<0.1	0.26	**4.72**
General Bin Rate for Ammonium Salt Uses (63 lb a.i./A)						
Ground spray						
Monocot	<0.1	<0.13	0.1	<0.1	0.13	0.42
Dicot	<0.1	<0.13	0.29	<0.1	0.13	0.57
Aerial spray						
Monocot	<0.1	<0.16	0.51	<0.1	0.16	**2.10**
Dicot	<0.1	<0.16	**1.43**	<0.1	0.16	**2.86**
General Bin Rate for Ammonium Salt Uses (10 lb a.i./A)						
Ground spray						
Monocot	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dicot	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aerial spray						
Monocot	<0.1	<0.1	<0.1	<0.1	<0.1	0.33
Dicot	<0.1	<0.1	0.23	<0.1	<0.1	0.45

[1] RQs for ground and aerial spray applications in this table were calculated using the maximum application rates for ammonium (103.8 lb a.i./A) salt uses and the general "bins" rates created in the problem formulation.
[2] Non-listed ammonium salt toxicity thresholds (EC_{25}) were >100, >100, 6.2, and 2.2 lb a.i./A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot.
[3] Listed ammonium salt toxicity thresholds (NOAEC) were 100, 100, 1.5, and 1.1 lb a.i./A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot.
[4] Values in bold are LOC exceedances.

IV.2. Risk Description

The risk hypothesis states that the use of the potassium, ammonium, and sodium salts of fatty acids as an insecticide, acaricide, herbicide, algaecide and mammal repellant for terrestrial crop sites has the potential to adversely affect survival, reproduction, and/or growth of non-target aquatic and terrestrial animals and plants, including Federally-listed endangered and threatened species.

Based on the LOC exceedances from available ecotoxicity data and predicted environmental exposures of the registered uses of potassium salts, the exceedances are for potential acute effects to fish (freshwater only), aquatic-phase amphibians, invertebrates (both freshwater and estuarine/marine), and terrestrial and aquatic (nonvascular only) plants; and potential chronic effects to freshwater invertebrates starting mostly at the general 'bin' application rate of 63 lb a.i./A and higher with the exception for invertebrates that the exceedance starts at 10 lb a.i./A.

Results of the risk estimation indicate that registered uses of ammonium salts result in LOC exceedances for non-listed and listed terrestrial plants exposed to offsite spray drift via aerial sprays starting at the general 'bin' application rate of 63 lb a.i./A and higher.

For sodium salts in mesh bags, no LOC exceedances occurred.

LOCs were not exceeded for beneficial insects, estuarine/marine fish, and aquatic vascular plants exposed to potassium or ammonium salts.

The following sections discuss the potential risks of the soap salts to these taxonomic groups; however, because of the numerous uncertainties in this assessment, additional data is needed before EFED can make a definitive call on whether effects to the Federally-listed endangered and threatened species receptors are likely if exposed.

IV.2.1 Exposure to Aquatic Organisms

Due to the high variability in the application rates and the inability to categorize uses by application rates, GENEEC2, a tier I model was used to conservatively estimate surface water EECs as a result of broadcast applications of potassium and ammonium salts using maximum and general 'bin' application rates coupled with the representative solubility. Environmental fate data were limited and largely based on EpiSuite estimates. In addition, EECs from aerial applications are higher than ground applications due to the differences in the spray drift assumption (13% vs. 6.6%, respectively).

For sodium salts in mesh bags, it is unlikely aquatic organisms would not be exposed to biologically significant concentrations of sodium salts in the environment as a result of surface water runoff and offsite spray drift; thus, aquatic organisms are excluded as aquatic receptors in this assessment and the adverse affects to aquatic organisms are anticipated to be minimal.

IV.2.1.1 Risks to Aquatic Organisms

Potassium and Ammonium Salts of Fatty Acids
For freshwater fish exposed to potassium salts applied at and greater than the application rate of 63 lb a.i./A, the acute RQs of 0.1 – 0.35 were above the listed species LOC of 0.05 and the restricted use LOC of 0.1, with the highest RQ 7x above the listed species LOC. For both freshwater and estuarine/marine invertebrates, the exceedances start at 10 lb a.i./A with these acute RQs ranging 0.1 – 5.6 and the highest RQ for freshwater and estuarine/marine invertebrates 100x and 54x, respectively, above the listed species LOC. For ammonium salts, the exceedances (acute RQs 0.05-0.13 above LOC of 0.05) were seen only with freshwater organisms at and greater than 63 lb a.i./A, with the highest RQ 3x above the listed species LOC.

For estuarine/marine fish exposed to both salts, acute RQs were not derived in the Risk Estimation section of this assessment because no mortality to sheepshead minnows was observed at the maximum dose of 105 mg a.i./L and at the solubility limit of 4.4 mg a.i./L for ammonium and potassium salts formulations, respectively.

There were chronic LOC exceedances observed only with freshwater invertebrates exposed to potassium salts applied at and greater than 116 lb a.i./A, with the highest RQ 2x above the chronic risk LOC. In contrast to freshwater invertebrates, no chronic LOC exceedances for freshwater fish and estuarine/marine invertebrates based on the chronic toxicity values estimated from ACR calculations using trout, daphnid, and mysid data. Also, the chronic RQs were not derived for estuarine/marine fish using a non-definitive NOAEC that was calculated from the ACR method using minnow and daphnid data. A comparison of the non-definitive NOAEC at the solubility limit (>3.9 mg/L potassium salts; >105 ammonium salts) with the highest GENEEC 60-day EEC (0.32 mg/L) indicates the estuarine/marine fish NOAEC is 12x to 328x greater than the environmentally relevant concentrations. An uncertainty to this chronic risk assessment still exists because the chronic RQs were based on these ACR-estimated toxicity values in absence of data; yet, potassium and ammonium salts need to be 25x to 50x more toxic to freshwater fish, 12x to 328x more toxic to estuarine/marine fish, and 1.3x to 125x more toxic to estuarine/marine invertebrates, respectively, than the ACR-estimated toxicity values to exceed the chronic LOC from a single application. Because it is unlikely for soap salts to be more toxic than the ACR-estimated values to result in LOC exceedances, the submission of reproduction studies with aquatic organisms are not required to address the uncertainty.

To further characterize the potential for chronic risk, EFED evaluated the likelihood that chronic exposures will be higher than those derived assuming one application. Current labels are unclear on the number of applications allowed and do not appear to limit the maximum number of applications per year or define a recommended minimum interval between applications. Thus if repeated applications were to occur it is unclear what the impact will be on longer-term (chronic) average exposure concentrations. To test the impact, alternative modeling was conducted to analyze whether additional applications coupled with the shortest reapplication interval of 7 days could result in higher chronic exposure to aquatic organisms that may exceed the chronic LOC. **Table IV.10** presents the aquatic EECs calculations generated from GENEEC2 for multiple ground applications of soap salts using the same default assumptions previously used. Due to uncertainty whether the high application rate at 205 lb a.i./A is actually broadcast or spot treated the aerial applications were excluded from this evaluation. The modeling indicates the concentrations, regardless the number of applications, increased only by 3%; this suggests that higher long-term exposures to aquatic organisms from repeated applications are unlikely. Thus, it is not likely that chronic exposure with repeated applications would increase enough in the long term to affect aquatic organisms.

Table IV.10. Exposure Estimates (ppm) for Soap Salts modeled as Nonanoic Acid

Application Rate (lb a.i./A) and no. of applications	Peak	21-Day Avg	60-Day Avg
Ground Application			
205 x 1	2.9	0.79	0.28
205 x 3	3.0	0.84	0.3
205 x 10	3.0	0.84	0.3
205 x 25	3.0	0.84	0.3
205 x 50	3.0	0.84	0.3

There is uncertainty with the aquatic risk assessment for some uses particularly those with the highest application rates. From the labels for selected uses (e.g. residential lawn, golf course turf, ornamental lawn/turf, recreational area lawn, and industrial/commercial lawn), it is unclear if the applications are broadcast across the landscape or represent spot treatments. EFED has completed the aquatic risk assessment using an assumption that the high rates are broadcast (**Table IV.11**). In making this assumption, EFED believes that exposure estimates for aquatic resources are possibly overly conservative for those uses that may be spot treated because the underlying assumption in the aquatic models is that 100% of the field is treated with the pesticide. In order to better characterize the importance of this assumption on the overall risk conclusions EFED has provided an estimate of the threshold of spot treatment for each taxa where the LOC would no longer be exceeded. As an example EFED estimated that for the highest application rate (i.e. 205 lbs a.i./acre) for freshwater fish if a site were only spot treated at less than 16% of the entire field the LOC would not be exceeded and no effect would be likely for this use. If the % of actual area treated is higher than the estimated threshold, EFED believe that the potential for a direct effect to that taxa exists. However, EFED does not have information to allow for an estimate of what is a reasonable assumption of a maximum percentage of a field that may be spot treated that can be used to determine what % of area is a typical spot treatment. Also, the existing labels do not specify whether any of the registered uses can only be spot treated. Additional data are needed on how much % of an area a typical spot treatment is before EFED can make a definitive call on whether effects are likely from these uses. Until a determination for listed species can be made, the risks of soap salts to aquatic organisms from spot treatments at high application rates are uncertain. Only potassium salts was assessed in the example.

Table IV.11 Percentage of Exposure Needed to Exceed the LOC

Taxa	**Application rates (lb a.i./A)**	**RQs (highest to lowest)***	**LOC**	**Percentage of exposure needed to exceed LOC[1]**
Potassium Salts				
Freshwater fish (acute effects)	205	**0.3**	Acute = 0.05	16%
	116	**0.2**		25%
	63	**0.1**		50%
	10	0.02		No exceedance
Freshwater invertebrates (acute effects)	205	**5**		1%
	116	**3**		2%
	63	**2**		3%
	10	**0.3**		17%
	1	0.03		No exceedance
Estuarine/marine fish (acute effects)	None	No effects; RQ not calculated		No exceedance
Estuarine/marine invertebrates (acute effects)	205	**2**		3%
	116	**1**		5%
	63	**1**		5%
	10	**0.1**		50%
	1	0.01		No exceedance
Freshwater fish (chronic effects)	205	0.04	Chronic = 1.0	No exceedance
Estuarine/marine fish (chronic effects)	None	Non-definitive endpoint; RQ not calculated		No exceedance
Freshwater invertebrate (chronic effects)	205	**2**		50%
	116	**1**		100%
	63	0.5		No exceedance
Estuarine/marine invertebrates	205	0.8		No exceedance

(chronic effects)				
Aquatic vascular plants (non-listed and listed effects)	None	No 50% inhibition; RQ not calculated	Non-listed = 1.0 Listed = 1.0	No exceedance
		0.6		No exceedance
Aquatic nonvascular plants (non-listed and listed effects)	205	**5**		20%
	116	**3**		33%
	63	**2**		50%
	10	0.3		No exceedance
	205	**7**		14%
	116	**4**		25%
	63	**2**		50%
	10	0.4		No exceedance

*Bold values indicate LOC exceedance

[1] The threshold percentage is assessed to determine how much percent of exposure that RQ needs to exceed the LOC. For example, the highest acute RQ for freshwater invertebrates inhabiting a pond adjacent a field applied at 205 lb a.i./A is 5 which is 100 times higher than the listed species LOC of 0.05; to assess the % of exposure needed at which the LOC exceedance occurred, results indicate 1% is needed for the RQ to exceed the LOC. A "no effect" or "may affect" determination was not made since it is unknown what % of an actual area is typical spot treatment.

The Agency believes there is no direct effect to aquatic organisms, for fatty acid salts of chain length C14 and higher, because such fatty acids are not sufficiently soluble in environmental water for toxic effects to be expressed. For shorter chain-length fatty acids (C9 – C11) there is uncertainty, because the available toxicity data is not clear as to what chain-length mixtures were tested. However, acute toxicity data for nearly pure nonanoic (pelargonic) acid, which is representative of the shorter chain-length fatty acids, indicate that it does not reach levels of concern with a Tier I exposure assessment. Overall, the Agency is uncertain that soap salts as a group will cause direct effects to listed aquatic species.

RQs were not derived for aquatic vascular plants, in the Risk Estimation section of this assessment because none of the non-target vascular plants were inhibited 50% or more in the duckweed studies (i.e., >5.0 mg a.i./L). However, for Listed vascular plants, no LOC was exceeded. For algae and diatoms, the Non-listed and Listed plant LOC exceedances were triggered at and greater than 63 lb a.i./A. As discussed above and in **Table IV.11**, if a site were only spot treated at less than 14% of the entire field at the maximum 205 lb a.i./A rate, the LOC would not be exceeded and no effect to listed aquatic nonvascular plants would be likely for this use. Additional data are needed on how much % of an area a typical spot treatment at the high application rates is before EFED can make a definitive call on whether effects are likely from these uses.

There is some uncertainty to the LOC exceedances for non-target aquatic plants inhabiting a pond adjacent the treated site since characterization suggests that if treatment occurs to only a portion of the use site by spot treatment in many cases the percentage of the site treated would need to be significant to yield sufficient loading to an adjacent water body to produce a toxic concentration., EFED believes given the chemical nature of soap salts that it is unlikely for soap salts to maintain its activity beyond or farther than the targeted area in a runoff event when the pesticide moves with water to a farm pond. This is supported by laboratory studies that stability was a problem because the salts rapidly degrade; no salts were detected at the end of the 96-hours studies. In addition, the studies also observed the salts to be algistatic to algae/diatoms. This suggests its algicidal activity as a contact pesticide only exists at the time of application and would not be maintained beyond the targeted area. Overall, as indicated in **Table IV.11**, the Agency is uncertain whether soap salts as a group will cause a direct effects to Listed aquatic plants. Thus, an "uncertain" determination is made for listed aquatic plants.

IV.2.2. Exposure to Terrestrial Wildlife

In the conceptual model, dietary ingestion of potassium and ammonium salts residues on vegetative matter and insects on treated areas as depicted in **Figure 1** are predicted as the most likely sources of exposure to terrestrial animals. Spray drift, runoff and wind erosion of soil particles with resulting residues on upland and/or wetland foliage and soil are the most likely sources of potassium and ammonium salts exposure to non-target terrestrial plants, including Federally-listed endangered and threatened species. Risks to terrestrial species (i.e. birds, mammals and plants) exposed to potassium and ammonium salts are assessed based on modeled estimated environmental concentrations (EECs) and available toxicity data. Dose-based and dietary-based EECs for the ecological exposure to the acute and chronic toxicity values of potassium and ammonium salts are estimated using T-REX (**Tables III.4, III.5, and III.6**) and surface water runoff and spray drift EECs are estimated using TerrPlant (**Table III.7**).

Direct ingestion of sodium salts mesh bags on treated areas is predicted as the most likely source of exposure to wildlife because it is unlikely that significant concentrations of sodium salts would be found on vegetative matter and insects. However, the repellent is not meant to be ingested, but works by producing an odor. Thus, based on the use pattern (suspended mesh bags), the low use rate (one ounce per bag), and the mode of action (mammal repellency), meaningful exposure of wildlife to the sodium salts is not anticipated.

IV.2.2.1 Risks to Birds

Available avian acute toxicity data indicates that the salts are practically nontoxic to upland game birds and waterfowls on an acute basis via either or both oral and dietary routes. Acute RQs were not derived for birds in the Risk Estimation section of this assessment due to the non-definitive endpoints observed in the acute oral and dietary avian studies. There is some uncertainty to the T-REX EECs calculated that resulted in exceedances of the LOCs if the non-definitive endpoints were used as definitive endpoints. T-REX EECs are more suitable for predicting maximum residue levels for low-to-moderate use application rates no more than 10 lb a.i./A or less, not as high as 205 lb a.i./A that automatically trigger the exceedances at the maximum doses tested. Furthermore, numerous ecological studies observed no mortality or sub-lethal effects in birds at doses as high as 5,000 - 10,000 mg/kg diet, the potential for acute risk to birds from exposure to potassium and ammonium salts is expected to be low.

Chronic RQs were not calculated because sub-lethal effects data were not available. The Agency is not asking for toxicity data to evaluate the reproductive risks to birds due to the salts undergoing rapid degradation via metabolism in less than a day and the lack of effects at high rates in the acute avian studies.

In addition, fatty acids are a major component in wildlife's diet.[1] Fatty acids or animal fats are also consumed in humans.[2] In addition to human consumption, potassium salts is recognized by the FDA as a "Generally Recognized As Safe" (GRAS) food additive.[3] It is anticipated that significant exposure of birds to soap salt is unlikely; thus, a "no effect" determination is made for listed birds.

IV.2.2.2 Risks to Mammals

Acute and chronic RQs were not derived for mammals in the Risk Estimation section of this assessment because no mammalian toxicity data were available for the soap salts. Since HED did not select any endpoints for the human health assessment due to no systemic toxicity observed at high rates, EFED presumes the ecological effects to mammals are expected to be minimal. Thus, a "no effect" determination is made for listed mammals.

IV.2.2.3 Potential Effects to Terrestrial Invertebrates

The available terrestrial insect toxicity data, based on tests with honeybees, indicate that the formulation products containing soap salts are practically non-toxic to bees on an acute contact basis. The highest LD_{50} value for potassium and ammonium salts was >100 µg a.i./bee. Risk to beneficial insects in the direct treatment area exposed to soap salts is expected to be minimal

However, other terrestrial insects or invertebrates could be impacted since potassium salts are registered as an insecticide and acaricide. Ammonium and sodium salts are not registered for use as an insecticide. With no toxicity data available for insects, honey bees were used as a surrogate for insects. In making this assumption for terrestrial arthropods, the weight of a bee was used to convert µg a.i./bee to a µg a.i./g (ppm) concentration and then compare this toxic level to concentrations expected on terrestrial arthropods that are sprayed on directly. The maximum concentration expected on terrestrial arthropods after one application at the maximum application rate is 19,270 ppm (**Table III.4**). If the Agency's LOC for terrestrial arthropods is 0.05, this toxic level has to be at or greater than 385,400 ppm to not exceed the LOC. To convert bee endpoints to terrestrial arthropod endpoints, 96.04 µg a.i./bee (MRID 45060901) was selected for conversion as 20% bee mortality, the highest mortality of all data, occurred at this high dose. Assuming the average fresh weight of a bee is 0.128 g, the LD_{50} of bees can be multiplied by 7.8 (1 bee ÷ 0.128 g) to determine the arthropod endpoint in ppm. The resulting terrestrial arthropods endpoint is 749 µg a.i./g (ppm). With maximum exposure concentrations of the maximum application rates ranging 94 ppm - 19,270 ppm, the RQs of 0.13 - 26 exceeds the

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[1] http://npic.orst.edu/factsheets/psfagen.pdf
[2] http://www.heart.org/HEARTORG/GettingHealthy/FatsAndOils/Fats101/Polyunsaturated-Fats_UCM_301461_Article.jsp
[3] Food Additives Permitted for Direct addition to Food for Human Consumption. *Code of Federal Regulations,* Part 172.863, title 21, 1998.

terrestrial arthropod LOC of 0.05 at and greater than 1 lb a.i/A, with the highest RQ 520x above the LOC. Overall, there is still significant uncertainty with the use patterns both in terms of labeled use rates and proximity of use sites to listed species, as well as uncertainty with available toxicity data to state with confidence that there is a direct effect from soap salts to terrestrial invertebrates..

While the honeybee was relatively insensitive to insecticidal soap, it is reported potassium salts are relatively selective in toxicity based on the insect species and stage of development. Soft-bodied insects such as aphids, whiteflies, and mealy bugs are more susceptible to soaps. The least affected are flying adult insects with heavier cuticle, such as ladybird beetles; however, insects in the immature, flightless stage of development can be vulnerable to the effects of potassium salts.[4] Thus, not all terrestrial arthropods but those that are small and soft-bodied including hard-bodied ones during larval development would be sensitive when exposed directly to potassium salt applications.

Lastly, formulated as a contact insecticide, it is unlikely the adverse affect of the use patterns would be maintained beyond the target area since potassium salts are effective only against those insects that come into direct contact; however, an "uncertain" determination would be appropriate for listed terrestrial arthropods since it is uncertain whether listed arthropods inhabit the use sites at the time of treatment.

IV.2.2.4 Risk to Terrestrial Plants

The risk to non-target plants is uncertain because TERRPLANT does not account for the rapid degradation of soap salts before or during runoff. Based on the available data, monocots are less sensitive to soap salts than dicots, and generally vegetative vigor is a more sensitive life-stage than seedling emergence. The RQs for runoff to semi-aquatic areas result in the highest RQs. This scenario represents a 10 acre area running off into a one acre area. While the potassium salts RQs for listed dicots range up to 13 (aerial application at the maximum application rate of potassium salts at 205 lb a.i./A), the highest listed monocot RQ is 1.6 for the same application; however, non-listed dicots and monocots were not affected.

For ammonium salts, the highest RQ for the same scenario above is 0.26 (aerial application at the maximum application rate of 103.8 lb a.i./A ammonium salts), which is below the plant LOC of 1.0. Risk to non-target plants exposed as a result of receiving surface water runoff contaminated with ammonium salts is expected to be low.

Exposure to plants is based on the highest single application rate; multiple applications are not considered. The current assumption is that plants will be mainly affected by the first application. Although there is uncertainty in this assumption, there would also be uncertainty in trying to model multiple applications. Data the Agency receives for terrestrial plants is based on a single application, followed by a 14 to 21 day observation period. To estimate the effect of a second application would require a simplistic assumption of additive effect, when in fact the effect may be much more complex.

RQs also exceed the non-listed and listed LOC for exposure to drift alone for both potassium

[4] http://greenmethods.com/site/weblog/2009/05/understanding-insecticidal-soaps-and-detergents

(ground and aerial application) and ammonium salts (aerial application only), with the highest RQs no higher than 3 for potassium salts and 5 for ammonium salts. There is not currently a vetted way to refine the risk posed by runoff, but to some degree, the area of exposure is reduced with distance from the application site. The TerrPlant assumptions for runoff, that sheet flow will result in a one to one area of exposure and that channelized runoff will result in a ten to one ratio of areas exposed do not take distance from application into consideration and assumes equal deposition across the non-target area. These assumptions also consider only solubility, while other chemical attributes, such as K_{oc}, likely affect the amount of soap salts deposited on the non-target areas.

Risk from drift alone can be refined using AgDRIFT. AgDRIFT was used to determine the distance from the edge of field where the RQ falls below the LOC for each of the species (**Tables IV.12-IV.14**) for both aerial and ground application for the highest application rates (205 lbs a.i./A potassium salts and 103.8 lb a.i./A ammonium salts). Model defaults for each scenario were used.

Table IV.12 Distance (feet) from the edge of field where the Potassium Salts RQ falls below the risk to terrestrial plant LOC for vegetative vigor and seedling emergence endpoints for aerial application, based on AgDRIFT EECs for the aerial application at 205 lbs a.i./A.

Plant Species	Vegetative Vigor				Seedling Emergence			
	EC_{25}	NOAEC	Nonlisted (feet)	Listed (feet)	EC_{25}	NOAEC	Nonlisted (feet)	Listed (feet)
Corn	5.91	4.239	112	154	62.6	62.34	1	1
Oat	>68.08	68.08	1	1	>62.34	62.34	1	1
Onion	>68.08	68.08	1	1	>62.34	62.34	1	1
Ryegrass	>68.08	68.08	1	1	>62.34	31.17	1	1
Bean	20.72	8.104	13	82	>62.34	31.17	1	1
Cucumber	23.05	16.208	10	23	>62.34	62.34	1	1
Oilseed rape	18.50	4.38 (EC05)	20	151	>62.34	15.58	1	23
Radish	57.27	16.208	1	23	53.9	3.865	1	158
Soybean	30.55	16.208	3	23	>62.34	62.34	1	1
Tomato	21.73	16.208	13	23	>62.34	62.34	1	1

Table IV.13 Distance (feet) from the edge of field where the Potassium Salts RQ falls below the risk to terrestrial plant LOC for vegetative vigor and seedling emergence endpoints for ground application, based on AgDRIFT EECs for the ground application at 205 lbs a.i./A.

Plant Species	Vegetative Vigor				Seedling Emergence			
	EC_{25}	NOAEC	Nonlisted (feet)	Listed (feet)	EC_{25}	NOAEC	Nonlisted (feet)	Listed (feet)
Corn	5.91	4.239	1	7	62.6	62.34	1	1
Oat	>68.08	68.08	1	1	>62.34	62.34	1	1
Onion	>68.08	68.08	1	1	>62.34	62.34	1	1
Ryegrass	>68.08	68.08	1	1	>62.34	31.17	1	1
Bean	20.72	8.104	1	1	>62.34	31.17	1	1
Cucumber	23.05	16.208	1	1	>62.34	62.34	1	1
Oilseed rape	18.50	4.38 (EC05)	1	7	>62.34	15.58	1	1
Radish	57.27	16.208	1	1	53.9	3.865	1	7
Soybean	30.55	16.208	1	1	>62.34	62.34	1	1
Tomato	21.73	16.208	1	1	>62.34	62.34	1	1

Table IV.14. Distance (feet) from the edge of field where the Ammonium Salts RQ falls below the risk to terrestrial plant LOC for vegetative vigor and seedling emergence endpoints for aerial application, based on AgDRIFT EECs for the aerial application at 103.8 lbs a.i./A.								
Plant Species	**Vegetative Vigor***				**Seedling Emergence**			
	EC_{25}	**NOAEC**	**Nonlisted (feet)**	**Listed (feet)**	**EC_{25}**	**NOAEC**	**Nonlisted (feet)**	**Listed (feet)**
Corn	6.2	1.5	16	141	>100	100	1	1
Oat	9.8	6.3	95	94	>100	100	1	1
Onion	>6.3	6.3	1	1	>100	100	1	1
Ryegrass	>6.3	6.3	1	1	>100	100	1	1
Bean	27	6.3	16	144	>100	100	1	1
Cucumber	6.6	1.3 (EC05)	16	164	>100	100	1	1
Oilseed rape	2.9	1.5	72	141	>100	100	1	1
Radish	5.8	0.094	20	>997	>100	100	1	1
Soybean	4.4	1.5	203	623	>100	100	1	1
Tomato	2.2	1.1 (EC05)	10	49	>100	100	1	1

*Highest concentration for tomato was 6.3 lb a.i./A. For corn, oilseed rape, cucumber, onion, ryegrass, and radish, highest concentration was 22 lb a.i./A. For bean, oat, and soybean, highest concentration was 94 lb a.i./A.

For potassium and ammonium salts, vegetative vigor is a much more sensitive life stage than seedling emergence, thus greater impacts on this life stage should be expected to non-target plants as well. Aerial applications result in considerably more drift than ground sprays, and so impacts are expected farther from the field edge for aerial applications. Application rate is a key variable in determining the distance effective drift is expected to travel, so ground applications of potassium salts at 205 lbs a.i./A will have an impact at greater distance from the application area than ammonium salts at the 103.8 lbs a.i./A rate.

For non-listed species exposed to both potassium and ammonium salts, most are not expected to be at risk greater than 20 feet from the edge of the application area. The big exception is plants with similar sensitivity as corn, where effects on vegetative vigor exposed to potassium salts could be expected 112 feet from the field edge at the maximum application rate tested for potassium salts (68 lbs a.i./A) from aerial application. For non-listed species exposed to ammonium salts at a rate of 94 lb a.i./A, the aerial application could also induce effects at 203 feet or less for species with sensitivities similar to soybean.

The sensitivity of species in the submitted studies is not easily translated directly into specific sensitivity of listed plant species and the range of sensitivities needs to be broadly applied as potentially representative of the variations that may be found in natural population of listed plants. However, for the purposes of this risk assessment, it is assumed that all listed species are as sensitive as the most sensitive monocot or dicot species in the available data.

Given this assumption, aerial applications of the 68 lbs a.i./A potassium salts rate could affect the vegetative vigor of listed dicot plants 151 feet from the edge of the field and listed monocot plants out to 154 feet. The seedling emergence of dicots could be affected out to 158 feet, although the seedling emergence of monocots is not likely to be affected. Ground applications at this rate could affect the vegetative vigor of listed dicots and monocots out to 7 feet. The seedling emergence of listed dicots may be affected out to 7 feet, although listed monocots are unlikely to be affected.

For ammonium salts at 94 lbs a.i./A, applied via aerial spray, the vegetative vigor of listed monocots may be affected 141 feet from the edge of the field while dicots as sensitive as radish could be affected >997 feet from the edge. The seedling emergence of listed dicots and monocots are not likely to be affected.

An uncertainty exists on the application methods for some uses particularly those with the high application rates in that it is unclear if aerial applications are permitted in the labels. The terrestrial plant risk assessment indicates that soap salts is more toxic to plants when exposed to the foliage via spray drift than through the roots (using vegetative vigor data which is more sensitive as a surrogate for foliar sensitivity) as a result of surface water runoff. However, if it is assumed that no aerial applications are allowed per current labels and only ground applications are allowed then the distance for spray drift is reduced to 7 feet. This assumption reduces the risk to non-target plants adjacent to a treated site exposed to soap salts as a result of spray drift and runoff from ground applications. Also, model defaults including fine to medium droplet spectra were used to calculate the distances. If alternative assumptions are made with a coarser droplet spectra then that would further reduce risk from spray drift.

Similar to the aquatic risk assessment, the labels for selected uses at high application rates are unclear if the applications are broadcast across the landscape or represent spot treatments. EFED has completed the terrestrial plant risk assessment using an assumption that the high rates are broadcast (**Table IV.15**). As discussed above (**Table IV.11**) and in **Table IV.15 below**, if a site were only spot treated at less than 42% of the entire field at the maximum 205 lb a.i./A rate, the LOC would not be exceeded and no effect determination for listed terrestrial plants would be likely for this use. Additional data are needed on how much % of an area a typical spot treatment at the high application rates is before EFED can make a definitive call on whether effects are likely from these uses. Both potassium and ammonium salts were assessed.

Table IV.15 Percentage of Exposure from Spray Drift Needed to Exceed the LOC				
Taxa	**Application rates (lb a.i./A)**	**RQs (highest to lowest)***	**LOC**	**Percentage of exposure needed to exceed LOC[1]**
Potassium Salts				
Terrestrial plants (non-listed effects)	205	**1.7**	Non-listed = 1.0	59%
	116	0.98		No exceedance
	63	0.5		No exceedance
Terrestrial plants (listed effects)	205	**2.4**	Listed = 1.0	42%
	116	**1.4**		71%
	63	0.7		No exceedance
Ammonium Salts				
Terrestrial plants (non-listed effects)	205	**2.4**	Non-listed = 1.0	42%
	116	**1.4**		71%
	63	0.2		No exceedance
Terrestrial plants (listed effects)	205	**4.7**	Listed = 1.0	21%
	116	**2.9**		34%
	63	0.5		No exceedance

*Bold values indicate LOC exceedance

[1] The threshold percentage is assessed to determine how much percent of exposure that RQ needs to exceed the LOC. For example, the highest listed RQ for terrestrial plants inhabiting an area adjacent to a field applied at 205 lb a.i./A potassium salts is 2.4 which is 2.4 times higher than the listed species LOC of 1.0; to assess the % of exposure needed at which the LOC exceedance occurred, results indicate 42% is needed for the RQ to exceed the LOC. A "no effect" or "may affect" determination was not made since it is unknown what % of an actual area is typical spot treatment.

Overall, an "uncertain" determination is made for listed terrestrial plants from the registered uses of soap salts given the high degree of uncertainty associated with labeled uses.

V. Federally Threatened and Endangered (Listed) Species Concerns

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

To facilitate compliance with the requirements of the Endangered Species Act (subsection (a)(2)), the Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (USEPA, 2004). After the Agency's screening level risk assessment is conducted, if any of the Agency's listed species' LOCs are exceeded for either direct or indirect effects, an analysis is conducted to determine if any listed or candidate species may co-occur in the area of the proposed pesticide use or areas downstream or downwind that could be contaminated from drift or runoff/erosion. If listed or candidate species may be present in the proposed action area, further biological assessment is undertaken. The extent to which listed species may be at risk is considered, which then determines the need for the development of a more comprehensive consultation package, as required by the Endangered Species Act.

The federal action addressed herein is the registration review of potassium, ammonium, and sodium salts of fatty acids on agricultural use sites it is expected that its use could occur nationwide.

V.1. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the registered use and not merely the immediate area where the pesticide is applied. At the initial baseline, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that listed terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and listed aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area, which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. **Section III** of this risk assessment presents the registered pesticide use sites that are used to establish initial co-location of species with treatment areas.

V.2. Taxonomic Groups Potentially at Risk

If the assumptions associated with the baseline action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxon, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects on listed species that depend upon the taxonomic group for which the RQ was calculated. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites are considered to determine the extent to which screening assumptions regarding an action area applies to a particular listed organism. These subsequent refinement steps will consider how this information would impact the action area for a particular listed organism and potentially include areas of exposure that are downwind and downstream of the pesticide use site.

Assessment endpoints, exposure pathways, and the conceptual models addressing the registered uses, and the associated exposure and effects analyses conducted for the soap salts (e.g. potassium, ammonium, and sodium salts of fatty acids) screening-level ecological risk assessment are in **Sections II to III**. The assessment endpoints used in the ecological risk assessment include those defined operationally as reduced survival, growth and reproductive impairment for both aquatic and terrestrial animal species and survival and growth of aquatic and terrestrial plant species from both direct acute and chronic exposures. These assessment endpoints are intended to address the standard set forth in the Endangered Species Act requiring federal agencies to ensure that any action they authorize does not appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species. Risk estimates (RQs), integrating exposure and effects, are calculated for broad based taxonomic groups in the screening-level risk assessment presented in **Section IV.**

Both acute listed species and chronic risk LOCs are evaluated in the screening-level ecological risk assessment to identify direct and indirect effects to taxa of listed species. This section identifies direct effect concerns, by taxon, that are triggered by exceeding endangered LOCs in the risk assessment, with an evaluation of the potential probability of individual effects for exposures that may occur at the established listed species LOC. Data on exposure and effects collected under field and laboratory conditions are evaluated to make determinations on the predictive utility of the direct effect screening assessment findings to listed species. For soap salts (**Table V.1**-Potassium/Ammonium; and **Table V.2**-Sodium), the ecological risk assessment along with a number of uncertainties suggest that the potential probability of a direct effect to a certain taxon cannot be determined until the uncertainties are addressed.

<table>
<tr><th colspan="5">Table V.1. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Potassium and Ammonium Salts, Based on Best Available Data.</th></tr>
<tr><th>Listed Plant Taxon</th><th colspan="4">Potential Direct Effects</th></tr>
<tr><td>Terrestrial and semi-aquatic plants – monocots and dicots</td><td colspan="4" rowspan="2">Uncertain – LOC exceedances were observed for broadcast applications; uncertain if LOC exceedances exists for spot treatments at high application rates</td></tr>
<tr><td>Aquatic plants</td></tr>
<tr><th rowspan="2">Listed Animal Taxon</th><th colspan="4">Potential Direct Effects</th></tr>
<tr><th>Acute</th><th>Notes</th><th>Chronic</th><th>Notes</th></tr>
<tr><td>Terrestrial invertebrates</td><td>Uncertain</td><td>While soap salts are used as insecticides, bee toxicity data indicate low toxicity</td><td>N/A</td><td>No tools available to measure chronic effects</td></tr>
<tr><td>Mammals</td><td>No effect</td><td>No toxic effects at highest dose tested</td><td>No effect</td><td rowspan="4">Undergo rapid degradation in less than a day, unlikely for wildlife to consume 100% of diet in treated spots, and fatty acid is an important diet for wildlife, chronic effects are not likely</td></tr>
<tr><td>Birds</td><td>No effect</td><td>No toxic effects at highest dose tested</td><td>No effect</td></tr>
<tr><td>Reptiles</td><td>No effect</td><td rowspan="2">Based on birds as surrogate</td><td>No effect</td></tr>
<tr><td>Terrestrial-phase Amphibians</td><td>No effects</td><td>No effect</td></tr>
<tr><td>Freshwater fish</td><td>Uncertain</td><td>LOC exceedances</td><td>No effects</td><td>No LOC exceedances</td></tr>
</table>

Table V.1. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Potassium and Ammonium Salts, Based on Best Available Data.				
Listed Plant Taxon	**Potential Direct Effects**			
Aquatic-phase Amphibians		were observed for broadcast applications; uncertain if LOC exceedances exists for spot treatments at high application rates	No effects	
Freshwater invertebrates			Uncertain	LOC exceedances were observed for broadcast applications; uncertain if LOC exceedances exists for spot treatments at high application rates
Estuarine/marine fish			No effects	No LOC exceedances
Estuarine/marine invertebrates			No effects	

Table V.2. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Sodium Salts, Based on Best Available Data.				
Listed Plant Taxon	**Potential Direct Effects**			
Terrestrial and semi-aquatic plants – monocots and dicots	No Effect			
Aquatic plants	No Effect			
Listed Animal Taxon	**Potential Direct Effects**			
	Acute	**Notes**	**Chronic**	**Notes**
Terrestrial invertebrates	No Effect	The one active product registration is a low volume, minor use product intended for homeowner use only, typically hanging bags, which results in	N/A	The one active product registration is a low volume, minor use product intended for homeowner use only, typically hanging bags, which results in low potential for runoff and spray drift;
Mammals	No Effect		No Effect	
Birds	No Effect		No Effect	
Reptiles	No Effect		No Effect	
Amphibians	No Effect		No Effect	
Freshwater fish	No Effect		No Effects	
Freshwater invertebrates				
Estuarine/marine fish				

Table V.2. Preliminary Conclusions for Potential Direct Effects to Federally Listed Taxa Associated with the Registered Uses of Sodium Salts, Based on Best Available Data.

Listed Plant Taxon	Potential Direct Effects			
Estuarine/marine invertebrates		low potential for runoff and spray drift; significant concentrations are not expected to reach the receptors. This use pattern is not expected to result in meaningful exposure.		significant concentrations are not expected to reach the receptors. This use pattern is not expected to result in meaningful exposure.

V.2.1. Probit Dose-Response Analysis

The Agency uses the probit dose-response relationship as a tool for providing additional information on the potential for acute direct effects to aquatic and terrestrial animals (USEPA, 2004). As part of this evaluation, the acute RQ for listed species is presented in terms of the chance of an individual event (*i.e.*, mortality or immobilization) should exposure at the EEC actually occur for a species with sensitivity to potassium and/or ammonium salts on par with the acute toxicity endpoint selected for RQ calculation. To accomplish this interpretation, the Agency uses the slope of the dose-response relationship available from the toxicity study used to establish the acute toxicity measures of effect for each taxonomic group except plants that is relevant to this assessment. The individual effects probability associated with the acute RQ is based on the mean estimate of the slope and an assumption of a probit dose-response relationship. In addition to a single effects probability estimate based on the mean, upper and lower estimates of the effects probability are also provided to account for variance in the slope, if available. Based on the available acute toxicity for soap salts, a summary of the probit dose-response analysis is provided in **Table V.3**. If no dose response information is available to estimate a slope for this analysis, a default slope assumption of 4.5 (with lower and upper bounds of 2 to 9) (Urban and Cook, 1986) is used.

Individual effect probabilities are calculated based on an Excel spreadsheet tool IECV1.1 (Individual Effect Chance Model Version 1.1) developed by the U.S. EPA, OPP, Environmental Fate and Effects Division (June 22, 2004). The model allows for such calculations by entering the mean slope estimate (and the 95% confidence bounds of that estimate) as the slope parameter for the spreadsheet. The desired threshold for the probability of an individual effect is entered as the listed species LOC. In addition, the probability of an individual effect is also derived based on the highest calculated acute RQ following one application at 205 lb a.i./A for maximum exposure and at 63 lb a.i./A where most of the exceedances were triggered.

Table V.3. Summary of Soap Salt Probit Dose Response Analysis for Listed Species			
Taxa (study type)	**Acute Effect Slope (95% C.I.)**	**Chance of Individual Effect at Listed Species LOC (95% C.I.)**	**Chance of Individual Effect at Derived Acute RQ (95% C.I.)[1,2,3]**
Bird oral dose	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Bird dietary	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Mammal oral dose	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Freshwater fish	Mortality Slope = 3.9 (3 – 5)	1 in 5.13E+06 (1 in 2.1E+4 to 1 in 2.58E+10)	1 in 26.5 (1 in 11.7 to 1 in 88.4)[A] 1 in 5.22E+7 (1 in 741 to 1 in 3.49E+6)[B]
Estuarine/marine fish	No mortality observed	Not calculated; no mortality observed	Not calculated; no mortality observed
Freshwater Invertebrates	Immobilization Slope = 3.2 (2 – 4)	1 in 6.38E+04 (1 in 216 to 1 in 1.03E+7)	1 in 1 (1 in 1 to 1 in 1)[C] 1 in 1.4 (1 in 1.6 to 1 in 1.3)[D]
Estuarine/marine Invertebrates	Mortality Default Slope = 4.5 (2 – 9)	1 in 4.18E+08 (1 in 216 to 1 in 1.75E+31)	1 in 1 (1 in 1.2 to 1 in 1)[E] 1 in 3 (1 in 2.36 to 1 in 5.22)[F]

[1] Highest acute RQ for freshwater fish = [A] 0.35 (1 app. @ 205 lb a.i./A); [B] 0.1 (1 app. @ 63 lb a.i./A).
[2] Highest acute RQ for freshwater invertebrates = [C] 5.6 (1 app. @ 205 lb a.i./A); [D] 1.5 (1 app. @ 63 lb a.i./A).
[3] Highest acute RQ for estuarine/marine invertebrate = [E] 2.7 (1 app. @ 205 lb a.i./A); [F] 0.8 (1 app. @ 63 lb a.i./A).

As shown in **Table V.3**, the probability for acute direct effects (*i.e.*, mortality) to individual listed fish (based on the most sensitive species, rainbow trout) and the highest derived RQ value is 1 in 26.5 following one application at 205 lb a.i./A and is 1 in 52,200,000 following one application at 63 lb a.i./A. This reflects a slope of 3.9. The chance of an individual effect for freshwater and estuarine/marine invertebrates, based on the daphnid and mysid, respectively, are both 1 in 1.

V.2.2. Listed Species Occurrence Associated with Soap Salts Use

The goal of the co-location analysis is determine whether sites of pesticide use are geographically associated with known locations of listed species [following the convention of the Services, the word 'species' in this assessment may apply to a 'species', 'subspecies', or an Evolutionary Significant Unit (ESU)]. At the screening level, this analysis is accomplished using the LOCATES database (version 2.10.3). The database uses location information for listed species at the county level and compares it to agricultural census data (from 2002) for crop production at the same county level of resolution. The product is a listing of Federally-listed species that are located in counties known to produce the crops upon which the pesticide will be used. Additional data is needed on the potentially affected species associated with the registered uses of soap salts; thus, until the uncertainties have been addressed, this analysis has not been conducted for this assessment.

VI. References

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Urban, D.J. and N.J. Cook, 1986. Hazard Evaluation Division Standard Evaluation Procedure Ecological Risk Assessment. EPA 540/9-85-001. U.S. Environmental Protection Agency, Office of Pesticide Programs, Washington D.C.

VI.1. Submitted Studies

Guideline: OPPTS 850.2100 Avian Single Dose Oral Toxicity

<u>AMMONIUM</u>

No studies available

<u>POTASSIUM</u>

MRID: 44980310

W.M.M. Stadens-peek and Drs. M.A. Leopold. 1996. Acute Oral toxicity Study in Bobwhite Quail. Unpublished study performed by NOTOX,'s-Hertogenbosch, Netherlands. Laboratory Study No. 185052. Sponsored by Neudorff GmbH KG, Emmerthal, Germany. Study completed December 20, 1996.

MRID: 40066202

Hinken C. & Jaber, M. 1987. Aphid-Mite Attack Concentrate: An Acute Oral Toxicity Study with the Bobwhite. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 227-103A. Sponsored by Reuter Laboratories, Manassas Park, Virginia. Study completed January 16, 1987.

MRID: 40053301

Grimes, J. & Jaber, M. 1987. Aphid-Mite Attack Concentrate: An Acute Oral Toxicity Study with the Bobwhite. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 227-103. Sponsored by Reuter Laboratories, Manassas Park, Virginia. Study completed December 29, 1986.

MRID: 30861

Hunsaker, D. 1979. Acute Oral Toxicity Study of Safer's Insecticidal Soap on Mallard Ducks. Unpublished study performed by San Diego State University, San Diego, CA. Laboratory study no.: Not reported. Sponsored by Safer-Agro Chem Ltd, Victoria, British Columbia. Study completed May 24, 1979.

SODIUM

No studies available

Guideline: OPPTS 850.2300 Avian Dietary Toxicity

AMMONIUM

MRID: 46206301

Bien, E. 2003. Avian Dietary Toxicity Test of NEU 1170 H in the Japanese Quail. Unpublished study performed by Harlan Bioservice for Science GmbH, Walsrode, Germany. Laboratory Study No.: 10-16-0146-03. Sponsored by Neudorff GmbH KG, Emmerthal, Germany. Study completed October 30, 2003.

POTASSIUM

MRID: 00157472

Beavers, J.B. 1986. Safer Herbicide H_2: A Dietary LC50 Study with the Bobwhite. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 208-104. Sponsored by Safer Agro-Chem Ltd., British Columbia, Canada. Study completed January 31, 1986.

MRID: 00105040

Beavers, J.B. and R. Fink. 1981. Untitled. Final Report on the Toxicity of Safer's Insecticidal Soap #1 to Mallard Duck (*Anas platyrhynchos*). Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: WI-447A. Sponsored by Applied Biological Sciences Laboratory, Glendale, California. Study completed May 5, 1981.

MRID: 40385601

Johnson, M. & Jaber, M. 1987. Herbicide H_2: A Dietary LC50 Study with the Mallard. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 508-106. Sponsored by Safer Ltd., Victoria, British Columbia, Canada. Study completed August 7, 1987.

MRID: 44980311

Leopold, M.A. 1997. 5-day Dietary Toxicity Study in Bobwhite Quail. Unpublished study performed by NOTOX, 's-Hertogenbosch, Netherlands. Laboratory Study Number 185085. Sponsored by W. Neudorff GmbH KG, Emmerthal, Germany. Study completed February 28, 1997.

MRID: 44980312

Leopold, M.A. 1997. 5-day Dietary Toxicity Study in Mallard Duck. Unpublished study performed by NOTOX, 's-Hertogenbosch, Netherlands. Laboratory Study Number 185118. Sponsored by W. Neudorff GmbH KG, Emmerthal, Germany. Study completed March 3, 1997.

MRID: 00096640

Beavers, J.B. and R. Fink. 1981. Untitled. Final Report on the Toxicity of Safer's Insecticidal Soap #1 to Bobwhite Quail (*Colinus virginianus*). Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 157-107. Sponsored by Applied Biological Sciences Laboratory, Glendale, California. Study completed April 22, 1981.

MRID: 40066203

Grimes, J., Hinken, C., Jaber, M. 1987. Aphid-Mite Attack Concentrate: A Dietary LC50 Study with the Bobwhite. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 227-101B. Sponsored by Reuter Laboratories, Manassas Park, Virginia. Study completed January 23, 1987.

MRID: 40053302

Grimes, J. & Jaber, M. 1986. Aphid-Mite Attack Concentrate: A Dietary Toxicity Study with the Bobwhite. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 227-101A. Sponsored by Reuter Laboratories, Manassas Park, Virginia. Study completed December 12, 1986.

MRID: 40053303

Grimes, J. & Jaber, M. 1986. Aphid-Mite Attack Concentrate: A Dietary Toxicity Study with the Mallard. Unpublished study performed by Wildlife International, Ltd., Easton, Maryland. Laboratory Study No.: 227-102. Sponsored by Reuter Laboratories, Manassas Park, Virginia. Study completed November 7, 1986.

MRID: 30862
Condrashoff, S.F. 1979. Avian Dietary LC50 Toxicity of Safer's Insecticidal Soap on the Mallard Duck. Unpublished study performed by Professional Ecological Services, Victoria, British Columbia. Laboratory Study No.: Not reported. Sponsored by Safer Agro-Chem Ltd, Victoria, British Columbia. Study completed October, 1979.

MRID: 30863
Condrashoff, S.F. 1979. Avian Dietary LC50 Toxicity of Safer's Insecticidal Soap on the Bobwhite Quail. Unpublished study performed by Professional Ecological Services, Victoria, British Columbia. Laboratory Study No.: Not reported. Sponsored by Safer Agro-Chem Ltd, Victoria, British Columbia. Study completed November, 1979.

SODIUM
No study available

Guideline OPPTS 850.2300 Avian Reproduction

AMMONIUM
No study available

POTASSIUM
No study available

SODIUM
No study available

Guideline OPPTS 850.1075 Freshwater Fish Acute Toxicity

AMMONIUM
MRID: 42806405
Ward, T.J., P.L. Kowalski, and R.L. Boari. 1993. Acute Toxicity of Hinder to the Rainbow Trout, *Oncorhynchus mykiss.* Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, Massachusetts. Laboratory Study No.: 211-UN. Sponsored by Uniroyal Chemical Company, Inc., Bethany, Connecticut. Study completed on May 28, 1993.

POTASSIUM
MRID: 00096636
Berlin, C. 1981. Static Acute Toxicity – Fish Bioassay with Rainbow Trout. Unpublished study performed by Applied Biological Sciences Laboratory, Glendale, California. Laboratory Study Number 17382. Sponsored by Safer Agro, British Columbia, Canada. Study completed June 12, 1981.

MRID: 00090936
Janssen, R. 1979. Acute Toxicity Study of Safer's Insecticidal Soap on the Rainbow Trout (Salmo gairdneri). Unpublished study performed by E.V.S. Consultants Ltd, Victoria, British Columbia. Laboratory Study Number 791/79-23. Sponsored by Safer Agro-Chem Ltd., Richmond, British Columbia, Canada. Study completed April, 1979.

MRID: 44980314
Grunert, B. 1996. Acute Toxicity Study in Bluegill Sunfish. Unpublished study performed by NOTOX, 's-Hertogenbosch, Netherlands. Laboratory study number 185142. Sponsored by W. Neudorff GmbH KG, Emmerthal, Germany. Study completed August 1, 1996.

MRID: 44980313
Nedvidek, W. 1996. Acute Toxicity Study in Rainbow Trout with Neudosan Neu. Unpublished study performed by BioChem GmbH, Karlsruhe, Germany. Laboratory study no.: 96 50 41 213 A. Sponsored by W. Neudorff GmbH KG, Emmerthal, Germany. Study completed July 30, 1996.

MRID: 40053304
Obenchain, F. 1986. Salmo gairdneri– Acute Toxicity Tests on Aphid-Mite Attack. Unpublished study performed by EA Engineering, Science, and Technology, Inc., Sparks, Maryland. Laboratory study no.: 12-19-133. Sponsored by Reuter Laboratories, Inc., Manassas Park, Virginia. Study completed December 1986.

MRID: 40053304
Obenchain, F. 1986. Lepomis macrochirus – Acute Toxicity Tests on Aphid-Mite Attack. Unpublished study performed by EA Engineering, Science, and Technology, Inc., Sparks, Maryland. Laboratory study no.: 12-19-133. Sponsored by Reuter Laboratories, Inc., Manassas Park, Virginia. Study completed December 1986.

MRID: 909737
Reid, B. 1979. Acute Toxicity of Safer's Insecticidal Soap on Goldfish. Unpublished study performed by E.V.S. Consultants Ltd., North Vancouver, British Columbia. Laboratory study no.: 791. Sponsored by Safer Agro-Chem Ltd., Victoria, British Columbia. Study completed November, 1979.

SODIUM
No study available

Guideline OPPTS 850.1075 Estuarine/marine Fish Acute Toxicity

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AMMONIUM
MRID: 48402202
Fournier, A.E. 2011. H01 Concentrate Herbicidal Soap - Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegates*) Under Static-Renewal Conditions, Following OPPTS Draft Guideline 850.1075. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No: 13989.6106. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 15, 2011.

POTASSIUM
MRID: 48469802
Fournier, A.E. 2011. Neudorff's Insecticidal Soap Concentrate - Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegates*) Under Flow Through Conditions, Following OPPTS Draft Guideline 850.1075. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No: 13989.6115. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed April 26, 2011.

MRID: 48636502
Sayers, L.E. 2011. Safer Brand O-Insecticidal Soap Concentrate – Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegates*) Under Flow-Through Conditions, Following OPPTS Draft Guideline 850.1075. Laboratory Study No.: 13999.6107. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed October 4, 2011.

SODIUM
No study available

Guideline OPPTS 850.1010 Freshwater Invertebrate Acute Toxicity

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AMMONIUM
MRID: 42806406

Ward, T.J., Kowalski, P.L., and R.L. Boeri. 1993. Acute Toxicity of Hinder to the Daphnid, *Daphnia magna*. Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, Massachusetts. Laboratory study no: 210-UN. Sponsored by Uniroyal Chemical Company, Inc., Bethany Connecticut. Study completed May 28, 1993 and amended June 2, 1993.

MRID: 44760402
Kleiner, R. 1998. Acute Immobilization Test Daphnia – *Daphnia magna* according to OECD Guideline 202-1 (1984) NEU 1170 H (22%). Unpublished study performed by BioChem Agrar, Labor fur biologische und chemische Analytik, Cunnersdorf, Germany. Laboratory study no.: 98 10 78 039. Sponsored by Neudorff GmbH KG, Emmerthal, Germany. Study completed July 8, 1998 and amended September 24, 1998. Addendum No. 1 was completed September 22, 1998.

POTASSIUM

MRID: 44980315
Grunert, B. 1996. Acute Daphnia Immobilization Test with Neudosan Neu. Unpublished study performed by BIOCHEM, Karlsruhe, Germany. Laboratory study number 96 50 41 213 B. Sponsored by Neudorff GmbH KG, Emmerthal, Germany. Study completed August 1, 1996 and amended August 22, 1997.

MRID: 40053305
Harrison, E. 1986. Aphid-Mite Attack Concentrate 48-hour Static Acute Bioassay: Daphnid pulex. Unpublished study performed by James R. Reed and Associates, Inc., Newport News, Virginia. Laboratory study number 86-3368. Sponsored by Reuter Laboratories, Inc., Manassas Park, Virginia. Study completed November 15, 1986.

MRID: 30865 (96638)
Condrashoft, S.F.. 1979. Acute Toxicity LC50 of Safer's Insecticidal Soap on Daphnid pulex. Unpublished study performed by Professional Ecological Services, Victoria, British Columbia. Laboratory study number not reported. Sponsored by Safer's Agro-Chem Ltd., Victoria, British Columbia. Study completed July, 1979.

SODIUM

No study available

Guideline OPPTS 850.1025 Estuarine/Marine Mollusk Acute Toxicity (Shell Deposition)

AMMONIUM

No study available

POTASSIUM

No study available

SODIUM

No study available

Guideline OPPTS 850.1035 Estuarine/Marine Invertebrate Acute Toxicity

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AMMONIUM

MRID: 48402201
A. E. Fournier. 2011. H01 Concentrate Herbicidal Soap -Acute Toxicity to Mysid (*Americamysis bahia*) Under Static-Renewal Conditions, Following OPPTS Guideline 850.1035. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13989.6105. Study sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 15, 2011.

POTASSIUM

MRID: 48469801
A. E. Fournier. 2011. Neudorff's Insecticidal Soap Concentrate -Acute Toxicity to Mysid (*Americamysis bahia*)

Under Flow Through Conditions, Following OPPTS Guideline 850.1035. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13989.6114. Study sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed April 22, 2011.

MRID: 48608707

Sayers, L.E. 2011. Safer Brand O-Insecticidal Soap Concentrate -Acute Toxicity to Mysid (*Americamysis bahia*), Under Flow Through Conditions, Following OPPTS Guideline 850.1035. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13999.6106. Study sponsored by Smithers Viscient, Wareham, Massachusetts. Study completed September 20, 2011.

SODIUM

No study available

Guideline OPPTS 850.1300 Freshwater Aquatic Invertebrate Life Cycle

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AMMONIUM

MRID: 48402203

Fournier, A.E. 2011. H01 Concentrate Herbicidal Soap – Full Life-Cycle Toxicity Test with Water Fleas (*Daphnia magna)* Under Static-Renewal Conditioning, Following OPPTS Draft Guideline 850.1300. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.: 13989.6107. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 24, 2011.

POTASSIUM

MRID: 48668601

Fournier, A.E. 2011. Neudorff's Insecticidal Soap Concentrate – Full Life-Cycle Toxicity Test with Water Fleas (*Daphnia magna)* Under Flow-Through Conditions, Following OPPTS Draft Guideline 850.1300. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.: 13989.6116. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed November 23, 2011.

MRID: 48664201

Sayers, L.E. 2011. Safer Brand O-Insecticidal Soap Concentrate – Full Life-Cycle Toxicity Test with Water Fleas (*Daphnia magna)* Under Flow-Through Conditions, Following OPPTS Draft Guideline 850.1300. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.: 13999.6108. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed November 18, 2011.

SODIUM

No study available

Guideline OPPTS 850.1350 Estuarine/Marine Invertebrate Life Cycle

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AMMONIUM

No study available

POTASSIUM

No study available

SODIUM

No study available

Guideline OPPTS 850.1400 Freshwater and Estuarine/marine Fish Early-Life Stage

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AMMONIUM

No study available

POTASSIUM
No study available

SODIUM
No study available

Guideline OPPTS 850.3020 Honeybee Acute Contact Toxicity

AMMONIUM

MRID: 44766401

Nengel, S. 1998. Assessment of Side Effects of NEU 1170 H to the Honey Bee, *Apis mellifera* L. in the Laboratory Following EPPO Guideline No. 170. Unpublished study performed by Arbeitsgemeinschaft, GAB Biotechnologie GmbH & IFU Umweltanalytik GmbH, Niefern-Oschelbronn, Germany. Laboratory Study No.: 97253/01-BLEU. Sponsored by Neudorff GmbH KG, Emmerthal, Germany. Study completed June 22, 1998.

MRID: 42806407

Ward, T.J., Kowalski, P.L., and Boari, R.L. 1993. Acute Toxicity of Hinder to the Honey Bee, *Apis mellifera*. Unpublished study performed by T.R. Wilbury Laboratories, Inc., Marblehead, Massachusetts. Laboratory Study No.: 209-UN. Sponsored by Uniroyal Chemical Company, Inc., Bethany, Connecticut. Study completed May 28, 1993.

POTASSIUM

MRID: 42806001

Hoxter, K.A., Bernard, W.L., and Smith, G.J. 1993. Ringer/Safer 50% Insecticidal Soap Concentrate Technical grade: An Acute Contact toxicity Study with the Honey Bee. Unpublished study performed by Wildlife International Ltd., Easton, Maryland. Laboratory Study No.: 333-101D. Sponsored by Ringer Corporation, Eden Prairie, Minnesota. Study completed on May 12, 1993.

SODIUM
No study available

Guideline OPPTS 850.4100 Seedling Emergence

AMMONIUM

MRID: 48402204

Martin, J.A. 2011. H01 Concentrate Herbicidal Soap – Seedling Emergence Test Following U.S. EPA OPPTS Draft Guideline 850.4225. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study Number 13989.6101. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 18, 2011.

POTASSIUM

MRID: 48608704

Martin, J.A. 2011. Safer Brand O-Insecticidal Soap Concentrate – Seedling Emergence Test Following U.S. EPA OPPTS Draft Guidelines 850.4100 and 850.4225. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study Number 13999.6102. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 13, 2011.

MRID: 48402301

Martin, J.A. 2011. Neudorff's Insecticidal Soap Concentrate – Seedling Emergence Test Following U.S. EPA OPPTS Draft Guideline 850.4225. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study Number 13989.6110. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 18, 2011.

SODIUM
No study available

Guideline OPPTS 850.4150 Vegetative Vigor

AMMONIUM
MRID: 48402205
Martin, J.A. 2011. H01 Concentrate Herbicidal Soap – Vegetative Vigor Test Following U.S. EPA OPPTS Draft Guideline 850.4250 (Tier II). Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study Number 13989.6102. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 15, 2011.

POTASSIUM
MRID: 48608703
Martin, J.A. 2011. Safer Brand O-Insecticidal Soap Concentrate – Vegetative Vigor Test Following U.S. EPA OPPTS Draft Guideline 850.4250 (Tier II). Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13999.6103. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 14, 2011.

MRID: 48402302
Martin, J.A. 2011. Neudorff's Insecticidal Soap Concentrate – Vegetative Vigor Test Following U.S. EPA OPPTS Draft Guideline 850.4225 (Tier II). Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.: 13989.6111. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 15, 2011.

SODIUM
No studies available

Guideline OPPTS 850.4400 Aquatic Vascular Plant Toxicity

AMMONIUM
MRID: 48402206
Softcheck, K.A. 2011. H01 Concentrate Herbicidal Soap – 7-day toxicity Test with Duckweed (*Lemna gibba)* following OPPTS Draft Guideline 850.4400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.13989.6103. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed on February 17, 2011.

POTASSIUM
MRID: 48608702
Softcheck, K.A. 2011. Safer Brand O-Insecticidal Soap Concentrate – 7-day Toxicity Test with Duckweed (*Lemna gibba*) following OPPTS Draft Guideline 850.4400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13999.6104. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 16, 2011.

MRID: 48469803
Softcheck, K.A. 2011. Neudorff's Insecticidal Soap Concentrate – 7-day Toxicity Test with Duckweed (*Lemna gibba*) following OPPTS Draft Guideline 850.4400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13989.6112. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed April 15, 2011.

SODIUM
No study available

Guideline OPPTS 850.5400 Algal Plant Toxicity

<u>AMMONIUM</u>

MRID: 48402207

Softcheck, K.A. 2011. H01 Concentrate Herbicidal Soap – 96-hour Toxicity Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata*, Following OPPTS Draft Guideline 850.4400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13989.6104. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 22, 2011.

<u>POTASSIUM</u>

MRID: 48608701

Softcheck, K.A. 2011. Safer Brand O-Insecticidal Soap Concentrate – 96-hr Toxicity Test with the Freshwater Diatom, *Navicula pelliculosa.* Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Study No. 13999.6111. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 16, 2011.

MRID: 48636501

Softcheck, K.A. 2010. Safer Brand O-Insecticidal Soap Concentrate – 96-hr Toxicity Test with the Freshwater Blue-Green Alga, *Anabaena flos aquae*, Following OPPTS Draft Guideline 850.5400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13999.6110. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 30, 2011.

MRID: 48608706

Softcheck, K.A. 2010. Safer Brand O-Insecticidal Soap Concentrate – 96-hr Toxicity Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata*, Following OPPTS Draft Guideline 850.5400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13999.6105. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 15, 2011.

MRID: 48402303

Softcheck, K.A. 2010. Neudorff's Insecticidal Soap Concentrate – 96-hr Toxicity Test with the Freshwater Green Alga, *Pseudokirchneriella subcapitata*, Following OPPTS Draft Guideline 850.5400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No. 13989.6113. Sponsored by W. Neudorff GmbH KG, Great Falls, Virginia. Study completed February 24, 2011.

MRID: 48608705

Softcheck, K.A. 2011. Safer Brand O-Insecticidal Soap Concentrate – 96-hr Toxicity Test with the Marine Diatom, *Skeletonema costatum,* Following OPPTS Draft Guideline 850.5400. Unpublished study performed by Smithers Viscient, Wareham, Massachusetts. Laboratory Study No.: 13999.6109. Sponsored by Soap Salts Reregistration Task Force, Washington, DC. Study completed September 15, 2011.

<u>SODIUM</u>

No study available

Appendix A.   GENEEC2 Inputs and Outputs

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   RUN No.   1 FOR soap salts       ON   any          * INPUT VALUES *
   --------------------------------------------------------------------
    RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE NO-SPRAY INCORP
     ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
   --------------------------------------------------------------------
205.000(205.000)   1   1     100.0  100.0   AERL_B( 13.0)     .0    .0

   FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
   --------------------------------------------------------------------
      1.00        2          N/A       .00-     .00     2.00      2.00

   GENERIC EECs (IN MILLIGRAMS/LITER (PPM))     Version 2.0 Aug 1, 2001
   --------------------------------------------------------------------
       PEAK      MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
       GEEC      AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
   --------------------------------------------------------------------
       3.17        2.52           .89           .32           .21

   RUN No.   2 FOR soap salts       ON   any          * INPUT VALUES *
   --------------------------------------------------------------------
    RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE NO-SPRAY INCORP
     ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
   --------------------------------------------------------------------
116.000(116.000)   1   1     100.0  100.0   AERL_B( 13.0)     .0    .0

   FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
   --------------------------------------------------------------------
      1.00        2          N/A       .00-     .00     2.00      2.00

   GENERIC EECs (IN MILLIGRAMS/LITER (PPM))     Version 2.0 Aug 1, 2001
   --------------------------------------------------------------------
       PEAK      MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
       GEEC      AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
   --------------------------------------------------------------------
       1.79        1.43           .50           .18           .12

   RUN No.   3 FOR soap salts       ON   any          * INPUT VALUES *
   --------------------------------------------------------------------
    RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE NO-SPRAY INCORP
     ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
   --------------------------------------------------------------------
103.800(103.800)   1   1     100.0  100.0   AERL_B( 13.0)     .0    .0

   FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
   --------------------------------------------------------------------
```

1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
1.60	1.28	.45	.16	.11

RUN No. 4 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
63.000(63.000)	1	1	100.0	100.0	AERL_B(13.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
973.47	775.90	273.81	97.62	65.08

RUN No. 5 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
10.000(10.000)	1	1	100.0	100.0	AERL_B(13.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
154.52	123.16	43.46	15.49	10.33

RUN No. 6 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
1.000(1.000)	1	1	100.0	100.0	AERL_B(13.0)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
15.45	12.32	4.35	1.55	1.03

RUN No. 7 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
205.000(205.000)	1	1	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
2.85	2.24	.79	.28	.19

RUN No. 8 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
116.000(116.000)	1	1	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
1.61	1.27	.45	.16	.11

RUN No. 9 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC)	No.APPS &	SOIL	SOLUBIL	APPL TYPE	NO-SPRAY	INCORP

```
    ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
  ----------------------------------------------------------------------
103.800(103.800)   1   1     100.0  100.0   GRHIFI(  6.6)     .0    .0

  FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
  ----------------------------------------------------------------------
  METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
   (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
  ----------------------------------------------------------------------
     1.00        2          N/A       .00-     .00     2.00      2.00

  GENERIC EECs (IN MILLIGRAMS/LITER (PPM))     Version 2.0 Aug 1, 2001
  ----------------------------------------------------------------------
      PEAK      MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
      GEEC      AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
  ----------------------------------------------------------------------
       1.44        1.13           .40           .14           .09

  RUN No.  10 FOR soap salts       ON   any           * INPUT VALUES *
  ----------------------------------------------------------------------
   RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE NO-SPRAY INCORP
    ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
  ----------------------------------------------------------------------
 63.000( 63.000)   1   1     100.0  100.0   GRHIFI(  6.6)     .0    .0

  FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
  ----------------------------------------------------------------------
  METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
   (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
  ----------------------------------------------------------------------
     1.00        2          N/A       .00-     .00     2.00      2.00

  GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
  ----------------------------------------------------------------------
      PEAK      MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
      GEEC      AVG GEEC       AVG GEEC      AVG GEEC      AVG GEEC
  ----------------------------------------------------------------------
     876.40      687.46        241.76         86.18         57.46



  RUN No.  11 FOR soap salts       ON   any           * INPUT VALUES *
  ----------------------------------------------------------------------
   RATE (#/AC)   No.APPS &   SOIL  SOLUBIL   APPL TYPE NO-SPRAY INCORP
    ONE(MULT)    INTERVAL    Koc   (PPM )    (%DRIFT)   (FT)     (IN)
  ----------------------------------------------------------------------
 10.000( 10.000)   1   1     100.0  100.0   GRHIFI(  6.6)     .0    .0

  FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)
  ----------------------------------------------------------------------
  METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
   (FIELD)   RAIN/RUNOFF   (POND)     (POND-EFF)    (POND)     (POND)
  ----------------------------------------------------------------------
     1.00        2          N/A       .00-     .00     2.00      2.00

  GENERIC EECs (IN MICROGRAMS/LITER (PPB))     Version 2.0 Aug 1, 2001
  ----------------------------------------------------------------------
      PEAK      MAX 4 DAY     MAX 21 DAY    MAX 60 DAY    MAX 90 DAY
```

GEEC	AVG GEEC	AVG GEEC	AVG GEEC	AVG GEEC
139.11	109.12	38.37	13.68	9.12

RUN No. 12 FOR soap salts ON any * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
1.000(1.000)	1	1	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MICROGRAMS/LITER (PPB)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
13.91	10.91	3.84	1.37	.91

EECs after 3, 10, 25, and 50 applications at the maximum rate

RUN No. 3 FOR soap salts ON * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
205.000(206.614)	3	7	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)		METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00-	.00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
3.01	2.38	.84	.30	.20

RUN No. 10 FOR soap salts ON * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL		SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
205.000(206.614)	10	7	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00- .00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
3.02	2.39	.84	.30	.20

RUN No. 25 FOR soap salts ON * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
205.000(206.614)	25 7	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00- .00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
3.02	2.39	.84	.30	.20

RUN No. 50 FOR soap salts ON * INPUT VALUES *

RATE (#/AC) ONE(MULT)	No.APPS & INTERVAL	SOIL Koc	SOLUBIL (PPM)	APPL TYPE (%DRIFT)	NO-SPRAY (FT)	INCORP (IN)
205.000(206.614)	50 7	100.0	100.0	GRHIFI(6.6)	.0	.0

FIELD AND STANDARD POND HALFLIFE VALUES (DAYS)

METABOLIC (FIELD)	DAYS UNTIL RAIN/RUNOFF	HYDROLYSIS (POND)	PHOTOLYSIS (POND-EFF)	METABOLIC (POND)	COMBINED (POND)
1.00	2	N/A	.00- .00	2.00	2.00

GENERIC EECs (IN MILLIGRAMS/LITER (PPM)) Version 2.0 Aug 1, 2001

PEAK GEEC	MAX 4 DAY AVG GEEC	MAX 21 DAY AVG GEEC	MAX 60 DAY AVG GEEC	MAX 90 DAY AVG GEEC
3.02	2.39	.84	.30	.20

Appendix B. Incident Reports

EIIS Pesticide Summary Report: Species Information

Potassium salts of fatty acids (079021)

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
PLANTS					
Cherry					
I008521-001					
	cherry	Prunus sp.	6 acres	plant damage	Treated directly
I008521-002					
	cherry	Prunus sp.	all .5 acres	plant damage	Treated directly

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
PLANTS								
Cherry								
I008521-002	6/18/1998	YAKIMA	WA	3	RU	N/R	Broadcast	3.5 ACRES
I008521-001	3/9/1999	YAKIMA	WA	3	RU	N/R	Broadcast	6 ACRES