# ECONOMIC ANALYSIS OF FINAL AMENDMENTS TO 40 CFR PART 171: CERTIFICATION OF PESTICIDE APPLICATORS

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# Executive Summary

This document provides an analysis of the costs and the benefits of the final changes in the Certification of Pesticide Applicators rule to meet the requirements of Executive Order 12866 on Regulatory Planning and Review, the Regulatory Flexibility Act as amended by the Small Businesses Regulatory Enforcement Fairness Act, and the Unfunded Mandates Reform Act. The Certification of Pesticide Applicators rule establishes requirements for applicators of restricted use pesticides. Pesticides that EPA has classified as restricted use may pose unreasonable adverse effects to human health and/or the environment without strict adherence to precise and often complex labeling provisions. To ensure these labeling provisions are followed, EPA requires that restricted use pesticides be applied only by applicators who have demonstrated a sufficient level of competency or by individuals under their direct supervision.

EPA is finalizing changes to the rule that will enhance private applicator competency standards, exam and training security standards, standards for noncertified applicators working under the direct supervision of a certified applicator, tribal applicator certification, and state, tribal, territories, and federal agency certification plans. The final rule revises the existing regulation to add categories of certification for private and commercial applicators, predator control certification categories for private and commercial applicators and a recertification interval and criteria for recertification programs administered by certifying authorities (States, Tribes, territories, and federal agencies). The final rule sets a minimum age for certified applicators and noncertified applicators working under direct supervision.

The final rule has been modified from the proposed revisions as a result of information received during the public comment period on the proposal. The biggest change has been in the recertification requirements, which have been revised to allow certifying authorities much more flexibility to determine the standards for recertification of certified applicators. Also, the final rule allows an exemption to the minimum age requirement for noncertified applicators under the supervision of a certified private applicator who is an immediate family member. EPA proposed requiring separate categories for soil fumigation and non-soil fumigation, but the final rule allows certifying authorities to combine those categories, or to create separate categories. The final rule allows the certifying authorities to determine the standards for identity verification for training and exams, and clarified what materials were restricted in a certification exam by the proposed rule. The final rule gives the certifying authorities more flexibility than the proposed rule for determining competency for noncertified applicators working under the supervision of a certified applicator. The proposed rule would have required the label to be provided for noncertified applicators, and the final rule requires certified applicators to provide the noncertified applicators access to the label, but not to provide the label for each application.

*Costs*

The total annualized cost of the final rule is estimated to be $31.3 million. EPA's cost analysis is generally based on a conservative methodology that tends to overestimate the cost of the rule, as

explained in Chapter 3. However, because of uncertainties in the estimation, some costs estimated in this Economic Analysis may represent underestimates. EPA estimates that affected industries would face incremental costs of about $24.8 million annually from final revisions, including costs of $8.6 million to private applicators (about 27% of the total cost of final revisions) and $16.2 million to commercial applicators (about 52% of the total cost of final revisions). The up-front costs of revisions to state plans and certification programs, including development of new categories, and updating tracking databases, are estimated to be about $3.8 million; and ongoing administration of exams or trainings for the new certification and recertification requirements would cost an estimated $2.7 million annually. These two components together, annualized over a 10-year time horizon, would cost $6.5 million annually. Many of the firms in the affected sectors are small businesses, particularly in the agricultural sector. The average cost per private applicator, typically a farm owner or operator, is estimated to be $25 per year. The estimated average cost per commercial applicator would be about $46 per year. The impact to the average small farm is anticipated to be less than one percent of annual sales while the impacts to small commercial pest control services are expected to be around 0.1 percent of annual gross revenue. Therefore, EPA concludes that there would not be a significant impact on a substantial number of small entities. Given these modest increases in per-applicator costs, EPA also concludes that the final rule would not have a substantial effect on employment in the industries affected by the rule. Table 1 summarizes the results of the cost analysis.

**Table 1. Costs from Final Revisions to the Requirements for Certification of Pesticide Applicators**

| | Private Applicators | Commercial Applicators | Certifying Authorities |
|---|---|---|---|
| Number Impacted | 483,000 | 421,000 | 68 |
| Annualized Cost | $ 8.6 million | $16.2 million | $6.5 million |
| Annual Per-Applicator Costs | • Average: $25<br>• Range: $3 - $127, depending on current state requirements and the number of applicators in the state | • Average: $46<br>• Range: $6 - $234, depending on current state requirements and the number of applicators in the state | n/a |
| Small Business Impacts | No significant impact on a substantial number of small entities.<br>• The rule may affect over 800,000 small farms that use pesticides, although about half are unlikely to apply restricted use pesticides.<br>• Impact less than 1% of the annual revenues for the average small entity. | | |
| Impact on Jobs | The rule will have a negligible effect on jobs and employment.<br>• Most private and commercial applicators are self-employed.<br>• Average annual cost per applicator represents from 0.2 to 0.5 percent of the cost of a part-time employee. | | |

The rule changes finalized by EPA will improve the pesticide applicator certification and training program substantially. Trained and competent applicators are more likely to apply pesticide products without unreasonable adverse effects and use them properly to achieve the intended results than applicators who have not received training or been certified. In addition to core pesticide safety and practical use concepts, certification and training ensures that certified applicators possess critical information on a wide range of environmental issues such as endangered species, water quality, worker protection and protecting non-target organisms such as pollinators. Pesticide safety education helps applicators improve their abilities to avoid pesticide misuse, spills and harm to non-target organisms.

*Benefits*

The benefits of the final rule accrue primarily to certified applicators, and the noncertified applicators they supervise. Other beneficiaries include the public, who can be exposed to RUPs, and the environment, including plants and animals that are not the intended target of RUPs. For certified applicators, and the noncertified applicators they supervise, the final rule is expected to substantially reduce the potential for adverse health effects (both acute and chronic) from occupational exposures to pesticides.

It is difficult to quantify a specific level of risk and project the human health risk reduction that will result from this rule, because people are potentially exposed to such a wide variety of pesticides, and few of these incidents are reported. The final changes, however, are designed to reduce human and environmental exposure to RUPs. There is sufficient evidence in the peer-reviewed literature to suggest reducing such exposure would result in a benefit to public health through reduced acute and chronic illness.

<u>Benefits from Avoiding Acute Incidents</u>

EPA cannot provide quantitative estimates for all benefits of the rule, but we do estimate the benefit of reduced acute illness from exposure to RUPs. We estimate that this rule will result in quantifiable annual benefits of between $13.2 and $24.3 million dollars through reduced acute illnesses from RUPs. Over a ten-year horizon, the present value of these estimates is between $112.4 and $207.8 million with a 3% discount rate, and $92.5 and $171.0 million with a 7% discount rate (see Table 2). However, these estimates are biased downward by an unknown degree. Pesticide incidents, like many illnesses and accidents, are underreported because sufferers may not seek medical care, cases may not be correctly diagnosed, and correctly diagnosed cases may not be filed to the central reporting database. The effect of under-reporting can be significant. If only 20% of poisonings are reported (a plausible estimate based on the available literature regarding occupational injuries or chemical poisoning incidents and EPA analysis), the quantified estimated benefits of the rule would be between $65.9 and $121.7 million annually; if 50% of poisonings are reported, then the quantified benefit estimates of the rule would be between $26.3 and $48.7 million annually. Moreover, the approach here only measures avoided medical costs and lost wages, not the willingness to pay to avoid possible symptoms due to pesticide exposure, which could be substantially higher. The benefits shown in Table 2 are annual benefits after the rule is in force. Because there is a period of time before state plans are revised, there may be no benefits until after the first few years. If the stream of benefits begins in year three to match the implementation schedule from the cost estimates, the

annualized benefits based on the low estimated reported in Tables 4.4-11 are estimated to be about $10.2 million annually when using a 3% discount rate, and about $9.8 million annually when using a 7% discount rate. The high estimate, based on Table 4.4-12 yields annualized benefits of $18.9 million with a 3% discount rate and $18.1 million with a 7% discount rate. These estimates do not account for underreporting, however. Based on the estimates in Table 4.4-13 with 20% reporting, the annualized benefits based on the low estimate would be about $51.1 million with a 3% discount rate, and about $48.9 million with a 7% discount rate. The annualized high end estimate would be about $94.4 million with a discount rate of 3%, and $90.4 million with a 7% discount rate. Estimates based on reporting rates of 50% are lower, the low estimates would be $20.4 million and $19.6 million with 3% and 7% discount rates, respectively, and the high estimates would be $37.8 million and $36.2 million with 3% and 7% discount rates, respectively.

**Table 2. Acute Benefits from Final Revisions to the Requirements for Certification of Pesticide Applicators**

| *Category* | *Description* | *Comment* |
|---|---|---|
| Avoided acute pesticide incidents | • $13.2 – 24.3 million per year without adjustment | • Cost of illness and reduced productivity |
| | • $65.9 – 121.7 million per year after adjustment for underreporting of pesticide incidents: 20% reporting | • Accounts for underreporting |
| | • $26.3 – 48.7 million per year after adjustment for underreporting of pesticide incidents: 50% reporting | • Accounts for underreporting |
| Qualitative Benefits | • Willingness to pay to avoid acute effects of pesticide exposure beyond cost of treatment and loss of productivity<br>• Reduced latent effect of avoided acute pesticide exposure<br>• Reduced harm to wildlife and non-target crops | |

Misapplication and misuse of RUPs have resulted in a range of damages to human health, up to and including death. The final changes to the rule would result in an estimated reduction of 157 to 198 acute poisonings per year. Underreporting would affect this estimate. If only 20% of incidents were reported the estimated reduction in incidents would range from 783 to 990; if 50% were reported, the estimated reduction in incidents would range from 313 to 396.

Unquantified Benefits

In addition to the quantified benefits from reduced acute exposure, we expect there would be benefits for which quantifiable benefits cannot be estimated. These benefits would include reduced chronic illness to applicators from repeated RUP exposure and benefits to the public from better protections from RUP exposure when occupying treated buildings or outdoor spaces, consuming treated food products, and when near areas where RUPs have been applied. The environment would also be better protected from misapplication, which will reduce the impact on water and non-target plants and animals. There are a range of health effects associated with chronic, generalized pesticide exposure, and benefits would accrue to agricultural workers from reduced chronic health effects. Although there have been relatively few proven cause and effect associations between real world pesticide exposure and long-term health effects in human populations, there are many well-documented associations between pesticide exposure and chronic disease reported in observational studies and the scientific peer reviewed literature. The health effects potentially caused by occupational pesticide exposure can have dramatic effects on the health and welfare of those who suffer these diseases. These illnesses do not only affect those who become ill, but they also may require extensive caregiving by family members or others. Because of the uncertainties in the number of chronic illnesses that may be caused by, and therefore prevented by reduced pesticide exposure, it is impossible to derive quantified estimates of pesticide-specific benefits from illness reduction. Therefore, reductions in RUP exposure through changes to the certification rule may have substantial benefits that cannot be quantified at this time.

Overall, the weight of evidence suggests that the final requirements would result in long term health benefits to certified applicators, the noncertified applicators they supervise, and their families. These benefits arise from reducing their daily risk of pesticide exposures but also reduced risk of chronic illness, resulting in a lower cost of healthcare, a healthier society and better quality of life.

**Table 3. Chronic Benefits from Final Revisions to the Requirements for Certification of Pesticide Applicators**

| *Category* | *Description* | *Comment* |
|---|---|---|
| Qualitative benefits from reduced effects of chronic pesticide exposure to certified applicators, noncertified applicators working under the supervision of certified applicators, and their families | A range of illnesses are associated with chronic pesticide exposure, including<br>• Non-Hodgkins lymphoma<br>• Prostate Cancer<br>• Parkinson's Disease<br>• Lung Cancer<br>• Chronic Bronchitis<br>• Asthma | Although the value of presenting instances of these diseases is not estimated, these are very serious illnesses; prevention would have substantial value. |

*Changes since the Proposal*

Changes in the requirements and the analysis between the proposed and final rule resulted in changes to cost and benefit estimates. The cost analysis has been updated to reflect the current wage information and number of affected entities. The public comments received on the proposed rule also resulted in the revision to the industry costs and costs to certifying authorities in complying with the final rule changes. The reduction in estimated costs to the industry come from two sources. First, the estimated costs of age requirements decreased from $14 million to $7 million annually. This reduction is largely attributed to lower estimates of the number of adolescent noncertified applicators affected by the rule, primarily because of recent changes to the Worker Protection Standard which prohibit adolescents, other than immediate family members, from mixing, loading, and applying pesticides on a crop farm. This greatly reduced the number of adolescents impacted by the final Certification rule. Another source of cost reduction is the revision to the proposed recertification standards, with the estimated costs decreasing to $6 million from $20 million annually for the proposed rule. Also reflecting the public comments received on the proposed rule, the estimated costs to certifying authorities increased significantly. The largest increase is from the revision to the estimated costs of changing state laws and regulations in order to update certification plans to implement the final rule. Many commenters, including the Small Business Administration Office of Advocacy, noted that EPA did not adequately consider travel costs associated with complying with the revised rule. Revised travel costs to training and/or exam sites add significantly to the cost estimates of administering certification and recertification training and exams. The added costs of updating state tracking databases to implement the final rule changes also increased the state costs. These changes resulted in the estimated total cost of the final rule to be $31.3 million, down from $47.3 million for the proposed rule.

The analysis of acute benefits has been revised using more recent incident data, as well as additional information from pesticide incident surveillance programs. The quantified estimate of benefits from reduced acute RUP exposure is between $13.2 and $24.3 million dollars through reduced acute illnesses from RUPs. Underreporting would affect this estimate. The discussion of under-reporting in the analysis for the proposed rule used 20% reporting rate as a baseline for discussion of underreporting. If only 20% of incidents were reported the benefits are between $65.9 million and $121.7 million, assuming that only 20% of pesticide incidents are reported (see Section 4.5). This estimate is wider than the $80.4 million to $81.8 million for the proposed rule because we used additional data on pesticide poisoning incidents, which reduced the low end estimate of prevented deaths per year while increasing the high end estimate. At the same time, the inflation adjustment for the value of a statistical life caused it to be higher than in the Economic Analysis for the proposed rule. In this analysis for the final rule, we are also using 50% reporting rates as a point for discussion to show how the estimates change based on different assumptions of under-reporting rates. If 50% of poisonings are reported, then the quantified estimates of the rule would be between $26.3 and $48.7 million annually. Estimates with 50% reporting were provided in the analysis for the proposed rule, but not discussed in detail. The relationships between the estimates for the proposed and final rules are the same, regardless of the under-reporting rate chosen.

The final rule allows jurisdictions a longer period (three years) to revise their certification programs than was proposed (two years). The rule further allows states to delay implementing any changes for up to two years after EPA has approved the new programs. As a result, full

implementation could take three to seven years and vary considerably by state. However, for the purpose of estimating the costs of the final revisions, EPA retains a two-year implementation period as in the analysis for the proposed rule. Delaying the implementation has the apparent effect of reducing the cost to applicators due to discounting of costs borne in the future. However, this seeming reduction is misleading in terms of truly reflecting the impact on applicators and small firms. Estimating the impacts using a short implementation period better reflects the costs firms will bear, not the costs discounted in the future. Using a two-year implementation period results in a slight overestimation of jurisdictions' annualized implementation costs because EPA assumes that jurisdictions expend a given amount of resources to revise their certification programs and are likely to utilize the time period allowed by the final rule, which is at least three years.

# Chapter 1. Introduction

EPA is finalizing modifications to 40 CFR part 171 governing the certification of applicators of RUPs. Broadly speaking, the modifications are meant to ensure that RUPs are used in accordance with the label to protect the health and safety of applicators, workers, the general public, and the environment.

This document provides an analysis of the costs and the benefits of the final changes to the regulations governing the certification of pesticide applicators. This chapter provides a brief background to the certification requirements, describes the reasons for EPA's changes and the statutory authority for the rule, and identifies entities that may be affected by the rule. Chapter 2 explains the final changes to the Certification rule and discusses qualitatively the expected benefits of the different components of the regulations. Chapter 3 presents the cost estimates for the final revisions. It also estimates the impact of the final changes on employment and small business. Chapter 4 presents quantitative estimates of the benefits of the rule from reduced acute pesticide poisoning events. Also presented are qualitative assessments of the benefits to human health from reduced chronic exposure to RUPs as well as reduced environmental exposure. The benefits of the rule accrue primarily to certified applicators and noncertified applicators under the direct supervision of certified applicators, as well as their families, the public and the environment.

This report is intended to meet the requirements of Executive Order 12866 on Regulatory Planning and Review, the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act, and the Unfunded Mandates Reform Act. The remaining regulatory requirements are addressed in the Preamble for this rule. This document also serves as input in preparing any analysis required under the Paperwork Reduction Act (44 U.S.C. § 3501-21), which is summarized in Chapter 5. The analysis for the revisions to the Certification rule is based on the best and most appropriate data available and meets the Agency's quality guidelines.

## 1.1 Background

EPA's pesticide worker safety program includes two primary regulations, the Certification of Pesticide Applicators and the Worker Protection Standard. The Certification of Pesticide Applicators regulation, in 40 CFR Part 171, establishes national standards for the certification of applicators of RUPs and the requirements for submission and approval of state plans for the certification of applicators. Programs for the certification of applicators of RUPs are implemented by all 50 states, four territories (the District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, and the Trust Territory of the Pacific Islands), and four tribes in accordance with their state or tribal certification plans. Additionally, there are five federal agency certification programs for the Departments of Agriculture (with two programs), Defense, Energy and the Interior. All plans are approved by the EPA Administrator and are on file with the Agency. This Economic Analysis focuses on the revisions to the rules regarding the certification of pesticide applicators.

The Worker Protection Standard (WPS), in 40 CFR part 170, protects employees of agricultural establishments and commercial pesticide application establishments from exposure to pesticides on farms, forests, nurseries and greenhouses. Specifically, the WPS covers farm workers, who engage in hand labor activities in crop production and who may be exposed to pesticide residues in treated fields, and handlers, who mix, load, and apply both general use pesticides and RUPs. The revised Worker Protection Standard final rule was published in November 2015 (EPA, 2015a).

These two regulations, along with the other components of the Agency's pesticide worker safety program, are intended to reduce and prevent potential exposures to pesticides among pesticide applicators, employees, the general public, including vulnerable populations such as children, and to the environment.

The certification regulation or rule is a means to ensure the competency of people who apply RUPs. EPA classifies certain products as RUPs because of their toxicity characteristics and/or their potential to cause unreasonable adverse effects to human health or the environment without strict adherence to often complex label restrictions. The designation of products as RUP restricts their use to certified applicators or persons working under their direct supervision. The designation, however, is product specific; thus, some active ingredients may also be formulated in products that are not RUPs. Most of the designated products are applied in agricultural and industrial settings although some are used in urban, recreational, and residential areas by certified commercial applicators. Applicator certification enables the registration of pesticides that otherwise would not meet EPA safety standards under widespread and commonly recognized practice [FIFRA 3(c)5], allowing the use of RUPs for pest management in agricultural production, building and other structural pest management, turf and landscape management, forestry, public health, aquatic systems, food processing, stored grain, and other areas.

Changes to the certification regulation will largely impact certified applicators, both commercial applicators (who apply RUPs for hire) and private applicators. Certified private applicators apply RUPs for purposes of producing an agricultural commodity on property owned or rented by themselves or their employers or on the property of another without compensation (trading of personal services is permitted). Certain final revisions may also affect commercial agricultural services, including pesticide dealers, certifying agencies, such as states or tribes, and noncertified applicators working under the direct supervision of certified applicators.

## 1.2 Problem Statement

Pesticides, although useful to control pests, can present health risks to people and harm the environment. Pesticides that EPA has classified as restricted use may pose unreasonable adverse effects to human health or the environment without strict adherence to precise and often complex use directions and mitigation measures specified on the pesticide labeling. To ensure these measures are followed, EPA requires that these pesticides be applied only by applicators who are certified, or by applicators working under the direct supervision of a certified applicator.

Certification serves to ensure competency and, therefore, to protect the applicator, persons working under the direct supervision of the applicator, the general public, and the environment through proper use of RUPs.

Since the last major revision of the certification regulation in 1978, poisonings involving RUPs indicate that the requirements are not adequate. In one of the most significant cases from the mid-1990s, there was widespread misuse of the restricted use pesticide methyl parathion, an insecticide used primarily on cotton and other outdoor agricultural crops (Blondell and Spann, 1998). The improper use of methyl parathion by a number of applicators across several states led to the widespread contamination of hundreds of homes, significant pesticide exposures and human health effects for hundreds of homeowners and children, and a clean-up cost of millions of dollars (Karpf, 1997). These incidents resulted in one of the most significant and widespread pesticide exposure cases in EPA's history, and highlighted the potential problems that can result from the misuse of RUPs. In a 2010 Utah incident, an applicator using the RUP aluminum phosphide caused the death of 2 young girls and made the rest of the family ill[1]. In 2015, improper use of methyl bromide in the Virgin Islands caused serious injury and long-term hospitalization of four people[2]. Also in 2015, fumigation with sulfuryl fluoride that did not follow proper procedures caused serious injury to a young boy[3]. Finally, several severe health incidents have resulted from the public getting access to RUPs that have been put into different containers, e.g., transferred to a soda bottle or a sandwich bag, that do not have the necessary labeling (Fortenberry *et al*,, 2016). These incidents highlight the potential problems that can result from the misuse of RUPs.

Many states have taken significant steps to improve regulatory controls of RUPs and changed their enforcement authorities to address the problems identified by the incident. EPA's own certification standards, however, have not been substantially amended to address the evolving risk concerns. Because no major revision has been made to the federal regulation in almost 40 years, many state programs have taken the lead in revising and updating standards for certification and recertification. As a result, the state requirements for certification of applicators are highly varied, and most certifying authorities go beyond federal requirements for applicator certification. However, some certifying authorities support only the federal minimum for applicator certification. This has created an uneven regulatory landscape, so that people face different risks based on where they live, as well as problems in program consistency.

Two kinds of 'market' failure may give rise to improper use of RUPs and undesirable effects on humans and the environment: incomplete information and externalities. The former implies that full information about proper use and the consequences of pesticide use is not available to the people who need it. The latter implies that some of the consequences of pesticide use do not fall on the person making use decisions and that, therefore, RUPs may be used in a socially undesirable way.

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[1]See http://www.justice.gov/archive/usao/ut/news/2011/bugman%20plea.pdf and http://cfpub.epa.gov/compliance/criminal_prosecution/index.cfm?action=3&prosecution_summary_id=2249.

[2]See https://www.justice.gov/opa/pr/terminix-companies-agree-pay-10-million-applying-restricted-use-pesticide-residences-us.

[3]See https://www.justice.gov/usao-sdfl/pr/fumigation-company-and-two-individuals-pled-guilty-connection-illegal-pesticide)

Applicators may not have full information about the negative consequences of pesticides or the possible measures that can be taken to avoid such negative outcomes. This may be particularly true when the adverse effects are not readily observable, but occur due to chronic exposure. Symptoms of acute pesticide poisoning may be confused with general fatigue, heat stress, or other factors. Long-term or chronic effects of pesticide exposure do not manifest themselves immediately and applicators may not be fully aware the risks they face.

Another factor that contributes to pesticide exposure is that the party making the application decision may not incur the negative effects of an incorrect pesticide application. When someone other than an applicator or decision maker is potentially affected by the use of an RUP, a classic externality can result in a divergence between the social and private costs in the use of a pesticide. An externality of this type means that applications of RUPs may pose greater risk than is socially desirable. In this case, the greater than optimal risk would not typically be faced by an applicator deciding to apply, but could be faced by those they supervise, the general public, and the environment that can be affected by the RUP application. Although EPA addresses negative externalities from pesticide use when it makes registration decisions and label restrictions, pesticides designated as RUPs generally pose higher risks than ordinary pesticides. The result of improper use can be more severe, as well, in terms of acute and chronic illness and damage to terrestrial and aquatic ecosystems that are not the target of the application. The higher risk requires additional safeguards to ensure safe applications to protect both human health and the environment and these additional measures require a higher level of skill than is otherwise required of a pesticide applicator making applications of non-RUPs.

## 1.3 Overview of Final Regulation

Most of the changes EPA is finalizing are designed to improve the competence of certified applicators. The final revisions jointly address the issues of inadequate information and externalities. The revisions address the problem of inadequate information by defining new certification categories and subcategories that include training or testing on the hazards specific to some application methods. To make sure the information used by applicators to make application decisions is current and complete, EPA is finalizing more rigorous certification standards and recertification requirements. EPA is also establishing new requirements on the supervision of noncertified applicators working under the supervision of a certified applicator to make sure they have enough information to safely apply RUPs, and immediate access to support from a certified applicator when needed. New categories for fumigants and aerial applications will help ensure that important information about these specialized applications is up to date. EPA is also finalizing the establishment of a minimum age for certified applicators and those working under their supervision. Age restrictions are meant to protect adolescents, who may be more susceptible to pesticide effects. Adolescents may also be less able to judge the potential risks of exposure, especially the long-term effects, and take greater risks, which may result in excess exposure to themselves and others. More details on the final changes are available in Chapter 2, or in the preamble.

## 1.4 Affected Entities

The entities that will be affected by the final changes include commercial and private certified applicators, people who work under the direct supervision of certified applicators, and states and other entities that certify pesticide applicators. Manufacturers of pesticides and pesticide dealers of RUPs may also be affected.

Based on the Certification and Training Plan and Annual Reporting Database (CPARD, 2015), there are nearly one million pesticide applicators certified to apply RUPs. About 489,000 are private applicators, who apply RUPs for purposes of producing an agricultural commodity on property owned or rented by him/her or his/her employer, and about 414,000 are commercial pesticide applicators, who apply RUPs for hire.

States and other certifying authorities will be affected by the final changes. FIFRA requires that certifying authorities submit plans for the certification of commercial and private applicators of RUPs to EPA for approval. The final revisions will necessitate changes to state plans and jurisdictions will have to implement the required changes.

The affected entities are part of a wide range of industries. Because agriculture is a heavy user of pesticides, several subsectors under NAICS code 110000 (agriculture) are likely to be affected. These include oilseed, soybean and grain farming (NAICS 111100), nut, fruit and vegetable farming (NAICS 111210 and 111300) greenhouses and nurseries (NAICS 1111400), and other crops (NAICS 111900), which includes crops like cotton and tobacco. Animal production firms will also be affected, which includes cattle production (NAICS 112100), pig and hog production (NAICS 112200), poultry and egg production (NAICS 112300) and aquaculture (NAICS 112400). Other industries classified under agriculture include forestry pest control (NAICS 115000 and 113300), agricultural pest control for plants (NAICS 115100) and animals (NAICS 115200), demonstration and research pest control (NAICS 115100 and 611300), soil preparation planting and cultivating (NAICS 115112), and support activities for animal production (NAICS 115210).

Firms in the manufacturing and service sectors will also be affected by various provisions of the final changes. These include firms providing pest control services, such as exterminating and pest control services (NAICS 561710), industrial, institutional, structural and health related pest control (also NAICS 561710), and landscaping services and ornamental and turf pest control (both NAICS 561730). In addition, firms in many other industries may employ certified applicators, if they need to apply pesticides on a regular basis. Firms that sell RUPs to applicators will also be affected (NAICS 424910, farm supplies merchant wholesalers). Among the manufacturing sectors, industries that manufacture pesticides, like NAICS 325320 (pesticide and other agricultural chemical manufacturing), NAICS 3339900 (seed treatment), and NAICS 321114 (wood preservation) will be affected.

## 1.5 Changes from the Analysis of Final Revisions

EPA previously assessed the costs and benefits of the proposed revisions to the Certification rule (BEAD, 2015b). The analysis of the final revisions follows the same methodology; however,

there are other important changes. First and foremost, the final rule has been modified somewhat from the proposed revisions as a result of information received during the public comment period on the proposal. A complete discussion of these changes is provided in the preamble to the final rule.

The cost analysis has been updated to reflect current wage information that has become available since the time of the proposal. The number of affected entities, including both private and commercial applicators, private applicator establishments (farms) and commercial pesticide service firms, has been updated with more recent data. Finally, based on comments received on the proposal, a few of the scenarios, notably those pertaining to the age requirements and recertification requirements, were revised. Also, the comments received led to changes in the estimates of costs to certifying authorities in complying with the final rule changes.

The total cost of the final rule is estimated at $31.3 million annually. The industry cost (cost to private and commercial applicators) decreased from $46.9 million to $24.8 million, but the costs to governmental entities increased by $6 million. The overall cost of the final rule is 34% lower than the $47.3 million annual cost for the proposed rule.

There are two major sources for the reduction in the industry cost estimates for the proposed and final rules. First, the estimated cost of age requirements for private applicators decreased to $240,000 per year from the proposal cost of $1.3 million annually. The reduction in cost in comparison to the estimate for the proposal is primarily due to revised estimates regarding the number of adolescents impacted by the rule. The final Worker Protection Standard (WPS) rule, which became effective after the publication of the proposed revisions to the Certification rule, prohibits adolescents, other than immediate family members, from mixing, loading, and applying all pesticides on a crop farm. The WPS change, estimated to cost $2.4 million annually, greatly reduced the number of adolescents impacted by the final Certification rule, resulting in a large reduction in the total cost. Costs of age requirements for commercial applicators also decreased significantly from the proposal due to more recent estimates of the number of adolescent non-certified applicators, decreasing the cost from $13.0 million to $6.4 million.

Another major source of cost reduction is the revision to the proposed recertification standards (see Section 3.4.6 for details). However, revised travel costs to training and/or exam sites to obtain necessary credentials for certification and recertification added substantially to the industry costs. Overall, all of these revisions decreased the cost of the rule to the industry from $47 million for the proposal to $25 million for the final requirements.

Also reflecting the public comments received on the proposed rule changes, estimated costs to certifying authorities increased significantly. The largest increase comes from the revision to the costs of changing state laws and regulations to implement the final revisions. Revised travel costs to training and/or exam sites add significantly to the ongoing costs of administering certification and recertification trainings and exams. Costs of updating tracking database to implement the final rule changes are also included to the state costs.

The analysis of acute benefits has also been revised. The analysis is based on reported incidents of RUP poisonings, and more years of data are used compared to the Economic Analysis of the

proposed rule. The quantified estimate of benefits from reduced acute RUP exposure is between $13.2 and $24.3 million dollars through reduced acute illnesses from RUPs. If only 20% of incidents were reported, the estimated benefits are between $65.9 million and $121.7 million, (see Section 4.5). This estimate is wider than the $80.4 million to $81.8 million for the proposed rule because we used additional data, which reduced the low end estimate of prevented deaths per year while increasing the high end estimate. At the same time, the inflation adjustment for the value of a statistical life caused it to be higher than in the Economic Analysis for the proposed rule. We also excluded information from incidents involving paraquat and soil fumigants, because other EPA actions are specifically targeting pesticides with additional risk mitigation proposals. In this analysis for the final rule, we are also using 50% reporting rates as a point for discussion to show how the estimates change based on different assumptions of under-reporting rates. If 50% of poisonings are reported, then the quantified estimates of the rule would be between $26.3 and $48.7 million annually. Estimates with 50% reporting were provided in the analysis for the proposed rule, but not discussed in detail.

One important aspect of the analysis has not been changed: the timing over which changes to the certification program impact the affected entities. The final rule allows jurisdictions a longer period (three years) to revise their certification programs than was proposed (two years). The rule further allows states to delay implementing any changes for up to two years after EPA has approved the new programs. As a result, full implementation could take three to seven years and vary considerably by state. However, for the purpose of estimating the costs of the final revisions, EPA retains a two-year implementation period as in the analysis for the proposed rule, after which applicators are assumed to be in compliance with the new requirements. Delaying the implementation has the apparent effect of reducing the cost to applicators due to discounting of costs borne in the future. However, this seeming reduction is misleading in terms of truly reflecting the impact on applicators and small firms. Estimating the impacts using a short implementation period better reflects the costs firms will bear, not the costs discounted in the future. Using a two-year implementation period results in a slight overestimation of jurisdictions' annualized implementation costs because EPA assumes that jurisdictions expend a given amount of resources to revise their certification programs and are likely to utilize the time period allowed by the final rule, which is at least three years. Overall, the present value of the total cost of the rule is overestimated because some costs will occur later in time than is modeled.

# Chapter 2. Final Revisions to the Rules Governing Certified Pesticide Applicators

EPA is finalizing the standards for certification of applicators of RUPs. RUPs are typically higher toxicity pesticides that pose higher environmental or health risks than other pesticides. Only certified applicators or noncertified applicators working under the direct supervision of a certified applicator can legally apply RUPs. Applicator certification enables the registration of pesticides that would not otherwise meet EPA's safety standards, because such pesticides would, without specific and often complex use restrictions, cause unreasonable adverse effects on human health or the environment. Certified applicators must demonstrate a level of competency to ensure that an RUP can be used without causing these unreasonable adverse effects.

This chapter provides a summary of the final changes to the certification requirements and describes how they will increase pesticide safety by certified applicators and noncertified applicators working under their direct supervision; the preamble to the final rule presents additional details. Chapter 3 estimates the costs of the revisions and Chapter 4 discusses the benefits of the revisions and provides quantitative estimates of the benefits from reduce acute exposure to RUPs.

The final rule changes are designed to ensure the improved competence of certified applicators through imposing more rigorous certification standards, improving recertification standards, adding categories for certification for specific application types, and minimum age requirements. Under the final rule, noncertified applicators working under the direct supervision of certified applicators will be provided additional training and protections that should increase their competence and safety and the safety of those around them. In addition, there are administrative changes that are necessary to support the goals of the revised regulation, such as requirements to proctor certification exams and establish the identity of test-takers, recordkeeping, updates to state regulatory programs, and other tasks.

The next section of this chapter describes EPA's non-regulatory programs that have been established to improve safety in the use of RUPs. In Section 2.2, the individual line items that make up the regulatory changes are described, and differences between the proposed options and final rule are discussed. Please refer to the preamble for the final Certification of Pesticide Applicators Rule Revisions for a complete discussion of the changes and the rationale for the Agency's decisions.

## 2.1 Non-regulatory Approaches to Improve Pesticide Safety

In addition to the regulatory changes EPA is finalizing, the Agency has and continues to pursue non-regulatory approaches to improve the competency of persons certified to use RUPs and those noncertified applicators working under their direct supervision, thereby protecting the applicators, the public, and the environment from pesticide exposure. Since the mid-1990s, EPA has continually engaged stakeholders to evaluate the effectiveness of the rule and to determine

what improvements, if any, are necessary to maintain an effective program that ensure RUPs are used safely.

EPA partners with stakeholders to pursue ways to improve certification programs across the United States. The Certification and Training Assessment Group (CTAG), composed of representatives from state lead agencies, EPA, USDA, and cooperative extension services, was formed in 1996. The purpose of CTAG is to evaluate the current state of the certification programs across states, tribes, and federal agencies, and proposes improvements at both the state and federal level. In 1999, CTAG issued a comprehensive report, *Pesticide Safety in the 21st Century* (CTAG, 1999), which recommended improvements for state and federal pesticide applicator certification programs, including specific proposals on how to strengthen the certification regulation. EPA has worked with CTAG and other program stakeholders continually since issuance of the 1999 CTAG report to implement many of the non-regulatory measures identified in the report to improve the applicator certification program. EPA has undertaken several non-regulatory efforts such as supporting national workshops and professional development programs for state and tribal personnel involved in carrying out certification programs, supporting development of national training manuals and exams, and developing key guidance documents for certifying agencies. These non-regulatory activities are discussed in more detail below.

In addition to CTAG, EPA has met with groups including, state regulators, professional pesticide applicator organizations, pesticide manufacturers, farmers, and organizations representing commodity producers to discuss potential improvements to the rule. Through public meetings and federal advisory committees, and as individuals and small groups, a broad spectrum of stakeholders provided recommendations to EPA. Some of the recommendations were not related to the regulation, for example, developing national training materials for pesticide applicators, promoting better cooperation between trainers and state regulatory agencies, and re-evaluating the formula used by EPA to distribute funds to agencies certifying pesticide applicators. Other recommendations, such as strengthening the initial certification requirements, establishing a recertification period and standards, and improving protections for persons working under the direct supervision of a certified applicator, could only be accomplished by changing the regulation. From these inputs, EPA prepared a report (EPA, 2014c), the National Assessment of the Pesticide Worker Safety Program, in which EPA identified activities that it could take to improve applicator competency and to better protect human health and the environment from exposure to RUPs.

As noted above, EPA has undertaken several non-regulatory efforts to improve the program and applicator competency including a variety of outreach activities designed to strengthen state applicator certification and recertification programs. EPA works with stakeholders and under cooperative agreements to develop best practices and model programs for state regulatory and training organizations such as criteria for secure exam administration, standards for online recertification training programs, and how to audit applicator training programs for effectiveness.

EPA developed the *Interim National Program Guidance for EPA Regional Offices on EPA's Pesticide Applicator Certification Program* (EPA, 2006) to clarify provisions in the current rule. The guidance covers administrative requirements for written examinations, legal authorities for

certification plans, how modifications to certification plans are to be made and reviewed, requirements for state-tribal agreements for certification, and issues related to tribal certification plans and federal plans for certification of applicators in Indian Country. While this document does clarify EPA's interpretation of the regulation, it is solely guidance and does not carry the weight of regulation.

EPA also developed an online tool, the Certification Plan and Reporting Database (CPARD) (http://cpard.wsu.edu/), which allows states, tribes, and federal agencies to efficiently maintain their certification plans electronically. The CPARD system also provides an easy web-based reporting system to submit required annual program certification and recertification reports to EPA electronically, thereby reducing administrative burden and paperwork.

EPA has taken a number of other non-regulatory steps to improve coordination with stakeholders in the program, including meeting regularly with stakeholders to review progress on key projects, supporting a biennial national meeting of regulatory program managers and pesticide safety educators, meeting biannually with CTAG, and providing updates to the Pesticide Program Dialogue Committee[4] (PPDC) on pesticide applicator certification and training issues. The National Assessment process developed a network of interested and engaged stakeholders that has strengthened the program and produced new opportunities for collaboration.

In cooperation with stakeholders, EPA supported the development of a national core manual and exam for pesticide applicator certification (National Association of State Departments of Agriculture Research Foundation, 2012a). This core manual and exam cover the general competencies a commercial applicator must possess in order to use RUPs safely and to protect himself, the public, and the environment from exposure to RUPs. In addition, EPA has collaborated with certifying authorities, applicators, and industry to develop and make available national training materials and exams for aerial (National Association of State Departments of Agriculture Research Foundation, 2011a), rights-of-way ((National Association of State Departments of Agriculture Research Foundation, 2011b), and soil fumigation (National Association of State Departments of Agriculture Research Foundation, 2012a) pesticide applications. The regulatory changes that EPA is finalizing are designed to complement these activities to improve national consistency in pesticide applicator certification and to raise the level of RUP applicator competency to better protect the public and the environment. In many cases, the individual final revisions came out of the process of consulting with stakeholders and industry participants.

Despite this constant activity by EPA and industry stakeholders, the need for revised regulatory standards remains. Even with the support these non-regulatory activities provide, there continue to be serious incidents of misapplication of RUPs and other products by certified applicators, resulting in effects on human health and the environment[5]. Certain protective changes essential to reducing incidents and improving the safe use of RUPs, such as a minimum age for applicators, certification in specific use categories, and establishing training requirements for noncertified

[4] The PPDC is the Office of Pesticide Programs' Federal Advisory Committee. It provides a forum for a diverse group of stakeholders to provide feedback to the pesticide program on various pesticide regulatory, policy and program implementation issues. The PPDC meets two or three times per year.

[5] See for example the discussion in Section II.B.3 of the final rule or the incident data in Chapter 4 of this document.

applicators applying RUPs under the direct supervision of a certified applicator can only be brought about at a national level by regulation change.

## 2.2 Final Changes to the Certification Standards

In the final regulation, EPA is revising the requirements for:

- Private Applicator General Competency Standards (Section 2.2.1)
- Establish Additional Categories for Commercial and Private Applicators (Section 2.2.2)
- Establish Predator Control Categories for Commercial and Private Applicators to Correspond to Existing Label Requirements (Section 2.2.3)
- Security Standards for Certifying or Recertifying Commercial and Private Applicators (Section 2.2.4)
- Standards for Supervision of Noncertified Applicators, and Provisions for Commercial Applicator Recordkeeping of Noncertified Applicator Training (Section 2.2.5)
- Age Requirements for Private and Commercial Applicators (Section 2.2.6)
- Age Requirements for Noncertified Applicators Applying RUPs under the Direct Supervision of Commercial and Private Applicators (Section 2.2.7)
- Standards for Recertification of Private and Commercial Applicators (Section 2.2.8)
- General Administrative Requirements for RUP Dealers, States, Tribes, and Federal Agencies (Section 2.2.9).

These changes are designed to enhance the competency of applicators, to provide more practical options for establishing certification programs, and to improve the overall clarity and organization of the rule. These measures work together to help prevent unreasonable adverse effects to human health and the environment. For each of these areas, a summary table of the existing, proposed, and final requirements is presented. We discuss the intent of the requirements and provide a discussion of expected benefits.

### 2.2.1 Enhancement of Private Applicator General Competency Standards

*Initial Certification for Private Applicators*

The final changes to the standards for initial certification are designed to more clearly reflect the knowledge and skills needed by private applicators to apply RUPs safely. These changes are summarized in Table 2.2-1.

| Table 2.2-1. Current, Proposed, and Final Competency Standards for Initial Private Applicator Certification | | | |
|---|---|---|---|
| **Regulatory Element** | **Current Regulatory Status** | **Proposed Option** | **Final Requirement** |
| Private Applicators | | | |
| Initial certification | Exam and/or Training options on five topics; varies by state | Initial Certification through exam or training with additional topics | Initial Certification through exam or training with additional topics |
| Non-reader certification | Non-readers can receive product-specific certification | Eliminate non-reader provision | Eliminate non-reader provision |

The current regulation contains five topics for private applicators to be covered in training: 1) recognize common pests to be controlled and damage caused by them, 2) read and understand the label and labeling information, 3) apply pesticides in accordance with label instructions and warnings, 4) recognize local environmental situations that must be considered during application to avoid contamination, and 5) recognize poisoning symptoms and procedures to follow in case of a pesticide accident. In contrast, the core standards of competency for commercial certification have nine major areas of focus with more specific sub-points listed under each.

The final private applicator general competency standards will cover the following topics 1) label and labeling comprehension, 2) safety, 3) environment, 4) pests, 5) pesticides, 6) equipment, 7) application methods, 8) laws and regulations, 9) responsibilities for supervisors of noncertified applicators, 10) professionalism, and 11) agricultural pest control. These competency standards substantially parallel the core standards for commercial applicators. Private and commercial applicators have access to the same set of RUPs, and these requirements will ensure a similar level of competency between private and commercial applicators.

The final rule will clarify and expand the requirements for initial certification for private applicators. The current rule allows private applicators to be certified through a "written or oral testing procedure, or such other equivalent system as may be approved as part of a State plan." The final requirement will enhance the competency standards for private applicators by specifying minimum standards and require private applicators either to pass a written exam or to complete training that covers the private applicator general standards described in Unit VII.A of the preamble. These more rigorous standards will ensure sufficient understanding of all of the required competency standards, so that certified applicators will have the information they need in order to prevent unreasonable adverse effects to human health and the environment.

Another revision will eliminate certification for private applicators who cannot read. Currently, non-readers can receive certification as private applicators for specific products using oral exams designed for non-readers. The final requirement eliminates this option. This is important because critical information on pesticide safety and use restrictions is transmitted through written material, such as the pesticide label. A certified applicator unable to read is not able to understand this critical information, unless informed by a third party. Pesticide labeling changes frequently and non-readers may not be able to understand important changes to the labeling for

the product(s) they are certified to use, putting the applicators, the environment, and public health at risk.

### 2.2.2 Establish Additional Categories for Commercial and Private Applicators

For commercial applicators to be certified, the current rule requires them to pass at least two written exams – a core exam, which ensures general knowledge of pesticide safety, as well as an exam in at least one category of RUP use, such as agricultural pest control or ornamental and turf pest control. The existing rule does not establish categories of certification for private applicators. Pesticide application and agriculture both are becoming increasingly specialized, and improper application may lead to increased risks to the health of the applicator, workers, the environment, and the public. Certain categories of pesticides and methods of application, pose an inherently higher risk of acute injury or death if the applicator does not understand and follow the labeling and apply the pesticide properly. These increased risks can be mitigated by requiring applicators to demonstrate a specific set of competencies related to the type of pesticide and application method being used.

Some states have addressed these elevated risks related to applicators by requiring applicators to be certified in specialized categories related to specific application methods. In the final regulations, EPA will add three new federal categories of certification for commercial and private applicators specific to the method of application used: aerial, soil fumigation, and non-soil fumigation. These changes are discussed in more detail in Unit VIII.A of the preamble. The final categories are shown in Table 2.2-2.

**Table 2.2-2. Current, Proposed, and Final Requirements for Additional Certification Categories for Commercial and Private Applicators**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Commercial Applicators | | | |
| Certification Categories | 10 commercial applicator categories of certification* | Existing 10 categories and additional categories:<br>• Soil fumigation<br>• Non-soil fumigation<br>• Aerial | Existing 10 categories and additional categories:<br>• Soil fumigation, non-soil fumigation or a combined category<br>• Aerial |
| Private Applicators | | | |
| Certification Categories | No categories of certification for private applicators | New categories:<br>• Soil fumigation<br>• Non-soil fumigation<br>• Aerial | New categories:<br>• Soil fumigation, non-soil fumigation or a combined category<br>• Aerial |

*(1) Agricultural pest control (plant or animal), (2) Forest pest control, (3) Ornamental & turf pest control, (4) Seed treatment, (5) Aquatic pest control, (6) Right-of-Way pest control, (7) Industrial, institutional, structural and health related pest control, (8) Public health pest control, (9) Regulatory pest control, (10) Demonstration and research pest control

Soil fumigation uses a pesticide to control pests or plant pathogens in the soil using a pesticide that either is or becomes a gas. Non-soil fumigation uses similar pesticides, but for control of pests in other places, such as structural treatment to buildings or to stored commodities. EPA is finalizing categories for soil and non-soil fumigation, under which commercial applicators will be certified by passing a written exam administered by the certifying authorities. Private applicators will demonstrate competency in these categories by either passing a written exam (similar to that for commercial applicators) administered by the states or completing a training program developed and administered by the states. The final soil fumigation category will ensure that certification in the category met all existing soil fumigant labeling requirements for applicators to have specific training. In the proposed rule, EPA proposed two separate categories, one for soil fumigation and one for non-soil fumigation, because although both involve the use of fumigants, the methods of application are quite different. In the final rule, certifying authorities can create both soil and non-soil fumigation categories, either soil or non-soil, as needed by the certified applicators in the state, or one combined category for both soil and non-soil fumigation. This allows the certifying authorities more flexibility to establish categories that meet the needs of applicators, which may vary by geography, while still providing specialized knowledge specific to fumigant use, although a combined category may not be as closely targeted as individual categories.

Aerial application refers to applying pesticides by aircraft. In the final rule, EPA will add a category for aerial application, under which commercial applicators will be certified by passing a written exam administered by the certifying authorities. Private applicators will be certified by either passing a written exam (similar to that for commercial applicators) administered by the certifying authorities or completing a training program developed and administered by the certifying authorities. Aerial certification will ensure that applicators applying pesticides by aircraft are able to apply products safely and in a manner to manage drift and potential exposure to adjacent areas and bystanders. EPA has already developed a certification manual and exam for aerial application that covers the standards being finalized. These materials are available to certifying authorities.

### 2.2.3 Establish Predator Control Categories for Commercial and Private Applicators to Correspond to Existing Label Requirements

In addition to the additional categories, in the final rule, EPA has added specific categories for the use of the predacides compound 1080 (sodium fluoroacetate) and sodium cyanide dispensed through an M-44 device. The categories for both commercial and private applicators will cover the use of these two specific pesticides which target predators of livestock and are highly dangerous to humans and non-target species. States and federal agencies that allow the use of these products already have a certification program in place for applicators using the products. The pesticide labeling for each of these products imposes specific requirements for the certification of applicators by any state or federal agency that allows their use. Thus, this requirement simply codifies the existing labeling requirements. These changes are discussed in more detail in Unit VIII of the preamble.

## 2.2.4 Security Standards for Certifying or Recertifying Commercial and Private Applicators

Under the current federal requirements, persons seeking to become certified as commercial applicators must demonstrate their competence by passing a written exam. Persons seeking certification as private applicators may pass a written exam or by completing an equivalent program administered by the state. Recertification requirements for commercial and private applicators may include options for exams or training. The requirements of the current, proposed, and final regulations for holding the exam and conducting training are summarized in Table 2.2-3, and discussed in detail in Unit X of the preamble.

**Table 2.2-3. Current, Proposed, and Final Requirements for Administering Exams and Training Courses**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Private and Commercial Applicators | | | |
| Require candidates to present identification for exams and training, and proctor exams | Some certifying authorities require identification and others do not<br><br>Depending on the state, exams may be written, proctored, and closed book | • Identity verification required for exams and training<br>• Exams will be proctored and "closed book" | • Identity verification required for exams and training; certifying authorities determine standards for identification and any exemptions<br>• Exams will be proctored without any outside materials allowed |

The proposed rule would have required that candidates seeking certification or recertification as a private or commercial applicator, whether by training or exam, to provide proof of their identity. In the final regulation, EPA retains this requirement, but makes clear that the certifying authorities will determine what identification is acceptable, and any exemptions that they will allow. EPA will also codify EPA's existing guidance that exams must be written, proctored, and closed book. The final rule also codifies EPA's guidance that exams must be written, proctored, and closed book. The requirement for the closed book permits the use of reference materials in the exam, but only those materials provided by the proctor are allowed. No materials may be brought to the exam by persons seeking certification or recertification.

The value of setting federal standards for examination practices is that certifying authorities, employers, and the public could be confident that all certified applicators will have met a consistent standard. Confirming the identity of the test takers will ensure that applicants satisfy the minimum age requirements. It will also help prevent persons from taking a certification exam or training or attending a recertification training session in the place of the actual candidate, thereby limiting certification to the candidates who are qualified.

In addition to verifying the identity of test takers, in the final rule, the Agency will codify existing policy related to the security of the exam process. These standards include requiring that the exam be proctored to prevent cheating and requiring closed-book exams to ensure that no outside materials will be used in the exam. These changes will also ensure that only competent applicators become certified. The certifying authorities will have to ensure that these standards are met.

### 2.2.5 Standards for Supervision of Noncertified Applicators, and Provisions for Commercial Applicator Recordkeeping of Noncertified Applicator Training

Noncertified applicators using RUPs under the direct supervision of a certified applicator currently have minimal requirements for training or competency. In addition, noncertified applicators also have a high potential for exposure and, if RUPs are misapplied, they may pose a risk to the public health and the environment. To address these risks, the Agency is revising the training requirement of the noncertified person and clarification on the communication requirements when under the direct supervision of a certified applicator. These changes are summarized in Table 2.2-4, and discussed in more detail in Unit X of the preamble.

**Table 2.2-4. Current, Proposed, and Final Requirements to Ensure the Competency of Noncertified Applicators Under the Direct Supervision of a Certified Applicator**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Competence of noncertified applicators working under the direct supervision of a certified applicator | Noncertified applicators must receive basic information but no formal training on safe pesticide use and protecting themselves and their families from pesticide exposure | Competency could be demonstrated one of three ways:<br>• complete required training (repeat annually), which would include:<br>o Training on pesticide information, application techniques, and how to protect themselves, other people, and the environment before, during, and after making a pesticide application<br>o Training on protecting the family<br>• take Worker Protection Standard (WPS) training for pesticide handler (repeat annually)<br>• pass the commercial applicator core exam (every three years)<br><br>Training records for noncertified applicators under the direct supervision of commercial applicators must be retained for 2 years; no requirement for records for private applicators | Competency must be demonstrated in one of the following ways:<br>• complete required training (repeat annually), which will include:<br>o Training on pesticide information, application techniques, and how to protect themselves, other people, and the environment before, during, and after making a pesticide application<br>o Training on protecting the family<br>• take Worker Protection Standard (WPS) training for pesticide handler (repeat annually)<br>• certifying authorities can also require demonstration of knowledge through an equivalent program that EPA does not specify<br>• certification in a category not related to the application<br><br>Training records for noncertified applicators under the direct supervision of commercial applicators must be retained for 2 years; no requirement for records for private applicators |
| Guidance provided by supervising certified applicator to noncertified applicator | Supervising certified applicator must provide noncertified applicator guidance on correct application and how to contact certified supervisor | In addition to the current requirements, the supervising certified applicator would:<br>• Provide the pesticide labeling for each application<br>• Provide instructions related to each application<br>• Explain all labeling restrictions | In addition to the current requirements, the supervising certified applicator must:<br>• Provide access to the pesticide labeling for each application<br>• Provide instructions related to each application<br>• Explain all labeling restrictions |

| Table 2.2-4. Current, Proposed, and Final Requirements to Ensure the Competency of Noncertified Applicators Under the Direct Supervision of a Certified Applicator | | | |
|---|---|---|---|
| **Regulatory Element** | **Current Regulatory Status** | **Proposed Option** | **Final Requirement** |
| Communication between supervising certified applicator and noncertified applicator | Supervising certified applicator must explain how noncertified applicator can contact him/her if needed | Supervising certified applicator would ensure noncertified applicator has equipment available for immediate 2-way communication with supervisor | Supervising certified applicator will ensure noncertified applicator has equipment available for immediate 2-way communication with supervisor |

Existing regulations require that a noncertified applicator using RUPs under the direct supervision of a certified applicator must be competent, but the rule does not specify how to determine the competency of the noncertified applicator. Currently, the rule does not require any training or exam to gauge noncertified applicator competency or ensure an initial level of training/competency. The current rule also does not specify any interval for retraining or instruction for ensuring the ongoing competency of noncertified applicators.

*Competence of Noncertified Applicators Working Under the Direct Supervision of a Commercial Applicator*

The Agency is finalizing the ways that noncertified applicators working under the direct supervision of commercial applicators must demonstrate competence. First, the noncertified applicator may complete training specified in the final rule for noncertified applicators, which includes a range of information about the hazards of pesticides, what to do in the case of pesticide poisonings, safety requirements, proper application techniques, how to protect oneself and one's family from pesticide exposure, and other topics related to the safe use of RUPs. Second, they could complete the WPS handler training (specified under 40 CFR 170). These final training requirements must be repeated annually. Applicators who hold certification in a category not related to the application being made will meet the minimum requirements for training. Records of the noncertified applicator training must be maintained for 2 years, and be accessible for the supervising commercial applicator. Records are a key component of an effective enforcement program. These records can help ensure that noncertified applicators under the direct supervision of a certified commercial applicator have met the minimum training requirements. In addition to the options for demonstrating competence specified in the rule, the rule allows the certifying authorities to determine an alternative approach to require demonstration of knowledge through an equivalent program, which allows flexibility for the certifying authorities while protecting noncertified applicators working under the direct supervision of a commercial applicator.

*Competence of Noncertified Applicators Working Under the Direct Supervision of a Private Applicator*

The Agency is finalizing the options that noncertified applicators working under the direct supervision of private applicators must demonstrate competence. First, the noncertified applicator may complete training specified in the final rule for noncertified applicators, which will include a range of information about the hazards of pesticides, what to do in the case of pesticide poisonings, safety requirements, proper application techniques, how to protect oneself and one's family from pesticide exposure, and other topics related to the safe use of RUPs. Second, they can complete the WPS handler training (specified under 40 CFR 170). The final training requirements must be repeated annually. Applicators who hold certification in a category not related to the application being made will meet the minimum requirements for training. EPA cannot require private applicators to keep records due to constraints in FIFRA, so EPA is not requiring any recordkeeping by private applicators to verify that the noncertified applicators working under their direct supervision have qualified under the requirements of the final rule. In addition to the options for demonstrating competence specified in the rule, the rule allows the certifying authorities to determine an alternative approach for demonstration of knowledge through an equivalent program, which allows flexibility for the certifying authorities while protecting noncertified applicators working under the direct supervision of a private applicator.

*Guidance Given To Noncertified Applicators Working under the Direct Supervision of Commercial and Private Applicators*

In addition to the general requirement to demonstrate competence through training or examination, the Agency is finalizing the instructions that must be given to noncertified applicators working under the direct supervision of commercial and private applicators. Currently the supervising commercial or private applicator must provide guidance on the labeling requirements and application restrictions and information on how to contact the supervisor. The final revision will require that, in addition to the above, the supervising commercial or private applicator provide access to all applicable labeling to each noncertified applicator for each supervised application; provide specific instructions related to each application, including the site-specific precautions and how to use the equipment; and explain how to comply with all labeling restrictions. In a change from the proposed rule, the final rule allows noncertified applicators working under the supervision of a certified applicator to have access to the pesticide labelling, but does not require the certified applicator to provide a copy for each application.

*Communication between the Supervising Commercial or Private Applicator and the Noncertified Applicator*

EPA is replacing the current requirement for the supervising commercial or private applicator to provide noncertified applicators with directions on how to contact the supervisor (such as directions to a pay phone and a phone number). The final rule requires the supervising commercial or private applicator to ensure the noncertified applicator has the ability to communicate immediately with the supervising applicator. Immediate communication between the supervising commercial or private applicators and the noncertified applicators working under their direct supervision may be important if the noncertified applicator has questions about the pesticide application or encounters an emergency situation. This immediate communication standard could be satisfied by, for example, cell phones or two-way radios.

## 2.2.6 Age Requirements for Private and Commercial Applicators

A summary of the age restrictions considered by EPA is shown in Table 2.2-5. These changes are a result of the need to protect adolescents from RUP exposure and to ensure that RUPs are applied by competent adults. These changes are discussed in more detail in Unit XII of the preamble.

**Table 2.2-5. Current, Proposed, and Final Minimum Age Requirements for Certified Applicators**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Commercial Applicators | | | |
| Minimum Age for Commercial Applicators | None | Commercial applicators must be at least 18 years old | Commercial applicators must be at least 18 years old |
| Private Applicators | | | |
| Minimum Age for Private Applicators | None | Private applicators must be at least 18 years old | Private applicators must be at least 18 years old |

There is currently no minimum age for certified applicators, so it is possible for adolescents to handle some of the highest risk pesticides and to supervise noncertified applicators using RUPs. As explained in more detail in Chapter 4, studies have suggested that the adverse effects of pesticides may be greater on children and adolescents than for mature individuals because developing systems are more sensitive (EPA, 2002; EPA 2008b; Golub, 2000). Thus, there can be substantial benefits to the health of adolescents by precluding them from engaging in tasks with the highest potential levels of risk. Further, young adults may take more risks than older workers because they may be less capable of evaluating the consequences of their decisions (Young and Rischitelli, 2006). Thus, they may be less likely to follow directions and use PPE properly and in appropriate situations. In the case of handlers, adolescents may not follow all label restrictions because they do not fully comprehend the potential impacts to themselves,

others, and the environment. The heightened potential for immature decision making places the applicator and others at significant risk if RUPs are mishandled. In the final regulation, Agency is requiring a minimum age of 18 for a person to become certified as a commercial or private applicator. It should be noted that under the final regulation, currently certified applicators will be able to maintain their certification, but those who do not meet the minimum age will not be allowed to obtain a certification.

### 2.2.7 Age Requirements for Noncertified Applicators Applying RUPs under the Direct Supervision of Commercial and Private Applicators

To protect noncertified applicators working under the direct supervision of commercial and private applicators as well as to protect the health of others and the environment, EPA is revising the minimum age requirement for noncertified applicators. The current, proposed, and final regulations for age requirements for noncertified applicators under the direct supervision of commercial and private applicators are shown in Table 2.2-6.

**Table 2.2-6. Current, Proposed, and Final Minimum Age Requirements for Noncertified Applicators Working Under the Direct Supervision of Commercial and Private Applicators**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Noncertified Applicators Working under the Direct Supervision of Commercial Applicators | | | |
| Minimum age of noncertified applicators under the direct supervision of a commercial applicator | None | Noncertified applicators working under the direct supervision of commercial applicators must be at least 18 years old | Noncertified applicators working under the direct supervision of commercial applicators must be at least 18 years old |
| Noncertified Applicators Working under the Direct Supervision of Private Applicators | | | |
| Minimum age of noncertified applicators under the direct supervision of a private applicator | None | Noncertified applicators working under the direct supervision of private applicators must be at least 18 years old | Noncertified applicators working under the direct supervision of private applicators must be at least 18 years old<br><br>Exception for immediate family members over 16 |

In the final regulation, the minimum age for persons to apply RUPs under the direct supervision of private and commercial applicators is 18. In a change from the proposed rule, the final rule provides an exception for noncertified applicators working under the supervision of private applicators who are also immediate family members; these noncertified applicators must be at least 16 years old. Allowing noncertified applicators that are at least 16 make applications minimizes the impact on smaller farms which likely do not use a high number of RUPs, but

relies on immediate family members to ensure the safety of the noncertified applicators, and to ensure they apply RUPs in a safe manner.

## 2.2.8 Standards for Recertification of Private and Commercial Applicators

The current recertification standards only require certifying authorities to have "provisions to ensure that certified applicators continue to meet the requirements of changing technology and to assure a continuing level of competency and ability to apply pesticides safely and properly" as part of their state plans (40 CFR 171.8(a)(2)). Currently, the rule specifies no requirements for the timing, content, or manner to evaluate ongoing competency, undermining the integrity of the applicator certification program. The lack of a national standard has resulted in the development of varying state programs that do not uniformly ensure that applicators have maintained their competency in core functions and the changing technology of pesticide application. The final recertification requirements establish a maximum duration for certifications, set minimum standards for continuing education programs, and require states to verify that applicants successfully complete the program, including verifying the identification of candidates for recertification. The specific proposals are summarized in Table 2.2-7, with a more complete discussion available in Unit XIV of the preamble.

**Table 2.2-7. Current, Proposed, and Final Recertification Requirements**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Commercial Applicators | | | |
| Maximum time before recertification | None | Recertification required every 3 years<br>Requirements: exams for core and each category of certification OR 6 Continuing Education Units (CEUs) for core recertification and 6 CEUs for each category of certification | Maximum recertification interval is 5 years. Applicator must meet the recertification requirements of their certifying authorities' approved plan. |
| Private Applicators | | | |

| Table 2.2-7. Current, Proposed, and Final Recertification Requirements | | | |
|---|---|---|---|
| **Regulatory Element** | **Current Regulatory Status** | **Proposed Option** | **Final Requirement** |
| Maximum time before recertification | None | Recertification required every 3 years<br>Requirements: exams for general private applicator certification and each category of certification OR 6 CEUs for general private applicator recertification and 3 CEUs for each category of certification | Maximum recertification interval is 5 years. Applicator must meet the recertification requirements of their certifying authorities' approved plan. |

The final rule establishes a maximum recertification period of five years. In addition to the maximum time frame, the final rule allows recertification by either written examination or continuing education, and allows certifying authorities to determine many of the key features of their continuing education programs. Unlike the proposal, the final rule allows certifying authorities substantially more flexibility when they choose to allow recertification with a continuing education program. A continuing education program designed for applicator recertification must be approved by the certifying authority as being capable of ensuring continued competency. The certifying authority must comply with the following requirements of the continuing education program:

- Ensure that the quantity, content, and quality of the continuing education program is sufficient to ensure the applicator continues to demonstrate the level of competency required by the rule.
- The certifying authority must approve any continuing education course or event as suitable for its purpose in the certifying authority's recertification process.
- The certifying authority must ensure that any continuing education course or event, including an online or other distance education course or event, relied upon for recertification includes a process to verify the applicator's successful completion of the course or event.

The advantage of the option chosen for the final rule is that it provides much more flexibility for the certifying authorities in ensuring competency for certified applicators than the options considered in the proposed rule, while minimizing the implementation impact on certifying authorities and EPA. The final rule acknowledges that there are different ways to accomplish the goals of ensuring the continued competency of pesticide applicators, and flexibility for the state programs combined with oversight by EPA of state plans will allow low cost implementation of requirements for recertification of pesticide applicators. The more flexible approach in the final rule reduces the cost of compliance for the certifying authorities by recognizing the value of different approaches that the certifying authorities have developed.

## 2.2.9 General Administrative Requirements for RUP Dealers, States, Tribes, and Federal Agencies

There are several requirements in the final rule that are administrative in nature: new recordkeeping requirements for industry and requirements for certifying authorities to implement the changes in the rule. The final regulations require new recordkeeping requirements for dealers of RUPs, shown in Table 2.2-8. A more detailed discussion is available in Unit XV of the preamble.

**Table 2.2-8. Current, Proposed, and Final Recordkeeping Requirements for RUP Dealers**

| Regulatory Element | Current Regulatory Status | Proposed Option | Final Requirement |
|---|---|---|---|
| Dealer recordkeeping of RUP sales | Not required | Dealers would be required to keep records of RUP sales, including:<br>• product purchased<br>• who purchased<br>• date of purchase<br>• applicator's certification information | Dealers will be required to keep records of RUP sales, including:<br>• product name and EPA registration number of purchase<br>• quantity purchased<br>• date of purchase<br>• name and address of the certified applicator<br>• applicator's certification information |

Under the final rule, all dealers of RUPs to both private and commercial applicators will be required by the certifying authorities to keep records of RUP sales, including information on what RUP was purchased, the date of purchase, the identity of the purchaser, as well as information verifying the applicator's certification is appropriate to purchase the RUP. All 50 states currently have recordkeeping requirements, but the rule will clarify the required content of the records. These records must be retained for 2 years and made available for authorized officials for inspection and investigation in the case of incidents involving RUPs.

Implementation of the rule means that States, Tribes, Territories and Federal agencies will engage in several activities to comply with changes elsewhere in the rule. These will include the certifying authorities revising regulations and making any required enabling legislative changes that will be necessary to bring their certification programs into compliance with final requirements as a consequence of the rule changes. They will also include the process of updating their required certification plans that must be revised and submitted to the EPA as a consequence of the rule changes. The Federal agencies and EPA will need to revise their plans and programs as a consequence of the rule changes. EPA will also need to review and approve all of the revised certification plans that will be submitted to the Agency as a result of the final rule changes. More information on all of these administrative requirements that will be necessary can be found in the preamble to the final rule (Units XV, XVI, and XVII, respectively).

There are other administrative requirements that will be imposed by the final rule that will be required to implement the rule changes that will not be discussed in detail here. These include

definitional changes that will clarify terms used in the regulation, and revisions that will clarify requirements for the content, submission and approval of certification plans by states, tribes, and federal agencies. Information on these requirements can also be found in the preamble to the final rule (Units XIX, XV, and XVII, respectively).

# Chapter 3. Cost Assessment, Regulatory Options

This chapter presents EPA's estimates of the cost of changes to Certification of Pesticide Applicators rule (C&T) requirements in 40 CFR 171. We estimate the compliance cost of the final requirements and compare it to the cost of the current requirements. The difference between the two sets of costs is the incremental cost attributable to the individual requirement.

## 3.1 Overview

The final rule will impose costs on certified applicators, noncertified applicators working under the direct supervision of certified applicators, pesticide dealers, and pesticide manufacturers. Certifying authorities will also be impacted by individual requirements as they employ certified applicators and will be required to incorporate any new requirements into state law and carry out the certification and training requirements of the final rule.

The final revisions to the rule will require employers of certified applicators and individuals certified as applicators to devote time and resources to the certification and training of using RUPs, as well as time and resources to the training of noncertified applicators applying RUPs under their direct supervision. In analyzing the cost of these requirements, EPA values the average time spent in required activities at the wage rate of the individual(s) involved in the task because the requirements implicitly take time from the productive activities of the operation or individual. Some requirements will also require expenditures on travel and materials.

Section 3.2 describes the general methodology of cost estimation. Estimations are conducted at the level of the certifying authority, or jurisdiction, to account for variation in existing certification programs. In section 3.3, the jurisdiction-level data are presented. Section 3.4 presents the results of cost analysis. The section is further divided into subsections, in which costs of different components of the final rule are assessed: 3.4.1 private applicator general competency requirements; 3.4.2 addition of categories for commercial and private applicators; 3.4.3 exam or training requirements; 3.4.4 standard for the supervision of noncertified applicators; 3.4.5 minimum age requirements for certified applicators and noncertified applicators under the direct supervision of certified applicators; 3.4.6 recertification requirements for certified applicators; 3.4.7 general administration requirements. Section 3.5 sums the various costs to private and commercial applicators and to state/jurisdictions to estimate the total cost of final rule. In section 3.6, impacts on jobs and employment are discussed, and in section 3.7, small business impacts are assessed.

EPA's cost analysis is generally based on a conservative methodology that tends to overestimate the cost of the rule, as explained in this chapter. However, because of uncertainties in the estimation, some costs estimated in its Economic Analysis may represent underestimates. Actions attributed to this rule could also be provided by state programs in the absence of federal action. If more states – in addition to those that have already adopted requirements comparable to those in this rule – were to pursue improvements in certification standards on their own without the rule, then the benefits and costs attributed to this rulemaking may be overestimated.

However, as is standard practice for the evaluation of federal regulations, the Economic Analysis reflects the anticipated impacts of the federal requirements irrespective of whether individual states might adopt similar requirements on their own initiative. EPA received comments on several areas in the analysis where cost estimates may be underestimated, including combining several jurisdictions into one "Other" category, the cost of updating tracking databases, failure rates for exam takers, the time spent studying while in training programs that do not have exams, the cost of travel time, and the time spent by government employees preparing for training or examination sections. In some cases, EPA was provided with information from States about costs, for example the cost of updating and maintaining tracking databases, travel time, and the amount of time people study during training programs. The information from States was based on the requirements in the proposed rule, but was consistent with EPA estimates based on the requirements in the final rule. Further discussion of these costs is provide in Appendix A.

## 3.2 Methodology

This section of the cost analysis presents the methodology used to evaluate the expected impacts of the revised certification and training requirements at the actor level (typically a certified applicator, a noncertified applicator working under the direct supervision of a certified applicator, or a state government employee) and extrapolates to the jurisdiction (state, tribe, or territory) and national levels. Note that this unit of analysis is not equivalent to who bears the burden of the cost. In particular, a certified applicator may be an employer, an employee, or self-employed. A self-employed applicator bears the cost him or herself, while an employee may pass some or all costs on to the employer.

### 3.2.1 General Methodology

EPA's approach consists of six steps. The first two steps calculate the baseline cost and the associated cost per actor or 'unit costs' of each change in certification requirements. These costs are estimated by actor, where actors are typically certified applicators, either commercial or private, noncertified applicators working under the direct supervision of a certified applicator, and state governments, depending on who will be implicated by a requirement or aspect of a requirement. These costs are a function of the labor costs to conduct an activity and any required material costs. As noted above, costs are generally a function of the average time necessary to meet the requirement and the frequency at which it occurs. Baseline requirements differ across the jurisdictions implementing certification programs where the jurisdictions consist of states, territories, tribes, and federal agencies, including EPA.

The third step multiplies the unit costs by the number of actors in each jurisdiction and sums across the categories of actors to arrive at the jurisdiction-level cost of each requirement and the associated baseline regulatory costs. In step four, we calculate the present value of each cost stream, and then in step five, we determine the incremental cost of the regulatory changes by taking the difference between the costs for the final requirements and the baselines at the jurisdiction level. In step six, we then sum across jurisdictions to obtain an estimate of the national costs and determine the annualized value.

To better compare the impacts across the various requirements and the flow of expected benefits, in step 4, EPA calculates the present value (PV) of jurisdiction and national costs over a ten-year time horizon. The timing of the requirements depends on the activity that has to occur. For example, the implementation of requirements will require the certifying authorities to review, revise current regulations and implement the revised regulations. These costs will begin upon finalization of the rule. Requirements on the applicators, however, will not be imposed until the state has revised its regulations and/or materials are developed for new training requirements. The time horizon is of limited importance as most of the costs will occur annually. Ten years was chosen because OMB suggests it as a way of more easily comparing the impact of rules across federal agencies. We use a discount rate of three percent, to represent the social discount rate, and seven percent to represent the private discount rate as suggested by the EPA *Guidelines for Preparing Economic Analyses* (EPA, 2010a).

Reflecting the public comments received on the proposal, the final rule allows jurisdictions a longer period (three years) to revise their certification programs than was proposed (two years). The rule further allows states to delay implementing any changes for up to two years after EPA's approval of the new programs. As a result, full implementation could take three to seven years and vary considerably by state. For the purpose of estimating the costs of the final revisions, EPA uses a two-year implementation period because it better reflects the costs applicators and small firms will bear. Delaying the implementation has the apparent effect of reducing the industry cost because future costs are discounted. However, this seeming reduction is misleading in terms of truly reflecting the impact on applicators and small firms. Using a two-year implementation period results in an overestimation of jurisdictions' annual implementation costs as discussed in Section 3.4.7.2.

The rest of this section presents the methodology in greater detail, including an example of the methodology applied to the creation of a new application category for commercial applicators applying RUPs by air. Data that are commonly used throughout the estimation are discussed in Section 3.3. Data that are specific to individual requirements are included in the discussion of the specific requirement.

Step 1. Calculate Per-Actor Costs of the Jurisdiction Baselines. For the purposes of cost analysis, EPA individually estimates costs for the 50 states and Puerto Rico. The other certifying authorities are combined into a single group. They include the District of Columbia, American Samoa, Guam, the Northern Marianas, the Republic of Palau, the Virgin Islands, the Cheyenne River Sioux, the Oglala Sioux, the Shoshone Bannock, Three Affiliated Tribes, and four federal agencies: the Departments of Defense, Interior, Energy, and Agriculture (which has separate programs for the Animal and Plant Health Inspection Service and the Forest Service). In addition, EPA administers two tribal programs: the Indian Country and the Navajo Nation certification plans. Applicators for these tribes are granted certifications in the states where they work and are reported to CPARD by the states. Throughout the cost analysis, the above 17 certifying authorities are grouped together in the "Other" category for the purposes of estimating costs of the requirements of the final rule. These are small programs, in terms of the number of applicators they certify. The combined total number of certified applicators in this combined category is about 3,300, approximately the same number of certified applicators as West Virginia, the 9th lowest in the U.S. in the total number of certified applicators. Some of the jurisdictions, i.e., the Tribes, do not administer an entire certification program (develop and administer exams, conduct recertification sessions), rather they issue certifications based completely on a certification issued by a state, which is much less burdensome. It is not reasonable to assume that these jurisdictions will bear costs similar to states that operate much larger certification programs. Based on these considerations, EPA believes the grouping of the 17 certifying authorities as one jurisdiction for the purposes of estimating costs is a reasonable approach. This "jurisdiction" level approach is needed because different jurisdictions currently have different requirements (baselines) for certifying and recertifying their applicators. We calculate the associated jurisdiction baseline cost of the existing regulatory requirement for each actor in each jurisdiction:

$$cost_{r,i,\mathrm{a}}{}^{B}{}_{t} = \sum_{j} w_{\mathrm{a}} \cdot H_{r,i,\mathrm{a},j}{}^{B}{}_{t} \cdot \mathrm{Prob}_{t}(j \vee i)$$

where $cost_{r,i,\mathrm{a}}{}^{B}{}_{t}$ is the expected annual cost of the current requirement $r$, in jurisdiction $i$, for an actor, a, in time $t$; $H_{r,i,\mathrm{a},j}{}^{B}{}_{t}$ is the average time required for activity $j$ in time $t$ under the current requirement; $w_{\mathrm{a}}$ is the wage rate for the actor doing the activity; and $\mathrm{Prob}_{t}(j|i)$ is the probability or frequency of activity $j$ in time $t$ given the jurisdiction. The actor is generally the applicator, who is either obtaining or renewing certification and the activity may be preparing for an exam or taking a training. The probability or frequency is determined by the situation. All first-time applicators must obtain initial certification (Prob = 1), while recertification requirements may be spread over a period of time, *e.g.*, a three-year cycle implies that one-third of the applicators seek recertification every year and/or applicators take about one-third of required training every year (Prob = 0.333).

Step 2. Calculate Per-Actor Costs of Final Requirement. The expected cost of a final requirement is calculated as:

$$cost_{r,i,\mathrm{a}}{}^{P}{}_{t} = \sum_{j} w_{\mathrm{a}} \cdot H_{r,i,\mathrm{a},j}{}^{P}{}_{t} \cdot \mathrm{Prob}_{t}(j \vee i)$$

where variables are defined as above, with *P* denoting the revised final requirement. As mentioned, many jurisdictions have revised their certification programs and may exceed the final federal standards. Thus, $H^{B}_{r,j|i,a} \geq H^{P}_{r,j|a}$. Jurisdictions are not anticipated to relax standards if the revised federal requirement is less stringent, thus $H^{P}_{r,j|i,a} = H^{B}_{r,j|a}$ in those jurisdictions.

Step 3. Calculate Jurisdiction Costs of Final Requirement and Jurisdiction Baseline. To estimate total compliance costs for the final requirements and compliance costs for the current jurisdiction baseline, we multiply the per-actor unit costs by the number of affected actors of each type (e.g., first-time private applicators and existing private applicators) in the jurisdiction and sum across all types of affected actors:

$$RC_{r,i}{}^{B}{}_{t} = \sum_{a} cost_{r,i,a}{}^{B}{}_{t} \times N_{a,it}$$

$$RC_{r,i}{}^{P}{}_{t} = \sum_{a} cost_{r,a}{}^{P}{}_{t} \times N_{a,it}$$

where $RC_{r,i}{}^{X}$ denotes the cost of a requirement *r* to jurisdiction *i*, for *X* = *B* and *P*; and $N_{a,i}$ is the number of affected actors in a jurisdiction *i*.

Step 4. Calculate Present Values of Jurisdiction Level Costs. In this step, we calculate the present value (PV) for both $RC^{B}$ and $RC^{P}$. Generally, per-actor costs are constant, but implementation of the regulations will occur only after jurisdictions have revised their programs and developed any new training or examination materials. EPA considered whether the number of applicators is changing over time, but the data generally indicate little or no changes. See Section 3.3 below. The present value of costs is calculated as

$$PV\left(RC_{r,i}{}^{X}\right) = \sum_{t=1}^{10} \frac{RC_{r,i}{}^{X}{}_{t}}{(1+\rho)^{t-1}}$$

where $\rho$ is the discount rate and all other variables are as previously defined. We use a time horizon of ten years, but this is not particularly important as most of the per-actor costs, especially baseline costs, will occur annually. Given constant annual costs, the PV of jurisdiction costs for the baseline simplifies to

$$PV\left(RC_{r,i}{}^{B}\right) = RC_{r,i}{}^{B}{}_{t=1} \cdot \sum_{t=1}^{10} \frac{1}{(1+\rho)^{t-1}}$$

and, assuming a two-year implementation period, the PV of jurisdiction costs for the final requirements can be calculated as

$$PV\left(RC_{r,i}{}^{P}\right) = RC_{r,i}{}^{B}{}_{t=1} \cdot \sum_{t=1}^{2} \frac{1}{(1+\rho)^{t-1}} + RC_{r,i}{}^{P}{}_{t=1} \cdot \sum_{t=3}^{10} \frac{1}{(1+\rho)^{t-1}}$$

Step 5. Calculate Present Values of Jurisdiction Incremental Costs of Final Requirements. We estimate the PV of incremental cost of the final requirement to each jurisdiction by subtracting

the PV of the jurisdiction baseline cost from the PV of the jurisdiction cost of the final requirement:

$$PV\left(RIC_{r,i}\right)=PV\left(RC_{r,i}{}^{P}\right)-PV\left(RC_{r,i}{}^{B}\right)$$

where $PV(RIC_{r,i})$ is the present value of the stream of incremental cost of the final requirement over the jurisdiction baseline in jurisdiction *i*.

Step 6. Calculate National Costs of the Final Requirements, Baseline, and Incremental Costs and Annualize. We sum the present values of jurisdiction level costs from Step 5 to obtain the present values of national costs for each final requirement ($NC^{P}_{r}$), the baseline requirement ($NC^{B}_{r}$), and the national incremental cost ($NIC_r$) where

$$PV\left(NC_r{}^{X}\right)=\sum_i PV\left(RC_{r,i}{}^{X}\right)$$

and

$$PV\left(NIC_r\right)=PV\left(NC_r{}^{P}\right)-PV\left(NC_r{}^{B}\right)$$

Finally, the PV of national costs are annualized over 10 years at the appropriate discount rate. This annualized cost is the estimated per year cost of the requirement.

$$AIC_r=PV\left(NIC_r\right)\times\frac{\rho\cdot(1+\rho)^{10}}{(1+\rho)^{10}-1}$$

### 3.2.2 Example Methodology

In the following example we apply the general 6-step methodology to the final requirement of initial certification for a commercial applicator which will require commercial applicators who intend to apply RUPs aerially to be certified in a commercial aerial certification category. In this example, we are evaluating the costs imposed on commercial applicators, but there are also costs to jurisdictions of developing and administering aerial applicator exams. The costs to jurisdictions are calculated separately (see Appendix A, sections 2.1.1.2 and 2.1.1.3).

Step 1. Calculate the Baseline Unit Costs (Per-Actor Costs).

Based on data from the Certification Plan and Reporting Database[6] (CPARD), 18 states (listed in Table 3.2-2) and Puerto Rico, do not require an aerial category certification (CPARD, 2015). Existing and first-time aerial commercial applicators in these jurisdictions currently bear no certification costs. Certifying authorities in 32 states require aerial category certification by exam, and are in full compliance with the final requirement as explained in Step 2. Other jurisdictions are assumed to either have the aerial category or do not need one. EPA estimates

[6] CPARD (Certification Plan and Reporting Database) is an electronic database that authorized agencies use to establish and update their certification plans as well as report certifications issued each year.

that all aerial applicators in these jurisdictions are employed by federal agencies which either have a certification program (for example, Department of Defense) or will go through the state certification program.

Step 2. Calculate the Per-Actor Costs of Final Requirement.

The actors are the existing and first-time commercial applicators who intend to apply RUPs aerially. These commercial applicators are presumed to be certified in an existing certification category (e.g., crop protection or forestry, etc.). EPA estimated that they would be required to obtain certification in the aerial category even if they already apply RUPs by air (certifying authorities may consider currently certified applicators who have met or exceeded the federal standard in the final rule to be grandfathered into the certifying authority's category). Existing aerial applicators are expected to expend about 6 hours of effort on average to prepare for and take the exam, while first-time aerial applicators are expected to expend about 8 hours of effort on average, since they do not have practical experience. The expected times to prepare and take the exams are averages across the range of applicators – some of whom may pass exams with minimal preparation because of their prior knowledge and experience, while some may need more study and others may fail an exam and require more time to study and multiple attempts to pass an exam. The wage rate for existing and first-time aerial applicators is $73.15 per hour (Lake Area Technical Institute, undated). To calculate the per-actor costs to existing and first-time aerial applicators, we multiply the wage rate by the number of hours required of them to complete the certification exam. This is a one-time cost for the applicator to become certified. Costs of maintaining certification (recertification) are calculated as part of the recertification requirements (Section 3.4.6). The per-actor costs are $535 and $681 for existing and first-time aerial applicators, respectively. Table 3.2-1 presents the per-actor costs for the final requirement for jurisdictions that currently lack an aerial category. For jurisdictions that have established an aerial category, baseline and final requirements are represented by the cost for first-time aerial applicators. Existing applicators only bear the costs of recertification.

**Table 3.2-1: Per-Actor Cost for Certification of Commercial Applicators in Aerial Category**

| Activity | Wage Rate | Average Time | Frequency | Cost |
|---|---|---|---|---|
| Existing Aerial Commercial Applicator (18 States, Puerto Rico, and Other) | | | | |
| Aerial category exam | $73.15/hour | 6 hours | 1 | $439 |
| Commercial applicator driving time to exam site[1] | $73.15/hour | 1 hour | 1 | $73 |
| IRS mileage[2] | $0.575/mile | 40 miles | 1 | $23 |
| Total | | | | $535 |
| First-Time Aerial Commercial Applicator (18 States, Puerto Rico, and Other) | | | | |
| Aerial category exam | $73.15/hour | 8 hours | 1 | $585 |
| Commercial applicator driving time to exam site[1] | $73.15/hour | 1 hour | 1 | $73 |
| IRS mileage[2] | $0.575/mile | 40 miles | 1 | $23 |
| Total | | | | $681 |

Source: Based on wage rate information from "May 2014 National Industry-Specific Occupational Employment and Wage Estimates" provided by the Bureau of Labor Statistics Occupational Employment Statistics (BLS, 2016a).

[1]Commercial applicator driving time to an exam site is based on a round trip of 40 miles from a public comment submitted by the Texas A&M Agrilife Extension Service (McCorkle *et al.*, 2015).

[2]IRS mileage is from a public comment submitted by the Texas A&M Agrilife Extension Service (McCorkle *et al.*, 2015).

Step 3. Calculate the Jurisdiction-level Costs of the Final Requirement and Baseline.

Table 3.2-2 presents the jurisdiction-level costs in Year 3 and the rest of the 10-year time horizon for the new requirement for those jurisdictions that do not currently have a commercial aerial category. Baseline costs are zero for those jurisdictions. Baseline and final costs for jurisdictions with the aerial category are equal and are presented in Appendix A. Jurisdiction-level costs are calculated as unit costs for existing and first-time applicators multiplied by the respective number of actors, and summed in each jurisdiction. Note that in the year (Year 3 of the 10-year time period) the final rule takes effect on the industry, all applicators including the first time and existing, are affected by the new requirement (shown in the column $RC^{P}_{t=3}$ in Table 3.2-2). However, in Year 4 and on, only the first time applicators incur the cost (shown in the column $RC^{P}_{t>3}$ of Table 3.2-2).

**Table 3.2-2: Jurisdiction-Level Costs for Commercial Aerial Certification**

| Jurisdiction | $N_{1st\ time}$ | $N_{Exist}$ | $RC^{P}_{t=3}$ | $RC^{P}_{t>3}$ |
|---|---|---|---|---|
| Alabama | 11.8 | 99 | 60,847 | 8,066 |
| Arizona | 8.2 | 68 | 42,007 | 5,568 |
| Arkansas | 21.7 | 181 | 111,384 | 14,765 |
| Colorado | 20.1 | 168 | 103,503 | 13,720 |
| Delaware | 5.8 | 48 | 29,688 | 3,935 |
| Idaho | 28.5 | 238 | 146,607 | 19,434 |
| Kansas | 43.7 | 364 | 224,758 | 29,793 |
| Missouri | 30.1 | 251 | 154,617 | 20,495 |
| Nevada | 0.0 | 0 | 0 | 0 |
| New Mexico | 2.2 | 18 | 11,081 | 1,469 |
| North Carolina | 18.4 | 153 | 94,338 | 12,505 |
| Oklahoma | 46.6 | 388 | 239,352 | 31,727 |
| Oregon | 22.4 | 187 | 115,360 | 15,292 |
| Rhode Island | 2.9 | 25 | 15,133 | 2,006 |
| South Dakota | 36.4 | 303 | 187,055 | 24,795 |
| Tennessee | 13.2 | 110 | 67,988 | 9,012 |
| Washington | 52.8 | 440 | 271,286 | 35,960 |
| West Virginia | 7.7 | 64 | 39,545 | 5,242 |
| Puerto Rico | 9 | 77 | 47,672 | 6,319 |
| Other jurisdiction | 12 | 99 | 61,146 | 8,176 |
| Total | 394 | 3,280 | 2,023,367 | 268,279 |

Source: EPA estimates (see Section 3.3 for explanation on estimation of the number of actors.
Wage rate calculations based on wage rate information from "May 2014 National Industry-Specific Occupational Employment and Wage Estimates" provided by the Bureau of Labor Statistics Occupational Employment Statistics (BLS, 2016a).

Steps 4 and 5. Calculate the Jurisdiction-level Incremental Costs and the Present Value.

Baseline unit costs are assumed to continue unchanged through the 10-year time horizon. The number of applicators is also anticipated to remain constant over the time horizon (see Section 3.3.1). Under the final regulation, baseline unit costs will be incurred for the first two years of the horizon at which point applicators will face the costs of the final requirement except that the existing applicators only have to be brought into compliance once. Beginning in Year 4, the only costs are to the new applicators entering the system (the column $RC^{P}_{t>3}$ of Table 3.2-2). Given those conditions, we calculate the present value of the cost streams shown in Table 3.2-3. We then subtract the PV of baseline cost from the PV of cost of the final regulatory requirement to get the PV of incremental costs (Table 3.2-3).

**Table 3.2-3: Present Value of Costs for Commercial Aerial Certification, by Jurisdiction**

| Jurisdiction | PV $RC^{P}$ ($1000) | PV $RC^{B}$ ($1000) | $PV^{IC}$ ($1000) |
|---|---|---|---|
| Alabama | 105 | 0 | 105 |
| Arizona | 72 | 0 | 72 |
| Arkansas | 192 | 0 | 192 |
| Colorado | 178 | 0 | 178 |
| Delaware | 51 | 0 | 51 |
| Idaho | 252 | 0 | 252 |
| Kansas | 387 | 0 | 387 |
| Missouri | 266 | 0 | 266 |
| Nevada | 0 | 0 | 0 |
| New Mexico | 19 | 0 | 19 |
| North Carolina | 162 | 0 | 162 |
| Oklahoma | 412 | 0 | 412 |
| Oregon | 199 | 0 | 199 |
| Rhode Island | 26 | 0 | 26 |
| South Dakota | 322 | 0 | 322 |
| Tennessee | 117 | 0 | 117 |
| Washington State | 467 | 0 | 467 |
| West Virginia | 68 | 0 | 68 |
| Puerto Rico | 82 | 0 | 82 |
| Total | 3,377 | 0 | 3,377 |

Source: EPA calculations. PVs are calculated using a three percent discount rate.

Step 6. Annualize the National Costs of the Final Requirement, Baseline, and Incremental Costs.

Finally, we sum costs across jurisdictions to obtain national cost for the final regulatory requirement, the national baseline cost, and the national incremental cost. These national-level costs are presented in Table 3.2-4. The costs are presented as present value over a 10-year time period with costs starting in Year 3 with a 3% discount rate.

**Table 3.2-4: Annualized Present Value of National-Level Costs of Commercial Aerial Applicator Certification[1]**

| Region | National-level Cost of Final Requirement PV($NC^P$) | National-level Cost of Baseline PV($NC^B$) | National-level Incremental Cost PV(NIC) |
|---|---|---|---|
| | ($1,000) | $1,000 | $1,000 |
| U.S. (present value) | 7,521 | 4,144 | 3,377 |
| U.S. (annualized value) | 856 | 472 | 384 |

[1]Discount rate of 3% over 10 years.

## 3.3 Cost Analysis Data

In this section, we present the major data elements required for the analysis. Data elements include the number of certified applicators by jurisdiction and age cohort, the number of applicators who will be likely to obtain certification in the new federal categories, the number of noncertified applicators working under the direct supervision of a certified applicator by jurisdiction and age, and wage rates for the various actors.

### 3.3.1 Commercial applicators

States and other certifying authorities (e.g., Puerto Rico, the District of Columbia, Federal Agencies, other territories and several tribes) report the number of certifications issued and maintained to the Certification Plan and Reporting Database (CPARD). EPA used data reported from 2008 to 2014 to determine the number of certified applicators that will be affected by changes to the certification programs (CPARD, 2015). Because some jurisdictions require all pesticide applicators to be certified, even those not applying RUPs, and reports those totals to CPARD, EPA is likely overestimating the number of applicators that are impacted by changes in the federal requirements. The number of applicators in the 'Other Jurisdictions' group is subject to some uncertainty as not all federal agencies report to the number of certifications issued to CPARD. However, some applicators with federal agencies obtain certifications in the states where they work so they may be counted more than once.

Table 3.3-1 presents the number of commercial applicators used in the analysis, including first-time applicators (those obtaining an initial certification), existing applicators (those who will recertify), and the average number of category certifications held by existing applicators. Commercial applicators must be certified in a core set of requirements and obtain at least one category certification, based on area of specialization, such as plant agriculture, forestry, and turf. Over time, many commercial applicators become certified in multiple categories. Any changes in recertification requirements will affect all the category certifications an applicator

holds. Some jurisdictions have created additional categories and this may lead to overestimating the impacts of changes in the federal requirements. As shown in Table 3.3-1, the average number of category certifications per applicator ranges from nearly one in Alabama and Tennessee to a high of 3.6 certifications per applicator in Wyoming. Data are not consistent for many non-state jurisdictions and appear to indicate more applicators than category certifications. EPA uses a simple average over the 2009 to 2014 period to estimate the number of commercial applicators impacted by the rule. Data from 2008 were not used as several states did not begin fully reporting until 2009 and, in the case of Wyoming, until 2010.

With the limited series of data available, trends are difficult to determine. We regressed the logarithm of the total number of commercial applicators in the U.S. against a time trend for the 2008 to 2014 period, for seven observations. For first-time applicators, the coefficient on time implies a two percent annual rate of growth, but the estimate is not statistically significant. For existing applicators, the coefficient on time estimates slightly less than a two percent annual growth rate and the estimate was statistically significant. We decided to use the simple average for both groups, implying no growth, due to the limited number of observations and some problems with the data. Several states did not begin reporting to CPARD until 2009 and others initially reported only certifications issued, not the number of applicators.

**Table 3.3-1. Commercial Applicators, by Jurisdiction**

| Jurisdiction | First-Time Applicators | Existing Applicators | Average Categories/Applicator |
|---|---|---|---|
| Alabama | 361 | 3,743 | 1.0 |
| Alaska | 75 | 435 | 1.5 |
| Arizona | 879 | 6,652 | 2.2 |
| Arkansas | 448 | 3,716 | 1.4 |
| California | 3,624 | 33,106 | 1.5 |
| Colorado | 697 | 3,346 | 2.7 |
| Connecticut | 132 | 2,688 | 1.6 |
| Delaware | 163 | 1,773 | 1.7 |
| Florida | 1,817 | 14,512 | 3.0 |
| Georgia | 1,510 | 9,563 | 1.4 |
| Hawaii | 114 | 1,089 | 1.3 |
| Idaho | 437 | 3,712 | 3.1 |
| Illinois | 3,566 | 11,759 | 1.5 |
| Indiana | 1,128 | 8,738 | 1.6 |
| Iowa | 1,583 | 12,190 | 2.3 |
| Kansas | 893 | 5,235 | 1.7 |
| Kentucky | 2,905 | 11,384 | 1.6 |
| Louisiana | 591 | 4,146 | 1.7 |
| Maine | 182 | 1,471 | 2.3 |
| Maryland | 495 | 4,148 | 1.4 |
| Massachusetts | 204 | 2,003 | 1.5 |
| Michigan | 2,027 | 12,388 | 2.4 |
| Minnesota | 1,950 | 8,625 | 1.5 |

| | | | |
|---|---|---|---|
| Mississippi | 290 | 2,700 | 1.4 |
| Missouri | 832 | 7,099 | 1.6 |
| Montana | 288 | 2,182 | 1.4 |
| Nebraska | 1,108 | 8,812 | 1.4 |
| Nevada | 285 | 1,433 | 2.2 |
| New Hampshire | 303 | 993 | 1.9 |
| New Jersey | 640 | 8,266 | 1.6 |
| New Mexico | 634 | 1,796 | 2.3 |
| New York | 1,187 | 17,553 | 1.4 |
| North Carolina | 1,325 | 17,741 | 1.5 |
| North Dakota | 434 | 5,031 | 1.6 |
| Ohio | 1,436 | 11,762 | 2.7 |
| Oklahoma | 1,711 | 9,348 | 2.8 |
| Oregon | 452 | 4,460 | 2.2 |
| Pennsylvania | 2,287 | 13,989 | 1.8 |
| Rhode Island | 57 | 597 | 1.9 |
| South Carolina | 724 | 5,041 | 1.6 |
| South Dakota | 862 | 5,011 | 1.8 |
| Tennessee | 840 | 12,304 | 1.0 |
| Texas | 1,678 | 18,035 | 2.0 |
| Utah | 1,061 | 3,531 | 2.0 |
| Vermont | 136 | 879 | 1.7 |
| Virginia | 1,179 | 6,396 | 2.0 |
| Washington | 1,368 | 14,569 | 2.4 |
| West Virginia | 240 | 1,837 | 1.5 |
| Wisconsin | 1,761 | 11,982 | 1.2 |
| Wyoming | 342 | 1,569 | 3.6 |
| Puerto Rico | 306 | 5,934 | 1.5 |
| Other Jurisdictions | 505 | 3,682 | 1.3 |
| **U.S.** | **50,050** | **370,949** | **1.8** |

Source: Certification Plan and Reporting Database (CPARD) 2015.

Data on the age distribution of certified applicators are not available. Because it is important to know the number of certified applicators that may be subject to an age restriction, EPA estimates the number of commercial applicators for different age groups. Due to restrictions on adolescents regarding driving, and the availability to work due to education requirements, as well as general liability concerns, it is unlikely that there are commercial applicators under the age of 16. Further, 31 states prohibit certification for those under 18. We also assume that Federal Agencies do not issue certifications to those under 18. For other jurisdictions, EPA assumes that 0.2 percent of new commercial applicators are 16 years old and 0.3 percent are 17 years old. This assumption follows the analysis of the Final Revisions to the Worker Protection Standard (EPA, 2015a). Data from the National Agricultural Worker Survey (DoL, 2011) indicated that just over two percent of on-farm pesticide handlers were under 18 years of age. For the WPS analysis, EPA assumed that commercial pesticide handling establishments would be less likely to employ adolescents in such a capacity and estimated that about one percent of commercial

handlers would be under 18 (EPA, 2015a). For this analysis, we assume it is even less likely that commercial establishments would hire adolescents to apply RUPs, i.e., half of one percent of the certified applicators are under 18. EPA assumes that 90 percent of certified 16 year olds return to work as 17 year olds. The estimated number of commercial certified adolescents is shown in Table 3.3-2.

**Table 3.3-2. Estimated Number of Commercial Applicators under 18 Years of Age**.

| Jurisdiction | 16 Year Old First-Time Applicators | 17 Year Old First-Time Applicators | 17 Year Old Existing Applicators |
|---|---|---|---|
| Alabama [1] | 0 | 0 | 0 |
| Alaska [1] | 0 | 0 | 0 |
| Arizona [1] | 0 | 0 | 0 |
| Arkansas [1] | 0 | 0 | 0 |
| California [1] | 0 | 0 | 0 |
| Colorado | 1.4 | 2.1 | 1.3 |
| Connecticut [1] | 0 | 0 | 0 |
| Delaware [1] | 0 | 0 | 0 |
| Florida [1] | 0 | 0 | 0 |
| Georgia [1] | 0 | 0 | 0 |
| Hawaii [1] | 0 | 0 | 0 |
| Idaho [1] | 0 | 0 | 0 |
| Illinois | 7.1 | 10.7 | 6.4 |
| Indiana | 2.3 | 3.4 | 2.1 |
| Iowa | 3.2 | 4.7 | 2.9 |
| Kansas [1] | 0 | 0 | 0 |
| Kentucky | 5.8 | 8.7 | 5.2 |
| Louisiana [1] | 0 | 0 | 0 |
| Maine [1] | 0 | 0 | 0 |
| Maryland [1] | 0 | 0 | 0 |
| Massachusetts [1] | 0 | 0 | 0 |
| Michigan [1] | 0 | 0 | 0 |
| Minnesota | 3.9 | 5.9 | 3.5 |
| Mississippi [1] | 0 | 0 | 0 |
| Missouri [1] | 0 | 0 | 0 |
| Montana | 0.6 | 0.9 | 0.5 |
| Nebraska | 2.2 | 3.3 | 2.0 |
| Nevada | 0.6 | 0.9 | 0.5 |
| New Hampshire [1] | 0 | 0 | 0 |
| New Jersey [1] | 0 | 0 | 0 |
| New Mexico | 1.3 | 1.9 | 1.2 |
| New York [1] | 0 | 0 | 0 |
| North Carolina [1] | 0 | 0 | 0 |
| North Dakota [1] | 0 | 0 | 0 |
| Ohio | 2.9 | 4.3 | 2.6 |

| | | | |
|---|---|---|---|
| Oklahoma | 3.4 | 5.1 | 3.1 |
| Oregon [1] | 0 | 0 | 0 |
| Pennsylvania [1] | 0 | 0 | 0 |
| Rhode Island | 0.1 | 0.2 | 0.1 |
| South Carolina [1] | 0 | 0 | 0 |
| South Dakota | 1.7 | 2.6 | 1.5 |
| Tennessee | 1.7 | 2.5 | 1.5 |
| Texas | 3.4 | 5.0 | 3.1 |
| Utah | 2.1 | 3.2 | 1.9 |
| Vermont [1] | 0 | 0 | 0 |
| Virginia [1] | 0 | 0 | 0 |
| Washington [1] | 0 | 0 | 0 |
| West Virginia | 0.5 | 0.7 | 0.5 |
| Wisconsin | 3.5 | 5.3 | 3.2 |
| Wyoming [1] | 0 | 0 | 0 |
| Puerto Rico | 0.6 | 0.9 | 0.5 |
| Other Jurisdictions | 0.6 | 0.9 | 0.5 |
| **U.S.** | **48.9** | **73.2** | **44.1** |

Source: EPA estimation. Zeros indicate states that have imposed a minimum age requirement.

[1] Minimum age of 18 required for commercial certification.

EPA also estimates the number of commercial applicators that will obtain and retain certification in new, application method-specific categories. Table 3.3-3 presents the expected number of applicators in each of these categories: aerial, soil fumigation, and non-soil fumigation. Many certifying authorities already have developed one or more of these certification categories. For those certifying authorities and categories, EPA uses the average number of applicators, as reported to CPARD between 2009 and 2014.

In order to estimate the number of existing aerial applicators in states without an aerial category, we regressed the number of aerial applicators in certifying authorities for which we had data against the number of certifications issued in agricultural plant protection, forestry, and turf categories, the number of acres of agricultural crops treated by air in the previous year, and several dummy variables for different parts of the country. Acres treated in the previous year was included to reflect the demand for aerial applications which, if increasing, may increase the number of people seeking certification. We do not include indicators for weather or other year-to-year fluctuations since obtaining and keeping a certification is a longer term business decision. Data on acres treated by air comes from an annual market survey (proprietary) of pesticide use. Observations were for each state and year, 2008 to 2014, for a total of 213 observations. The estimated coefficients were used to predict the number of existing applicators in the rest of the certifying authorities. For the certifying authorities with an aerial category, first time aerial applicators averaged 12 percent of existing applicators and that average value was used to predict the number of first time aerial applicators in the other certifying authorities.

**Table 3.3-3. Expected Number of Commercial Applicators in Additional Categories.**

| Jurisdiction | Aerial Applications | | Soil Fumigation | | Non-Soil Fumigation | |
|---|---|---|---|---|---|---|
| | First-Time | Existing | First-Time | Existing | First-Time | Existing |

| | Applicators | Applicators | Applicators | Applicators | Applicators | Applicators |
|---|---|---|---|---|---|---|
| Alabama [2] | 12 | 99 | 1 | 12 | 4 | 60 |
| Alaska [2 3] | 0 | 4 | 0 | 0 | 0 | 0 |
| Arizona [1 2] | 8 | 68 | 8 | 75 | 19 | 273 |
| Arkansas [1] | 22 | 181 | 4 | 40 | 10 | 139 |
| California [3] | 51 | 425 | 48 | 437 | 220 | 3,142 |
| Colorado [1 2] | 20 | 168 | 0 | 0 | 7 | 106 |
| Connecticut | 0 | 2 | 0 | 2 | 1 | 18 |
| Delaware [1] | 6 | 48 | 8 | 75 | 6 | 87 |
| Florida | 39 | 326 | 12 | 111 | 433 | 6,191 |
| Georgia [2] | 34 | 284 | 11 | 101 | 17 | 248 |
| Hawaii [2] | 1 | 8 | 2 | 19 | 15 | 217 |
| Idaho [1 3] | 29 | 238 | 25 | 223 | 12 | 175 |
| Illinois | 30 | 249 | 1 | 9 | 16 | 229 |
| Indiana [2] | 34 | 283 | 8 | 76 | 27 | 379 |
| Iowa [2] | 97 | 811 | 39 | 358 | 42 | 596 |
| Kansas [1 2 3] | 44 | 364 | 8 | 75 | 43 | 619 |
| Kentucky [2] | 9 | 74 | 3 | 29 | 33 | 476 |
| Louisiana [2 3] | 46 | 386 | 1 | 6 | 13 | 191 |
| Maine [2] | 3 | 26 | 0 | 0 | 6 | 81 |
| Maryland [2] | 5 | 45 | 6 | 50 | 98 | 1,402 |
| Massachusetts [2] | 2 | 17 | 1 | 9 | 3 | 39 |
| Michigan [2 3] | 10 | 80 | 19 | 176 | 32 | 461 |
| Minnesota | 48 | 398 | 2 | 19 | 21 | 305 |
| Mississippi [2] | 28 | 233 | 1 | 10 | 4 | 63 |
| Missouri [1 2] | 30 | 251 | 2 | 16 | 29 | 411 |
| Montana [2 3] | 3 | 26 | 0 | 0 | 0 | 0 |
| Nebraska | 64 | 535 | 1 | 8 | 31 | 449 |
| Nevada [1 2] | 0 | 0 | 0 | 0 | 3 | 47 |
| New Hampshire [1 2] | 3 | 24 | 0 | 0 | 1 | 8 |
| New Jersey [2] | 9 | 79 | 6 | 54 | 9 | 131 |
| New Mexico [1 2] | 2 | 18 | 1 | 12 | 5 | 67 |
| New York | 6 | 46 | 78 | 709 | 12 | 167 |
| North Carolina [1] | 18 | 153 | 4 | 37 | 13 | 181 |
| North Dakota | 44 | 363 | 12 | 107 | 34 | 482 |
| Ohio | 12 | 101 | 7 | 60 | 27 | 379 |
| Oklahoma [1 2] | 47 | 388 | 13 | 114 | 52 | 747 |
| Oregon [1] | 22 | 187 | 23 | 205 | 12 | 176 |
| Pennsylvania | 8 | 70 | 2 | 17 | 35 | 498 |
| Rhode Island [1 2] | 3 | 25 | 0 | 0 | 1 | 10 |
| South Carolina [2] | 11 | 88 | 0 | 1 | 12 | 175 |
| South Dakota [1] | 36 | 303 | 9 | 83 | 16 | 222 |
| Tennessee [1 2 3] | 13 | 110 | 2 | 14 | 22 | 318 |
| Texas [2] | 64 | 533 | 19 | 177 | 70 | 995 |
| Utah [2] | 6 | 47 | 1 | 12 | 7 | 99 |
| Vermont [2 3] | 1 | 10 | 0 | 0 | 0 | 0 |
| Virginia | 10 | 85 | 8 | 73 | 13 | 181 |
| Washington [1] | 53 | 440 | 70 | 636 | 11 | 160 |
| West Virginia [1 2] | 8 | 64 | 0 | 0 | 3 | 40 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Wisconsin | 9 | 71 | 8 | 69 | 14 | 194 |
| Wyoming [2] | 5 | 43 | 3 | 30 | 3 | 42 |
| Puerto Rico [1 2 3] | 9 | 77 | 3 | 29 | 0 | 0 |
| Other Jurisdictions [1 2 3] | 12 | 99 | 2 | 22 | 12 | 175 |
| **U.S.** | **1,086** | **9,049** | **484** | **4,400** | **1,529** | **21,849** |

Source: CPARD (2015) and EPA estimation.

[1] No commercial aerial category; estimated number of applicators. Federal agencies may have established an aerial application category (e.g., the Department of Defense), but do not report the number of certifications issued.

[2] No commercial soil fumigation category; estimated number of applicators.

[3] No commercial non-soil fumigation category; estimated number of applicators.

Table 3.3-3 also presents the expected number of commercial applicators who have or will obtain certification in soil and non-soil fumigation. Seventeen states have a soil fumigation category from which we can extrapolate to other states. As with aerial application, we estimate a regression model where the number of applicators with a soil fumigation certification is hypothesized to be a function of the number of applicators in agricultural plant protection, forestry, and turf, as well as the crop acres fumigated by commercial firms the previous year. Data on crop treatments come from a proprietary market survey conducted annually. For the years 2008 to 2014, we have 104 observations with complete data. Initial certifications in soil fumigation average 11 percent of the existing certifications.

Most jurisdictions have a category for non-soil fumigation by commercial applicators; some even have separate categories for fumigation of structures and fumigation of commodities. The regression model for non-soil fumigation included the number of applicators in agricultural plant protection and in the industrial, institutional, and structural category. The latter is quite broad and we included a dummy variable for states issuing more than 3,000 certifications in that category as many states subdivide it into more specialized areas. We also included a variable for acres of grain harvested in the previous year, as an indicator of commodity fumigation, but the estimated coefficient was not significant. There are 270 observations. Initial certifications in non-soil fumigation average seven percent of the existing certifications.

### 3.3.2 Noncertified applicators working under the direct supervision of commercial applicators

Data on the number of noncertified applicators applying RUPs under the direct supervision of commercial applicators ("noncertified applicators") are not available in CPARD. Therefore, EPA used data from the Bureau of Labor Statistics, by state, on employment in occupations related to pest control (BLS, 2015). To estimate the number of noncertified applicators, EPA averaged the total number of people employed as pest control workers in each state in the Agricultural Support Sector, the Structures and Buildings and Turf Sector, the Construction Sector, and in Federal, State, and Local Governments, from 2012 to 2014, and subtracted the average number of certified applicators in the state over the same time period. This approach sometimes resulted in negative numbers. For example, in the case of Kentucky, BLS reports an average of 8,853 people employed in pest control. However, Kentucky reports an average of 13,959 commercial applicators over the same period. Therefore, as one alternative, EPA

calculated the number of noncertified applicators assuming three noncertified applicators for every existing commercial applicator. In the case of Kentucky, the six-year average number of commercial applicators is 11,384, resulting in an estimate of 34,151 noncertified applicators. As a second alternative approach, we made a calculation where different categories of applicators will have different numbers of noncertified applicators. For example, there may be three noncertified applicators for every applicator in the turf category (e.g., a golf course or landscaping enterprise) but public health applicators will not have noncertified applicators. This approach resulted in an estimate of 28,281 noncertified applicators in Kentucky. If the estimated number of noncertified applicators in a state based on the BLS data appeared reasonable, defined as at least half the value but not more than twice the value of the alternative approaches, EPA utilizes the number derived with the BLS data. This was the case for 23 states. In 26 states, Puerto Rico, and the other jurisdictions, the approach utilizing the BLS data was negative or unreasonably small in comparison to the other approaches. In those cases, we used the lesser of the two numbers calculated from the number of applicators or number and type of certifications. For Kentucky, therefore, we use the estimate of 28,281 noncertified applicators based on the number and type of certifications. Overall, estimates in half the jurisdictions are based on the number of applicators and half are based on the number and type of certifications. Only in Massachusetts did the number of noncertified applicators based on BLS data appear unreasonably large. For that jurisdiction, we employ the greater of the two numbers calculated using the alternative approaches, which happened to be the estimate based on the number and type of certifications.

Finally, based on the state regulations, four states (Iowa, Minnesota, New Hampshire, and South Dakota) do not allow noncertified applicators to apply RUPs. The number of noncertified applicators in those states is set to zero. Estimated numbers of noncertified applicators are presented in Table 3.3-4. The total number of noncertified applicators in the U.S. is estimated to be nearly 930,000 people.

**Table 3.3-4: Estimated Number of Noncertified Applicators Applying RUPs under Direct Supervision of Commercial Applicators, by Jurisdiction**

| Jurisdiction | Total | Agricultural Support Sector | Non-Agricultural Pest Control | Less than 18 Years of Age |
|---|---|---|---|---|
| Alabama [1] | 9,330 | 40 | 9,289 | 61 |
| Alaska [1] | 617 | 0 | 617 | 4 |
| Arizona [1] | 13,548 | 162 | 13,387 | 88 |
| Arkansas [3] | 6,877 | 155 | 6,722 | 45 |
| California [1] | 75,332 | 3,907 | 71,424 | 491 |
| Colorado [1] | 15,277 | 49 | 15,229 | 100 |
| Connecticut [1] | 10,059 | 0 | 10,059 | 66 |
| Delaware [2] | 5,318 | 0 | 5,318 | 35 |
| Florida [1] | 68,247 | 966 | 67,281 | 445 |
| Georgia [1] | 17,670 | 169 | 17,501 | 115 |
| Hawaii [1] | 3,950 | 11 | 3,939 | 26 |
| Idaho [2] | 11,135 | 302 | 10,833 | 73 |
| Illinois [1] | 20,617 | 147 | 20,470 | 134 |
| Indiana [2] | 26,213 | 102 | 26,111 | 171 |

| | | | | |
|---|---|---|---|---|
| Iowa [4] | 0 | 0 | 0 | 0 |
| Kansas [2] | 15,704 | 32 | 15,672 | 102 |
| Kentucky [3] | 28,281 | 628 | 27,653 | 184 |
| Louisiana [3] | 9,327 | 118 | 9,209 | 61 |
| Maine [1] | 2,744 | 0 | 2,744 | 18 |
| Maryland [1 5] | 16,381 | 0 | 16,381 | 0 |
| Massachusetts [3 5] | 6,910 | 0 | 6,910 | 0 |
| Michigan [2] | 37,164 | 72 | 37,092 | 242 |
| Minnesota [4] | 0 | 0 | 0 | 0 |
| Mississippi [1] | 2,857 | 32 | 2,825 | 19 |
| Missouri [3] | 20,326 | 291 | 20,035 | 133 |
| Montana [3] | 3,805 | 110 | 3,695 | 25 |
| Nebraska [3] | 23,323 | 43 | 23,280 | 152 |
| Nevada [1] | 7,921 | 0 | 7,921 | 52 |
| New Hampshire [4] | 0 | 0 | 0 | 0 |
| New Jersey [1 5] | 19,342 | 21 | 19,321 | 0 |
| New Mexico [1] | 2,724 | 64 | 2,660 | 18 |
| New York [3] | 51,971 | 60 | 51,911 | 339 |
| North Carolina [2] | 53,223 | 261 | 52,961 | 347 |
| North Dakota [3] | 13,638 | 337 | 13,301 | 89 |
| Ohio [1] | 17,775 | 12 | 17,763 | 116 |
| Oklahoma [2] | 28,043 | 0 | 28,043 | 183 |
| Oregon [2] | 13,379 | 183 | 13,195 | 87 |
| Pennsylvania [2] | 41,968 | 166 | 41,802 | 274 |
| Rhode Island [1] | 3,156 | 0 | 3,156 | 21 |
| South Carolina [1] | 8,993 | 30 | 8,963 | 59 |
| South Dakota [4] | 0 | 0 | 0 | 0 |
| Tennessee [3] | 23,622 | 35 | 23,587 | 154 |
| Texas [1] | 56,310 | 566 | 55,744 | 367 |
| Utah [1] | 5,378 | 0 | 5,378 | 35 |
| Vermont [2 5] | 2,636 | 0 | 2,636 | 0 |
| Virginia [1 5] | 22,023 | 41 | 21,982 | 0 |
| Washington [2] | 43,707 | 887 | 42,819 | 285 |
| West Virginia [3 5] | 4,649 | 0 | 4,649 | 0 |
| Wisconsin [3] | 30,819 | 176 | 30,643 | 201 |
| Wyoming [2] | 4,708 | 0 | 4,708 | 31 |
| Puerto Rico [2] | 17,803 | 0 | 17,803 | 116 |
| Other Jurisdictions [3] | 4,271 | 0 | 4,271 | 25 |
| **U.S.** | **929,065** | **10,174** | **918,892** | **5,589** |

Source: EPA estimation based on BLS (2015) and CPARD (2015).

[1] Estimate based on employment in pest control reported in BLS, less number of certified applicators.

[2] Assumes an average of three noncertified applicators for every certified applicator.

[3] Assumes the number of noncertified applicators varies across certification category.

[4] State prohibits noncertified applicators from applying RUPs.

[5] State minimum age of 18 for noncertified applicators applying RUPs.

EPA also estimates there are 10,174 noncertified applicators in the agricultural sector and 918,892 in the non-agricultural sectors. Under the final revisions to the Certification requirements, noncertified applicators must undergo pesticide safety training. Noncertified applicators in the agricultural sector will be in compliance with this requirement as they are also subject to training provisions under the Worker Protection Standard (WPS). To estimate the number of noncertified applicators already subject to the WPS requirement, EPA multiplies the total number of noncertified applicators by the proportion of people employed in pest control in the Agricultural Support Sector out of all pest control employment reported in the BLS data (2015). Several states have no reported employment in pest control within the Agricultural Support Sector including the New England states, but also states such as Maryland, Delaware, Nevada, Oklahoma, Utah, West Virginia, and Wyoming where employment would be expected. Therefore, the number of noncertified applicators in compliance with the training requirement in the baseline is likely underestimated. In the Economic Analysis of the Worker Protection Standard Revisions (EPA, 2015), EPA estimated there are approximately 14,000 pesticide handlers employed by commercial pesticide handling establishments, but did not estimate the number of handlers for each state.

The number of noncertified adolescents applying RUPs under the direct supervision of a commercial applicator is also of interest, given that EPA is establishing a minimum age of 18. According to the Current Population Survey (BLS, 2016b), over the 2012 to 2014 time period, an average of 76,700 people were employed in pest control occupations within the category of Building and Grounds Cleaning and Maintenance, of which 1,000 were aged 16 to 19 inclusive. This category is representative of the turf and ornamental and the industrial, institutional, and structural category which houses the majority of commercial applicators. Assuming a uniform distribution across the years, about 500 adolescents, aged 16 and 17, are employed in pest control, or 0.65 percent of the 76,700 persons employed. We apply this percentage across all states to estimate the number of noncertified 16 and 17 year olds applying RUPs under the direct supervision of a commercial applicator. For Federal Agencies, we assume there are no adolescents working under the supervision of a certified applicator. We are likely overestimating the number of adolescents applying RUPs, since 18 and 19 year olds probably make up more than half of the employed persons in this age group. Several states have set a minimum age of 18 for applying RUPs. As shown in Table 3.3-4, EPA estimates about 5,600 adolescents UTS of commercial applicators.

### 3.3.3 Private applicators

The number of private applicators is also reported to CPARD by the certifying authorities. To assess the possibility of a trend, the total number of private applicators in the U.S. from 2008 to 2014 was regressed against a time variable. The estimated coefficient on time for the number of initial certifications was positive, but not was statistically significant, while that for existing applicators was negative and statistically significant. Given the limited time series and conflicting results, EPA estimates the number of private applicators affected by changes to the Certification regulations as the simple average over the 2009 to 2014 period, *i.e.*, no trend over time for either first-time or existing private applicators. As with the number of commercial

applicators, data from 2008 was excluded because of some reporting problems or lack of reporting. Table 3.3-5 presents the numbers for private applicators in each jurisdiction.

**Table 3.3-5: Private Applicators, by Jurisdiction**

| Jurisdiction | First-Time Applicators | Existing Applicators |
|---|---|---|
| Alabama | 633 | 4,914 |
| Alaska | 6 | 72 |
| Arizona | 75 | 372 |
| Arkansas | 1,462 | 19,417 |
| California | 1,241 | 17,275 |
| Colorado | 375 | 4,955 |
| Connecticut | 21 | 522 |
| Delaware | 80 | 634 |
| Florida | 338 | 3,649 |
| Georgia | 1,672 | 17,305 |
| Hawaii | 33 | 387 |
| Idaho | 134 | 3,401 |
| Illinois | 1,086 | 15,755 |
| Indiana | 751 | 11,961 |
| Iowa | 721 | 21,793 |
| Kansas | 1,099 | 13,674 |
| Kentucky | 2,338 | 10,883 |
| Louisiana | 377 | 7,229 |
| Maine | 82 | 1,081 |
| Maryland | 115 | 3,174 |
| Massachusetts | 80 | 1,025 |
| Michigan | 489 | 7,009 |
| Minnesota | 722 | 16,503 |
| Mississippi | 1,317 | 9,179 |
| Missouri | 1,570 | 19,723 |
| Montana | 237 | 5,896 |
| Nebraska | 785 | 20,812 |
| Nevada | 50 | 256 |
| New Hampshire | 36 | 466 |
| New Jersey | 201 | 1,561 |
| New Mexico | 223 | 2,410 |
| New York | 253 | 6,619 |
| North Carolina | 480 | 15,397 |
| North Dakota | 922 | 10,700 |
| Ohio | 289 | 14,285 |
| Oklahoma | 1,804 | 11,059 |
| Oregon | 169 | 4,021 |
| Pennsylvania | 692 | 17,326 |
| Rhode Island | 6 | 175 |
| South Carolina | 733 | 5,735 |

| | | |
|---|---|---|
| South Dakota | 2,244 | 14,203 |
| Tennessee | 391 | 10,242 |
| Texas | 2,987 | 40,405 |
| Utah | 665 | 1,190 |
| Vermont | 45 | 527 |
| Virginia | 1,023 | 5,483 |
| Washington | 669 | 13,177 |
| West Virginia | 71 | 1,153 |
| Wisconsin | 1,029 | 12,711 |
| Wyoming | 375 | 4,216 |
| Puerto Rico | 769 | 16,728 |
| Other Jurisdictions | 108 | 213 |
| **U.S.** | **34,071** | **448,854** |

Source: Certification Plan and Reporting Database (CPARD) 2015.

As with commercial applicators, CPARD does not provide information on the age of private applicators. Since private applicators are often the owner or operator of a farm, EPA bases its estimates of adolescent applicators on the number of principal operators under the age of 25, as reported in the 2012 Census of Agriculture (NASS, 2014c). EPA also recognizes that there are adolescents involved in 4-H and Future Farmers of America and other vocational programs that may use RUPs as part of their training, but EPA does not have information about their ages. Given that the age distribution is probably heavily skewed to operators in their early 20s rather than mid- to late-teens, we assume 0.5 percent of principal operators under the age of 25 are 14 and obtain initial certification as a private applicator, 0.75 percent are 15 and 16 and will be certified, and one percent are 17 years old with certification. Not all principal operators will be certified applicators since not all farms use pesticides, much less RUPs. However, there are other situations where an adolescent may be a certified applicator. Many certifying authorities have age restrictions, however, typically either 16 or 18 years of age and we adjust our estimates accordingly. Where the minimum age is 16, we assume that all adolescents who would otherwise have obtained certification by that age will do so. Table 3.3-6 presents the estimated adolescent private applicators. Included is an estimate of adolescents hired as a private applicator. The above approach applies to family members only. Hired adolescents with certification as a private applicator on farms are likely very rare. According to the National Agricultural Worker Survey (DoL, 2011), only about 2.3 percent of those handling any kind of pesticide were under 18 and fewer would handle RUPs. Moreover, revisions to the WPS have been finalized, including a requirement that all hired pesticide handlers (i.e., other than family members) must be 18. The WPS applies to crop production, but there may be a few applicators employed to apply RUPs for livestock production. For the Economic Analysis of the proposed certification requirements, EPA assumed that hired 17 year-olds may obtain certification, at a rate of 25 percent of the number of family members obtaining certification at that age. To estimate the number of private certified applicators working on livestock operations, we weight the result by the proportion of commercial certifications for livestock protection out of all commercial certifications issued for crop and livestock protection.

**Table 3.3-6. Estimated Number of Private Applicators under 18 Years of Age**.

| Jurisdiction | First-Time Applicators, | Existing Applicators, | First-Time |
|---|---|---|---|

| | Family | | Family | | Applicators, Hired |
|---|---|---|---|---|---|
| | < 16 YO | 16-17 YO | < 16 YO | 16-17 YO | 16-17 YO |
| Alabama [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Alaska | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Arizona | 1.1 | 0.6 | 0.5 | 1.8 | 0.0 |
| Arkansas [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| California | 1.9 | 1.1 | 1.1 | 3.3 | 0.0 |
| Colorado | 1.2 | 0.6 | 0.6 | 2.0 | 0.0 |
| Connecticut [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Delaware [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Florida [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Georgia [3] | 0.0 | 1.6 | 0.0 | 1.0 | 0.0 |
| Hawaii [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Idaho [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Illinois [3] | 0.0 | 5.6 | 0.0 | 3.5 | 0.0 |
| Indiana [3] | 0.0 | 3.4 | 0.0 | 2.2 | 0.0 |
| Iowa | 4.7 | 2.4 | 2.6 | 8.1 | 0.0 |
| Kansas | 2.8 | 1.5 | 1.5 | 4.6 | 0.0 |
| Kentucky [3] | 0.0 | 4.4 | 0.0 | 2.7 | 0.0 |
| Louisiana [3] | 0.0 | 1.6 | 0.0 | 1.0 | 0.0 |
| Maine [3] | 0.0 | 0.6 | 0.0 | 0.5 | 0.0 |
| Maryland [3] | 0.0 | 0.9 | 0.0 | 0.5 | 0.0 |
| Massachusetts [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Michigan [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Minnesota | 3.3 | 1.7 | 1.8 | 5.6 | 0.0 |
| Mississippi [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Missouri [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Montana | 1.0 | 0.5 | 0.5 | 1.6 | 0.0 |
| Nebraska [3] | 0.0 | 4.9 | 0.0 | 3.1 | 0.0 |
| Nevada | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 |
| New Hampshire [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| New Jersey [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| New Mexico | 1.7 | 1.0 | 0.9 | 2.8 | 0.0 |
| New York [2] | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |
| North Carolina [3] | 0.0 | 2.4 | 0.0 | 1.5 | 0.0 |
| North Dakota [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Ohio | 3.6 | 1.8 | 2.0 | 6.2 | 0.0 |
| Oklahoma | 3.4 | 1.8 | 1.9 | 5.9 | 0.1 |
| Oregon [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Pennsylvania [3] | 0.0 | 4.6 | 0.0 | 2.9 | 0.0 |
| Rhode Island [3] | 0.0 | 0.1 | 0.0 | 0.1 | 0.0 |
| South Carolina [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| South Dakota | 2.0 | 1.1 | 1.1 | 3.4 | 0.0 |
| Tennessee [1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

| | | | | | |
|---|---|---|---|---|---|
| Texas | 6.3 | 3.2 | 3.5 | 10.6 | 0.1 |
| Utah [3] | 0.0 | 0.9 | 0.0 | 0.5 | 0.0 |
| Vermont [3] | 0.0 | 0.2 | 0.0 | 0.2 | 0.0 |
| Virginia [3] | 0.0 | 1.9 | 0.0 | 1.2 | 0.0 |
| Washington [3] | 0.0 | 1.9 | 0.0 | 1.3 | 0.0 |
| West Virginia | 0.4 | 0.2 | 0.3 | 0.9 | 0.0 |
| Wisconsin [3] | 0.0 | 3.8 | 0.0 | 2.3 | 0.0 |
| Wyoming [3] | 0.0 | 0.6 | 0.0 | 0.4 | 0.0 |
| Puerto Rico | 0.1 | 0.1 | 0.0 | 0.2 | 0.0 |
| Other Jurisdictions | 1.3 | 0.7 | 0.6 | 2.2 | 0.0 |
| **U.S.** | **34.8** | **59.8** | **18.9** | **84.2** | **0.2** |

Source: EPA estimation.

[1] State minimum age of 18 for noncertified applicators applying RUPs.

[2] State minimum age of 17 for noncertified applicators applying RUPs.

[3] State minimum age of 16 for noncertified applicators applying RUPs.

EPA also estimates the number of private applicators that will obtain and retain certification in the new categories. Table 3.3-7 presents the expected number of applicators in the aerial, soil fumigation, and non-soil fumigation categories. Wisconsin is the only state that has established a private aerial applicator category and they have not reported any certifications. Private aerial application is likely very rare. EPA simply assumes that there will be one private aerial applicator in a state for every 100 commercial aerial applicators. As with commercial applicators, we assume that new certifications will be 12 percent of existing certifications based on the observed ratio between new and existing certifications nationally.

**Table 3.3-7. Expected Number of Private Applicators in New Categories.**

| | Aerial Applications | | Soil Fumigation | | Non-Soil Fumigation | |
|---|---|---|---|---|---|---|
| Jurisdiction | First-Time Applicators | Existing Applicators | First-Time Applicators | Existing Applicators | First-Time Applicators | Existing Applicators |
| Alabama [1 2 3] | 0.0 | 0.0 | 12 | 112 | 3 | 36 |
| Alaska [1 2 3] | 0.0 | 0.0 | 0 | 0 | 0 | 0 |
| Arizona [1 2] | 0.0 | 0.0 | 7 | 65 | 2 | 29 |
| Arkansas [1 2 3] | 0.1 | 1.0 | 56 | 509 | 6 | 84 |
| California [1 2 3] | 0.5 | 4.0 | 91 | 828 | 18 | 254 |
| Colorado [1 2 3] | 0.1 | 1.0 | 13 | 121 | 4 | 64 |
| Connecticut [1 2 3] | 0.0 | 0.0 | 1 | 5 | 0 | 1 |
| Delaware [1 2 3] | 0.0 | 0.0 | 1 | 8 | 1 | 10 |
| Florida [1 2 3] | 0.4 | 3.0 | 36 | 325 | 35 | 501 |
| Georgia [1 2] | 0.2 | 2.0 | 69 | 626 | 2 | 29 |
| Hawaii [1 3] | 0.0 | 0.0 | 3 | 27 | 1 | 18 |
| Idaho [1 2 3] | 0.2 | 2.0 | 21 | 194 | 1 | 20 |
| Illinois [1 2 3] | 0.2 | 2.0 | 41 | 377 | 1 | 19 |
| Indiana [1 2 3] | 0.2 | 2.0 | 31 | 286 | 2 | 31 |
| Iowa [1 2] | 1.0 | 8.0 | 58 | 524 | 3 | 48 |
| Kansas [1 2 3] | 0.4 | 3.0 | 36 | 326 | 4 | 50 |
| Kentucky [1 2 3] | 0.0 | 0.0 | 29 | 259 | 3 | 39 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Louisiana [1 2 3] | 0.4 | 3.0 | 19 | 169 | 4 | 63 |
| Maine [1 2 3] | 0.0 | 0.0 | 2 | 19 | 0 | 7 |
| Maryland [1 2 3] | 0.0 | 0.0 | 8 | 70 | 8 | 113 |
| Mass. [1 2 3] | 0.0 | 0.0 | 2 | 17 | 0 | 3 |
| Michigan [1 2 3] | 0.0 | 0.0 | 21 | 187 | 4 | 53 |
| Minnesota [1] | 0.4 | 3.0 | 1 | 8 | 2 | 35 |
| Mississippi [1 2 3] | 0.2 | 2.0 | 24 | 216 | 3 | 38 |
| Missouri [1 2 3] | 0.2 | 2.0 | 55 | 499 | 2 | 33 |
| Montana [1 2 3] | 0.0 | 0.0 | 15 | 136 | 0 | 0 |
| Nebraska [1 2 3] | 0.6 | 5.0 | 56 | 508 | 3 | 36 |
| Nevada [1] | 0.0 | 0.0 | 2 | 20 | 6 | 85 |
| New Hampshire [1 2 3] | 0.0 | 0.0 | 0 | 4 | 0 | 1 |
| New Jersey [1 2 3] | 0.0 | 0.0 | 3 | 32 | 3 | 43 |
| New Mexico [1 2 3] | 0.0 | 0.0 | 6 | 56 | 8 | 121 |
| New York [1 2 3] | 0.0 | 0.0 | 17 | 155 | 4 | 55 |
| N Carolina [1 2 3] | 0.1 | 1.0 | 68 | 622 | 8 | 109 |
| North Dakota [1 2] | 0.4 | 3.0 | 28 | 255 | 68 | 966 |
| Ohio [1 2 3] | 0.1 | 1.0 | 37 | 341 | 2 | 31 |
| Oklahoma [1 2 3] | 0.4 | 3.0 | 29 | 262 | 4 | 60 |
| Oregon [1 2 3] | 0.1 | 1.0 | 15 | 140 | 4 | 58 |
| Pennsylvania [1] | 0.0 | 0.0 | 8 | 76 | 11 | 164 |
| Rhode Island [1 2 3] | 0.0 | 0.0 | 0 | 0 | 0 | 1 |
| S Carolina [1 2 3] | 0.0 | 0.0 | 19 | 173 | 7 | 105 |
| South Dakota [1 2 3] | 0.4 | 3.0 | 37 | 339 | 2 | 26 |
| Tennessee [1 2 3] | 0.1 | 1.0 | 27 | 245 | 2 | 26 |
| Texas [1 2 3] | 0.6 | 5.0 | 112 | 1,014 | 6 | 80 |
| Utah [1 2] | 0.0 | 0.0 | 2 | 21 | 4 | 57 |
| Vermont [1 2 3] | 0.0 | 0.0 | 1 | 5 | 0 | 0 |
| Virginia [1 2 3] | 0.0 | 0.0 | 15 | 138 | 8 | 109 |
| Washington [1 2 3] | 0.5 | 4.0 | 62 | 567 | 7 | 96 |
| West Virginia [1 2 3] | 0.0 | 0.0 | 2 | 20 | 2 | 24 |
| Wisconsin [3] | 0.0 | 0.0 | 4 | 41 | 2 | 22 |
| Wyoming [1 2 3] | 0.0 | 0.0 | 10 | 95 | 0 | 5 |
| Puerto Rico [1 2 3] | 0.0 | 0.0 | 44 | 400 | 0 | 0 |
| Other Jurisdictions [1 2 3] | 0.0 | 0.0 | 0 | 0 | 0 | 0 |
| **U.S.** | **7.8** | **65.0** | **1,259** | **11,442** | **270** | **3,857** |

Source: CPARD (2015) and EPA estimation.

[1] No private aerial category; estimated number of applicators.

[2] No private soil fumigation category; estimated number of applicators.

[3] No private non-soil fumigation category; estimated number of applicators.

Table 3.3-7 also presents the expected number of applicators who have or will obtain private applicator certification in soil and non-soil fumigation. Five states (Hawaii, Minnesota, Nevada, Pennsylvania, and Wisconsin) have a private applicator soil fumigation category. For the remaining states, we estimate existing applicators using the estimated coefficients from the regression model for commercial applicators holding certification in a soil fumigation category,

where the number of applicators with soil fumigation certification is a function of the number of private applicators in the state and the crop acres treated with soil fumigants by the farmer. Data on crop treatments come from a privately conducted market survey conducted annually. Initial private applicator certifications in soil fumigation are expected to be 11 percent of the existing certifications, as with commercial applicators using soil fumigation.

Seven states (Arizona, Iowa, Minnesota, Nevada, North Dakota, Pennsylvania, and Utah) have a category for non-soil fumigation by private applicators. As these states also have a commercial non-soil fumigation category, EPA calculated the ratio of private to commercial certifications in the category. The ratio varies from about 0.1 to almost 2.0, with an average of 0.6. The number of private applicator certifications in states without the category was estimated as the number of commercial applicator certifications in the category multiplied by the average ratio or the ratio of a state with similar agronomic characteristics, following the Farm Resource Regions defined by the U.S. Department of Agriculture (ERS, 2000). Initial private applicator certifications in non-soil fumigation average seven percent of the existing certifications, as with commercial applicator certifications in this category.

### 3.3.4 Noncertified applicators under the direct supervision of private applicators

The number of noncertified applicators applying RUPs on farms is likely to be a function of farm size, where farm size is measured by value of sales. Most smaller farms would not need more than one applicator, in general, and even larger farms would probably not have a large enough demand for RUPs that they would need to rely on a certified applicator. We assume that one of every two private applicators on a farm with sales between $100,000 and $1 million per year will have an applicator under his or her supervision to apply RUPs, while private applicators on farms with more than $1 million per year in sales will, on average, have one noncertified applicator under his or her supervision. We obtain the number of farms, by sales, in each state from the 2012 Census of Agriculture (NASS, 2014c). From a special tabulation of data from the 2007 Census of Agriculture (NASS, 2008), we have a national estimate of the proportion of farms in each sales class that utilize pesticides. Using this national figure, we estimate the number of farms in each state that use pesticides. For example, nearly 80 percent of farms with sales between $100,000 and $1 million per year used pesticides in 2007. We therefore estimate that nearly 80 percent of farms in that sales class in every state used pesticides in 2012. In the case of Alabama, this means that we estimate that, out of 3,445 farms with sales between $100,000 and $1 million, 2,753 will use pesticides. Following this procedure with other size classes of farms gives us an estimated 16,630 farms using pesticides. Those in the $100,000 and $1 million sales class account for 16.6 percent of those farms and, we estimate, 16.6 percent of certified applicators. By our previous assumption of half those applicators have someone under their supervision, 8.3 percent of Alabama private applicators will have someone under their supervision. Another 7.0 percent of Alabama private applicators are estimated to be on farms with more than $1 million in sales and will have someone applying RUPs under their supervision. Therefore, we estimate that the number of noncertified applicators in Alabama is 15.3 percent of the 4,914 private applicators, or 753 noncertified applicators. Table 3.3-8 presents estimates for all the states and jurisdictions.

**Table 3.3-8: Estimated Number of Noncertified Applicators Applying RUPs under Supervision of Private Applicators, by Jurisdiction**

| Jurisdiction | Noncertified Applicators UTS of Private Applicator | Noncertified Applicators without WPS training | Noncertified Applicators, Family | | Noncertified Applicators, Hired | |
|---|---|---|---|---|---|---|
| | | | < 16 YO | 16-17 YO | < 16 YO | 16-17 YO |
| Alabama [2] | 753 | 252 | 0.0 | 0.0 | 0.0 | 0.0 |
| Alaska [3] | 9 | 8 | 0.0 | 0.2 | 0.0 | 0.2 |
| Arizona | 42 | 13 | 7.2 | 10.2 | 0.0 | 0.0 |
| Arkansas | 4,490 | 1,354 | 11.2 | 15.8 | 0.0 | 0.2 |
| California | 4,873 | 1,660 | 12.8 | 18.2 | 1.1 | 5.4 |
| Colorado | 901 | 272 | 7.3 | 10.3 | 0.0 | 0.0 |
| Connecticut [2] | 54 | 17 | 0.0 | 0.0 | 0.0 | 0.0 |
| Delaware [2] | 261 | 90 | 0.0 | 0.0 | 0.0 | 0.0 |
| Florida | 519 | 159 | 10.0 | 14.1 | 0.0 | 0.1 |
| Georgia | 3,882 | 1,228 | 8.2 | 11.6 | 0.4 | 1.7 |
| Hawaii | 33 | 10 | 0.7 | 1.1 | 0.0 | 0.0 |
| Idaho | 784 | 241 | 6.3 | 8.9 | 0.0 | 0.1 |
| Illinois | 4,863 | 1,476 | 11.6 | 16.3 | 0.1 | 0.5 |
| Indiana | 3,042 | 913 | 16.6 | 23.3 | 0.0 | 0.0 |
| Iowa [1] | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Kansas | 3,329 | 1,052 | 10.3 | 14.5 | 0.3 | 1.5 |
| Kentucky | 1,098 | 329 | 17.1 | 24.0 | 0.0 | 0.0 |
| Louisiana | 1,224 | 367 | 5.0 | 7.0 | 0.0 | 0.0 |
| Maine | 126 | 39 | 1.6 | 2.4 | 0.0 | 0.0 |
| Maryland | 741 | 248 | 3.8 | 5.4 | 0.1 | 0.7 |
| Massachusetts | 121 | 36 | 2.3 | 3.4 | 0.0 | 0.0 |
| Michigan | 1,414 | 432 | 12.7 | 18.0 | 0.0 | 0.2 |
| Minnesota [1] | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mississippi | 1,654 | 699 | 6.5 | 9.3 | 1.2 | 5.5 |
| Missouri | 2,711 | 890 | 22.0 | 30.9 | 0.4 | 2.1 |
| Montana | 1,450 | 510 | 4.7 | 6.7 | 0.4 | 2.0 |
| Nebraska [3] | 7,597 | 2,487 | 0.0 | 12.6 | 0.0 | 5.6 |
| Nevada | 58 | 23 | 1.0 | 1.4 | 0.0 | 0.1 |
| New Hampshire | 36 | 11 | 1.5 | 2.3 | 0.0 | 0.0 |
| New Jersey [2] | 236 | 73 | 0.0 | 0.0 | 0.0 | 0.0 |
| New Mexico | 246 | 91 | 5.5 | 7.8 | 0.1 | 0.5 |
| New York | 1,351 | 442 | 11.1 | 15.6 | 0.2 | 1.0 |
| North Carolina | 3,596 | 1,327 | 9.8 | 13.8 | 1.4 | 6.7 |
| North Dakota | 4,021 | 1,206 | 5.1 | 7.3 | 0.0 | 0.0 |
| Ohio | 2,978 | 929 | 23.7 | 33.3 | 0.2 | 1.0 |
| Oklahoma | 1,293 | 513 | 17.5 | 24.7 | 0.7 | 3.4 |
| Oregon | 657 | 203 | 8.0 | 11.4 | 0.0 | 0.2 |
| Pennsylvania | 3,428 | 1,151 | 24.0 | 33.8 | 0.7 | 3.3 |
| Rhode Island | 17 | 5 | 0.5 | 0.7 | 0.0 | 0.0 |
| South | 782 | 255 | 5.0 | 7.0 | 0.1 | 0.6 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Carolina | | | | | | |
| South Dakota [1] | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Tennessee | 842 | 253 | 15.3 | 21.7 | 0.0 | 0.0 |
| Texas | 3,869 | 1,580 | 42.0 | 58.9 | 2.4 | 11.4 |
| Utah | 153 | 50 | 4.8 | 6.8 | 0.0 | 0.1 |
| Vermont [3] | 90 | 29 | 0.0 | 2.3 | 0.0 | 0.0 |
| Virginia | 662 | 218 | 10.5 | 14.7 | 0.1 | 0.5 |
| Washington | 2,739 | 901 | 7.1 | 10.1 | 0.5 | 2.1 |
| West Virginia | 66 | 26 | 5.0 | 7.1 | 0.0 | 0.2 |
| Wisconsin | 3,020 | 975 | 18.8 | 26.6 | 0.4 | 1.9 |
| Wyoming | 953 | 445 | 2.0 | 3.0 | 0.9 | 4.3 |
| Puerto Rico | 3,479 | 1,601 | 1.0 | 1.4 | 3.2 | 15.1 |
| Other Jurisdictions | 44 | 15 | 6.0 | 8.6 | 0.0 | 0.1 |
| **U.S.** | **80,587** | **27,104** | **403.1** | **584.5** | **15.3** | **78.4** |

Source: EPA estimation based on CPARD data and NASS (2014c, 2008)

[1] State prohibits noncertified applicators from applying RUPs.

[2] State minimum age of 18 for noncertified applicators applying RUPs.

[3] State minimum age of 16 for noncertified applicators applying RUPs.

As with noncertified applicators applying RUPs under the supervision of commercial applicators, noncertified applicators applying RUPs under the supervision of private applicators must undergo pesticide safety training. Pesticide handlers who receive training under the WPS will be in compliance; these would be pesticide handlers working in crop production. To estimate the number of noncertified applicators who might not be subject to the WPS requirement because the pesticide is used for livestock protection, EPA multiplies the total number of noncertified applicators by the proportion of people employed in pest control in the Agricultural Support Sector out of all pest control employment reported in the BLS data (2015). In addition, since immediate family members of the farm owner are exempt from the WPS training requirement, we add another 30 percent of noncertified applicators across all certifying authorities.

Finally, we estimate the number of noncertified adolescents that may apply RUPs under the direct supervision of a private applicator.

To estimate the number of noncertified adolescent family members who might apply RUPs under the direct supervision of a private applicator, we follow a procedure similar to that of estimating adolescent private applicators. In this case, we base the estimates on the number of second and third farm operators under the age of 25, as reported in the 2012 Census of Agriculture (NASS, 2014c). We again assume 0.5 percent of second and third operators under the age of 25 are 14, 0.75 percent are 15 and 16, and one percent are 17 years old.

To estimate the number of noncertified non-family adolescents applying RUPs under the direct supervision of a private applicator, we rely on data from the National Agricultural Worker Survey (DoL, 2011). According to the survey, 0.4 percent of pesticide handlers were under 16 and 1.9 percent were 16 and 17 years old. We multiply these percentages by the total number of applicators UTS in each state to obtain the estimates shown in Table 3.3-8. Because the WPS prohibits adolescents working in crop production from handling pesticides, we weight this

number by the proportion of commercial certifications for livestock protection out of all commercial certifications issued for crop and livestock protection.

Finally, some states have age restrictions precluding adolescents from applying RUPs. Four states (Alabama, Connecticut, Delaware, and New Jersey) have set a minimum age of 18 and three states (Alaska, Nebraska, and Vermont) have set a minimum age of 16.

### 3.3.5 Wage Rates

Wage rates are used to estimate unit costs for the baseline and final requirements. The Bureau of Labor Statistics' (BLS) Occupational Employment Statistics (OES) data series for national industry-specific occupational employment and wage estimates are used to determine hourly wage rates of affected actors. Wages vary by jurisdiction, but EPA used the national average wage rates. This would result in the over (under)-estimation of impacts for the low (high) wage jurisdictions. However, the differences in wages across jurisdictions should largely cancel out at the national level.

*Wage rates of commercial applicators*

For commercial applicators 18 years and over, we obtain the unloaded mean wage rate ($14.74) for Pesticide Handlers & Applicators (Standard Occupational Code 37-3012) from the U.S. Department of Labor, Bureau of Labor Statistics (BLS, 2016a). Commercial applicators are paid benefits that amount to 46.3% of the unloaded wage rate (BLS, 2013b), which is added to the unloaded wage rate to obtain the loaded wage rate of $21.56. However, for aerial applicators, which is a new application method-specific certification category of the final rule, the loaded wage rate of $73.15/hour is used, as this type of application requires highly skilled labor. This wage rate is based on the average salary for agricultural pilot jobs before benefits of $52,000 for 6 months of employment (Lake Area Technical Institute, undated), plus 46.3% benefits. We assume that commercial applicators aged 16 or 17 years are paid the loaded wage rate that is 75% of the loaded wage rate for commercial applicators 18 years and over. That is, the loaded wage rate for commercial applicators aged 16 or 17 is $16.17.

*Wage rates of private applicators*

The unloaded hourly wage rate for private applicators is from the BLS employment category 11-9013 (Farmers and Ranchers), which has a wage rate of $35.17 (BLS, 2016a). Private applicators are paid benefits that amount to 46.3% of the unloaded wage rate (BLS, 2013b), which is added to the unloaded wage rate to obtain the loaded wage rate of $51.45.

In addition to the age groups used for commercial applicators, we include a third age group of private applicators — those who are under the age of 16. We assume that private applicators under 16 years old are paid a wage that is 50% of the operator wage rate, and that private applicators aged 16 or 17 years old are paid a wage 60% of the operator wage rate. Thus, private applicators under 16 years old are paid the loaded wage rate of $25.73 and private applicators aged 16 or 17 years old are paid the loaded wage rate of $30.87.

*Wage rates of noncertified applicators that apply RUPs under the direct supervision of commercial applicators*

The loaded wage rate for all noncertified applicators applying RUPs under the direct supervision of commercial applicators is based on the national mean unloaded hourly wage rate of $12.11 for the employment category 37-3011 (Landscaping and Groundskeeping Workers), as reported in the OES data series for May 2014 (BLS, 2016a). Noncertified applicators are paid benefits that amount to 46.3% of the unloaded wage rate (BLS, 2013b), which is added to the unloaded wage rate to obtain the loaded wage rate of $17.72. We assume that there are no noncertified applicators applying RUPs under the direct supervision of commercial applicators under age 16. Noncertified applicators applying RUPs under the direct supervision of commercial applicators aged 16 or 17 years old are assumed to earn 75% of the adult wage rate or $13.29.

*Wage rates of noncertified applicators that apply RUPs under the direct supervision of private applicators*

For noncertified applicators applying RUPs under the direct supervision of private applicators, we have identified the same three age groups as those for private applicators. For noncertified applicators 18 years and over, we obtain the unloaded mean wage rate ($14.74) for Pesticide Handlers & Applicators (Standard Occupational Code 37-3012) from the U.S. Department of Labor, Bureau of Labor Statistics (BLS,2016a), to which is added 46.3% in benefits to obtain the loaded wage rate of $21.56. EPA assumes that wage rates for noncertified applicators under age 16 and 16-17 years-old are, respectively, 50% and 60% of the average wage rate for a noncertified applicators 18 years or older applying RUPs under the direct supervision of a private applicator. Assuming that private applicators are paid benefits that amount to 46.3% of the total remuneration, we calculate average loaded wage rate for noncertified applicators under age 16 to be $10.78 and for those aged 16 or 17 to be $12.94.

The loaded average overall wage rates for each age group and labor category appear in Table 3.3-11.

**Table 3.3-11: Applicator Loaded Average Hourly Wage Rates, by Age Group**

| Labor Category | Under age 16 | Age 16 to 17 | 18 years or older |
|---|---|---|---|
| Commercial applicators | | | |
| Certified | *No commercial or noncertified applicators in this age group* | $16.17 | $21.56 |
| Noncertified applying RUPs under the direct supervision | | $13.29 | $17.72 |
| Private applicators | | | |
| Certified | $25.73 | $30.87 | $51.45 |
| Noncertified applying RUPs under the direct supervision | $10.78 | $12.94 | $21.56 |

Source: BLS 2016a.

*Wage rates for state employees*

Wage rates for state implementation costs are organized into three groups: Senior Technical, Junior Technical, and Clerical. Unloaded wage rates for these three groups are obtained from BLS (BLS, 2016a) for 11-0000, Management Occupations; 19-0000, Life, Physical, and Social Science Occupations; and 43-0000, Office and Administrative Support Occupations, respectively. We then load the unloaded wage rates with benefit rate of 46.3% to obtain loaded wages. Table 3.3-12 presents the wage rates for each group of state costs.

**Table 3.3-12: Wage Rates for State Costs**

| | Senior Technical | Junior Technical | Clerical |
|---|---|---|---|
| Unloaded Wage Rate ($/hour) | 40.88 | 27.80 | 19.17 |
| Benefits Factor | 1.463 | 1.463 | 1.463 |
| Loaded Wage Rates ($/hour) | 59.81 | 40.68 | 28.05 |

Source: Unloaded wage rates and benefits factors are obtained from BLS Employer Costs for Employee Compensation - May 2014 (BLS, 2016a)).

## 3.4 Cost of Final Requirements

This section provides EPA's cost estimates for the final requirements. Cost estimates are presented in tabular format, with a brief description. Details on the calculation method, data, and assumptions are provided in Appendix A.

The primary group affected by the final rule are commercial and private applicators, including those obtaining certification for the first time. These applicators may be owners of farms or commercial pest control firms or their employees. Other commercial and government entities may also hire commercial applicators to apply RUPs. Pesticide dealers and registrants are also

impacted by the final requirements. State governments are required by the final rule to implement the changes by changing state regulations and state certification plans and to carry out many of the activities under the final requirements including training, administering exams, and development of training and examination materials.

This analysis assumes that states and other jurisdictions will take two years to update their certification programs after which certified applicators must meet the new requirements. As a result, most costs for the certified applicators start in Year 3 of the analysis. Costs incurred before Year 3 include state costs to rewrite regulations, work changes through their legislatures, develop training programs and examination materials, and to revise tracking databases that maintain applicators' certification/recertification status. This analysis assumes a significantly shorter implementation period than the rule requires. The rule allows certifying authorities up to three years to revise their plans, and gives EPA two years to approve those plans. However, it is unlikely that actual implementation will take that long in all jurisdictions. The assumption of two years before the requirements take effect for the purpose of deriving cost estimates is to avoid underestimating costs over the ten-year time horizon.

Below, we provide a brief summary of the cost of each final requirement in tabular form by affected entity for each area of the final rule. The cost estimates presented in these tables are the present value of the cost over the ten-year time horizon and provide national level costs considering the jurisdiction baselines ($NC^B$) and national level costs for the final requirements ($NC^P$). This is followed by the national level incremental costs (NIC) from the national level cost for the final requirement to the current national level cost of the jurisdiction baseline. Tables are followed by a brief description of the costs of the final requirements.

Industry (i.e., commercial and private applicators) and state costs are presented together for each final requirement.

The section is organized as:

3.4.1 -- Enhancement of Private Applicator Competency Standards;
3.4.2 -- Additional Categories;
3.4.3 -- Examination and Alternate Certification Method Security Standards for Commercial and Private Applicators;
3.4.4 -- Standards for Supervision of Noncertified Applicators Applying RUPs under the Direct Supervision of Certified Applicators, Levels of Supervision, and Provisions for Commercial Applicator Recordkeeping of Applicator Training for Noncertified Applicators Applying RUPs under the Direct Supervision of Certified Applicators;
3.4.5 -- Age Requirements for Certified Applicators and Noncertified Applicators Applying RUPs under the Direct Supervision of Certified Applicators;
3.4.6 -- Standards for Recertification of Certified applicators;
3.4.7 -- Requirements for Submission, Approval and Maintenance of State Certification Plans, and Federal Agency Certification Plans, Tribal Certification Plans, and EPA-Administered Federal Certification Plans.

There are essentially no cost interactions between the various components of the final rule, so estimated incremental costs of each component can be summed to estimate the total incremental cost of the final revisions, which are presented in Section 3.5.

### 3.4.1 Enhancement of Private Applicator General Competency Standards

The final requirements in this category will enhance private applicator core competency standards and certification requirements to more clearly reflect the knowledge and skills needed by private applicators to apply restricted use pesticides (RUPs) safely and effectively. The current requirements for commercial applicator general competency are not being revised.

Currently, private applicators must be certified as competent on five general topics: recognizing pests; reading and understanding labeling; applying pesticides in accordance with the labeling; recognizing environmental conditions and avoiding contamination; and recognizing poisoning symptoms and procedures to follow in the case of a pesticide accident.

The final rule requires that private applicators must demonstrate competency in the general core competency standards similar to those for commercial applicators (i.e., label and labeling comprehension; safety; environment; pests; pesticides; equipment; application techniques; laws and regulations; responsibilities for supervisors of noncertified applicators; stewardship) along with general knowledge of agricultural pest control. See Unit VI.A of the preamble to the final rule for details and Chapter 2.2.1 for the reasons to place these requirements on applicators.

The final revision will require persons seeking initial certification as private applicators to take a written exam or complete a training course. Courses EPA has designed for tribal areas take about 12 hours, which is probably also reflective of the time spent preparing for and taking a written exam. Private applicator incremental costs are $4.3 million annually. See Table 3.4-1. This is the highest cost requirement of the final revisions, but many certifying authorities currently have similar requirements and are in compliance as, high baseline costs indicate.

Table 3.4-1 presents the national-level annualized costs for final requirement, baseline, and incremental cost for the affected parties. The $4.3 million incremental costs for enhancing private applicator general competency standards is from only eight states (AR, GA, KY, MO, MT SD, TN, and WY). These states have low costs in the baseline, so they face higher incremental costs. The incremental costs to these states is 52% of the total cost of the rule. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-1: Annualized Costs of Enhancing Private Applicator General Competency Standards[1]**

| Final Requirement | Type of Cost | National Cost of Final Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Certification of Private Applicators | | | | |
| Exam or 12-hour training for private certification | Industry costs | 23,391 | 19,044 | 4,348 |
| | State costs: develop exam or training | 6.4 | 0 | 6.4 |
| | State costs: administer exam or training | 128 | 60 | 68 |

[1] Source: EPA calculations using a three percent discount rate over a ten-year horizon.

State costs are $6,400 for developing the exam or the trainings per year and $68 thousand per year to administer the exam or trainings. Certifying authorities can choose between requiring certification training for the specified time period or a written certification exam.

## 3.4.2 Additional Categories

The final revision establishes additional certification categories for commercial and private applicators using restricted use pesticides (RUPs) in fumigation (including soil and non-soil fumigation) and aerial application. Final requirements address the elevated risks associated with certain application methods and promote consistency in protections across jurisdictions. See Section 2.2.2 or Unit VII of the preamble for more details.

### 3.4.2.1 Establish Certification Categories for Commercial Applicators

Table 3.4-2 presents the number of commercial applicators in each of the certification categories at the national level. See Section 3.3.1, Table 3.3-3 for state-level estimates.

**Table 3.4-2: Commercial Applicator Numbers by Potential Category**

| Region | First-time Certifications | Existing Certifications | Total Certifications |
|---|---|---|---|
| Commercial Applicator Certifications in the Aerial Category | 1,086 | 9,049 | 10,135 |
| Commercial Applicator Certifications in the Non-Soil Fumigation Category | 1,529 | 21,849 | 23,378 |
| Commercial Applicator Certifications in the Soil Fumigation Category | 484 | 4,400 | 4,884 |

Source: CPARD 2015 and EPA estimations.

Final requirements will require that commercial applicators who intend to apply aerially, or through fumigation must be certified in a specific commercial category by passing a written exam expected to take about 30 minutes (with 6 to 8 hours of preparation time). EPA assumes that the applicator already has core certification and certification in an existing category according to site (e.g., agricultural plant pest control, forest pest control, ornamental and turf pest control, etc.). As explained in the example above (Section 3.2.2), in certifying authorities that currently do not have an additional category, commercial applicators already conducting those applications will have to become certified. In subsequent years, only new entrants to these application methods would require certification. Recertification costs are estimated in Section 3.4.6.

Soil fumigation labels already require training in the use of these products. This rule merely codifies those requirements and bring them under the state certification programs. Therefore, applicators do not bear any additional costs.

Table 3.4-3 below presents the national-level annualized costs for final requirement, baseline, and incremental cost for the affected parties. The annual national incremental costs for commercial applicators obtaining aerial certification are estimated to be $396 thousand, while state costs to develop the exams are estimated at $9 thousand. Commercial applicator incremental costs of obtaining non-soil fumigation certifications are estimated to be $151 thousand per year for commercial applicators employed by industry. State incremental costs to develop non-soil fumigation certification exams are estimated at $7 thousand. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-3: Annualized Costs for Establishing Additional Certification Categories for Commercial Applicators[1]**

| Final Requirements | Type of Cost | National Cost of Final Requirement ($NC^F$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Add commercial aerial category | Industry costs | 868 | 472 | 396 |
| | State costs: administer exam | 1.9 | 0.9 | 0.9 |
| | State costs: develop exam | 9 | 0 | 9 |
| Add commercial non-soil fumigation categories | Industry costs | 406 | 255 | 151 |
| | State costs: administer exam | 2.7 | 1.2 | 1.4 |
| | State costs: develop exam | 7 | 0 | 7 |

[1] Source: EPA calculations using a three percent discount rate over a ten-year horizon.

In addition to the costs described above, these requirements will also entail relatively small state costs of administering certification exams with a total of about $2,500 per year (Table 3.4-3).

### *3.4.2.2 Establish Certification Categories for Private Applicator*

For the private certification categories (aerial, soil, and non-soil fumigation), EPA developed estimates of the number of applicators by new category as presented in Table 3.4-4.

**Table 3.4-4: Private Applicator Numbers by Potential Category**

| Region | First-time Certifications | Existing Certifications | Total Certifications |
|---|---|---|---|
| Private Applicator Certifications in the Aerial Category | 8 | 65 | 73 |
| Private Applicator Certifications in the Non-Soil Fumigation Category | 270 | 3,857 | 4,127 |
| Private Applicator Certifications in the Soil Fumigation Category | 1,259 | 11,442 | 12,701 |

Source: CPARD 2015 and EPA estimations.

The final requirements are that private applicators who intend to apply aerially, or through fumigation must be certified in a specific private category by passing a written exam or completing a training course. Training requirements will entail about four hours for each category; preparation for an exam is expected to take a similar amount of time on average. Certifying authorities would be able to choose between training covering specified content and a written exam for each of the final requirements. The aerial category is relatively low cost as a result of the small number of aerial applicators who would pursue certification. (See Table 3.4-5). The cost to private applicators for non-soil fumigation certification is estimated to be about $97,000 per year nationally. As with commercial applicators, private applicators using soil fumigants are required by label to obtain equivalent training.

Table 3.4-5 presents the national-level annualized costs of final requirement, baseline, and incremental cost for the affected parties. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-5: Annualized Costs of Certification Categories for Private Applicators[1]**

| Final Requirements | Type of Cost | National Cost of Final Requirement ($NC^F$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Add private aerial category and require exam or 4-hour training for certification | Industry costs | 3.3 | 0 | 3.3 |
| | State costs: administer exam | 0.02 | 0 | 0.02 |
| | State costs: develop exam | 25 | 0 | 25 |
| Add private non-soil fumigation categories and | Industry costs | 125 | 28 | 97 |
| | State costs: administer exam | 0.78 | 0.16 | 0.63 |

| Final Requirements | Type of Cost | National Cost of Final Requirement ($NC^F$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| require exam or 4-hour training for | State costs: develop exam | 46 | 0 | 46 |

[1] Source: EPA calculations using a three percent discount rate over a ten year horizon.

State costs for developing the trainings for aerial applications and non-soil fumigations are expected to cost $25,000 and $46,000 respectively over two years following finalization of the rule. Thereafter, certifying authorities are estimated to bear costs of less than $1,000 to administer the trainings or exams.

### 3.4.3 Examination and Alternate Certification Method Security Standards for Commercial and Private Applicators

Security standards for commercial and private applicators aim to improve the quality and administration of pesticide applicator certification. The final revisions add requirements for those seeking certification or recertification by exam to present identification at the time of the session and for examination sessions to be proctored. The final revisions add requirements for private applicators seeking certification by training to present identification at the time of the training. For recertification by continuing education, certifying authorities must include a process that ensures the applicant's successful completion of the course or event. Identification checks will take a few seconds of applicators' and proctor's time and are estimated as part of the proctoring cost because the proctor will check applicators' identification (e.g., driver's license) as they enter the exam or training room.

Administration requirements will primarily impose costs on individuals or employers of individuals seeking to become certified or recertified; private or commercial pesticide applicators; as well as certifying authorities administering certification programs. Administration requirements will have a minimal industry impact on a per applicator basis but, nonetheless, individuals and employers affected by these requirements will pay an opportunity cost for their time or their workers' time while fulfilling the requirements.

Costs of the final revisions are presented together with the costs of the final requirements that entail them. For example, in Table 3.4-5 above, certifying authorities' costs of proctoring application method-specific category exams for private applicator certification are presented together with the industry costs.

### 3.4.4 Standards for Supervision of Applicators that Apply RUPs under the Supervision of Certified Applicators, Levels of Supervision, and Provisions for Commercial Applicator Recordkeeping of Applicator Training for Noncertified Applicators

Currently, there are no specific training or competency requirements for noncertified applicators using RUPs under the direct supervision of a certified applicator. However, under current regulations, the certified applicator must provide verifiable instructions including detailed guidance for each RUP application.

The final revisions require noncertified applicators that use RUPs under the direct supervision of a certified applicator to receive annual training on safe pesticide application and protecting themselves and others from pesticide exposure. The training will be similar to WPS handler training. Those with valid WPS handler training or who hold a valid certification but not in the category of the application being conducted are in compliance with the training requirement. Certifying authorities can also implement a noncertified applicator program that meets or exceeds EPA's standards. See Unit X of the preamble for details.

Table 3.4-6 presents the national-level annualized costs for final requirement, baseline, and incremental cost for the affected parties. The table is followed by a brief description of the costs. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-6: Costs of Standards for Supervision of Noncertified Applicators that Apply RUPs under the Supervision of Commercial Applicators and Establishing Levels of Supervision[1]**

| Final Requirement | Type of Cost | National Cost of Final Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Competency Requirements for Noncertified Applicators under the Supervision of Commercial Applicators | | | | |
| Noncertified applicators applying RUPs under the direct supervision of commercial applicators must complete training, or have taken handler training under the Worker Protection Standard, hold certification in an alternate category to the current application, or qualify under certifying authority's EPA-approved program for noncertified applicator competence | Industry costs | 22,201 | 15,726 | 6,475 |
| Training records of noncertified applicators applying RUPs under the direct supervision of commercial applicators retained for two years; records must be verified and available for supervising commercial applicator | Industry costs | 585 | 248 | 343 |
| Competency Requirements for Noncertified Applicators under the Supervision of Private Applicators | | | | |
| Noncertified applicators applying RUPs under the direct supervision of private applicators must complete training or have taken handler training under the Worker Protection Standard, hold certification in alternate category to the current application, or qualify under certifying authority's EPA-approved program for noncertified applicator competence | Industry costs | 1,801 | 1,183 | 617 |

| Final Requirement | Type of Cost | National Cost of Final Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Guidance Given from Supervisors to Noncertified Applicators | | | | |
| Clarify guidance provided to noncertified applicators applying RUPs under the direct supervision of certified applicators | Industry costs | This proposal involves EPA codifying the current practices by jurisdictions which are in compliance with the proposal, and thus the incremental cost is negligible. | | |
| Communication between Commercial Supervisor and Noncertified Applicator | | | | |
| Noncertified applicators applying RUPs under the direct supervision must have method of immediate 2-way communication with supervisor | Industry costs | Little or no incremental cost as most certified and noncertified applicators own and communicate via cell phone. | | |
| Communication between Private Supervisor and Noncertified Applicator | | | | |
| Noncertified applicators applying RUPs under the direct supervision must have method of immediate 2-way communication with supervisor | Industry costs | 244 | 0 | 244 |

[1] Source: EPA calculations using a three percent discount rate over a ten-year horizon.

Under the final revisions, noncertified applicators who use RUPs under the direct supervision of commercial applicators must complete training as proposed, have completed handler training under the Worker Protection Standard (WPS), hold valid certification, or comply with their certifying authority's approved program for noncertified applicators. Commercial applicators providing services for crop protection are already covered by the WPS, but in estimating the cost, EPA assumes that all noncertified applicators take training covering the content outlined in the rule. The training must be provided by a qualified trainer as described in the final rule. EPA estimates the incremental cost of the final revision at $6.5 million (Table 3.4-6). The cost is high due to a large number of noncertified applicators that need to be trained.

Records of training of the noncertified applicators working under direct supervision of a commercial applicator must be created, verified, and retained for two years, with access available for the supervising commercial applicator. The incremental cost of the requirement is estimated to be $343 thousand.

Noncertified applicators working under the direct supervision of a private applicator must also establish competency by completing training specified in the rule, having completed handler training as required under the Worker Protection Standard, hold a valid certification, or have met their certifying authorities' approved program for noncertified applicators. Many noncertified applicators will already receive handler training under the WPS. Only those working solely with livestock pest control or who are eligible for the immediate family exemption under the WPS will have to be trained under this provision. EPA estimates that this requirement will cost $617 thousand. EPA cannot require private applicators to keep records due to constraints in FIFRA, so there are no requirements to keep records of training for noncertified applicators working under direct supervision of private applicators.

The final revision clarifies the content of the guidance that must be provided by commercial and private applicators to the noncertified applicators applying RUPs under their direct supervision regarding the pesticide application they are conducting. This is expected to be a little or no cost requirement as certified applicators are already providing guidance to noncertified applicators under their supervision.

The proposed rule included a requirement for the certified applicator to provide a copy of the applicable product label to the noncertified applicator. Under the final rule, the certified applicator must ensure the noncertified applicator has access to the applicable product labeling at all times during its use. EPA assumes this cost to be negligible as the pest control firm has the relevant product labeling, which will be made available to noncertified applicators.

The final rule requires commercial and private applicators and individuals working under their direct supervision to have a method for immediate communication during use of an RUP by a noncertified applicator under the direct supervision of a certified applicator. Based on information from five States about communication between supervisors and noncertified applicators under their direct supervision (EPA, 2014b), EPA estimates that in all jurisdictions most supervisors and noncertified applicators applying RUPs under their supervision own and communicate via cell phone. This is presumed to be a normal business practice for commercial pesticide applicators, who work away from a central location and travel extensively for pesticide applications. Thus, EPA assumes the cost of this requirement to commercial certified pesticide applicators will be negligible.

For noncertified applicators under the supervision of private certified applicators, cell phone ownership may be less likely. They may be more likely to be hired because of family relationships or because they live nearby, so they may not have a requirement for cell phones as a requirement for employment. According to Pew Research data (Anderson, 2015), 87 percent of individuals in rural areas own cell phones and EPA assumes this reflects cell phone ownership among private certified applicators and those under their supervision. The cost of the new communications requirement is calculated assuming that 13 percent of noncertified applicators, about 10,500, will be provided with a cell phone or two-way radio. For the purposes of estimating costs, EPA looked at prices of three popular models of two-way radios at an on-line retailer, which were between $40 and $60 (Amazon.com, 2016). Cell phones can be found for similar prices. EPA uses the higher value, $60, as the estimated cost to account for other costs such as a cell phone or data plan. Assuming they must be replaced every two years, the incremental cost, on an annualized basis, is estimated to be $244,000.

There may be situations where cell phones or radios do not work due to poor reception. In those situations, a certified applicator will have to be on-site with any applicators under his or her supervision. This represents an opportunity cost in that the certified applicator cannot be engaged in other pesticide applications or other activities.

### 3.4.5 Age Requirements for Certified Applicators and Applicators Applying RUPs under the Supervision of Certified Applicators

Minimum age requirements for certified applicators aim to improve the safety of application of RUPs. The final revisions require commercial and private applicators to be at least 18 years old. It should be noted that under the final revisions, currently certified applicators who are younger than 18 will be able to maintain their certification, but adolescents will not be allowed to obtain a certification unless they are of age. Noncertified applicators applying RUPs under the direct supervision of these certified applicators will also have to be 18 years old. Under an exception in the rule, a noncertified applicator of 16 years or older may make an application under the supervision of a private applicator member of their immediate family. The final revisions will not allow for current noncertified applicators applying RUPs under the direct supervision of certified applicators under the age of 18 to continue to apply RUPs, except as allowed by the exception.

Table 3.4-7 below presents the national-level annualized costs for the final requirements, baseline, and incremental costs for the affected parties. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-7: Costs of Minimum Age Requirements[1]**

| Final Requirement | Type of Cost | National Cost of Final Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Certified Applicators | | | | |
| Minimum Age of 18 for Commercial Applicators | Industry costs | 1,504 | 1,204 | 300 |
| Minimum Age of 18 for Private Applicators | Industry costs | 524 | 352 | 172 |
| Noncertified Applicators | | | | |
| Minimum Age of 18 for Noncertified Applicators under the Supervision of Commercial Applicators | Industry costs | 29,909 | 23,765 | 6,145 |
| Minimum Age of 18 for Noncertified Applicators under the Supervision of Private Applicators; 16 for family members | Industry costs | 801 | 733 | 69 |

[1] Source: EPA calculations using a three percent discount rate over a ten-year horizon.

The cost of the final revisions will be borne primarily by employers, who will have to pay higher wages to older employees. To the extent that adolescents would be prevented from applying RUPs, they may be confined to lower wage positions or replaced entirely. These losses represent a transfer from adolescent workers to adult workers.

*Minimum Age for Commercial Applicators*

Under the final revisions, all commercial applicators must be at least 18 years old. Due to restrictions on adolescents regarding driving, and the availability to work due to education requirements, as well as general liability concerns, it is unlikely that there are commercial applicators under the age of 16. Existing applicators under 18 years of age will be "grandfathered in" and will not be affected by this requirement. Thus, those affected by the minimum age requirement of 18 would be potential first time commercial applicators aged 16 or 17 years who would no longer be eligible to become certified. As a result, under the final requirement, these underage applicators will be replaced with commercial applicators aged 18 years or older.

EPA estimates that the loaded average wage rate for commercial applicators aged 18 and older is $21.56 while the loaded wage rate for commercial applicators aged 16 and 17 is $16.17. EPA further assumes that the average commercial applicator under the age of 18 years old works 16 weeks and 40 hours per week for a total of 640 hours per year. This is based on the fact that the typical 16 and 17 year old will also be a full time student. EPA assumes that 16 and 17 year old commercial applicators apply pesticides for the entire 640 hours and that they apply RUPs 70% (448 hours per year) of the time that they are applying pesticides, which may be reasonable for extermination services, but not for landscaping work or even many agricultural support firms. Based on the difference in employment costs of noncertified applicators applying RUPs under the direct supervision of certified applicators younger than 18 and those who are 18 and older, EPA estimates industry costs of the final requirement to be $300 thousand (Table 3.4-7). This slight increase from the proposal cost of $294 thousand is due to the updated wage rates and the number of certified commercial applicators.

*Minimum Age for Private Applicators*

Under the final revisions, private applicators must be at least 18 years old. Existing applicators under 18 years of age will be "grandfathered in" and will not be affected by this requirement. EPA assumes that all private applicators make 20 applications per year at about 4 hours per application for a total of 80 hours per year applying pesticides (EPA, 2015c). We further assume that 70 percent of the time, or 56 hours, are spent making applications of RUPs. This is highly conservative since market survey data indicate only about 20 percent of acres are treated with RUPs (Market Research Data, 2008 - 2013).

The loaded average wage rate for private applicators over the age of 18 is $51.45 per hour, the rate for those who are 16 or 17 years old is $30.87 per hour, and the rate for those who are 14 and 15 is $25.73 per hour. Based on the difference in employment costs of private applicators younger than 16, 16 and 17 years old, and applicators 18 years old or older, EPA estimates industry costs of the final revision would be $172 thousand (Table 3.4-10). This slight decrease from the proposal cost of $174 thousand is due to the updated wage rates and the number of certified private applicators.

*Minimum Age of Noncertified Applicators Applying RUPs under the Direct Supervision of Commercial Applicators*

The final revision requires all noncertified applicators applying RUPs under the direct supervision of commercial applicators to be at least 18 years old. Thus, all adolescent noncertified commercial applicators must be replaced by adult noncertified applicators. EPA assumes that the average adolescent applying RUPs under the direct supervision of commercial applicators works 16 weeks and 40 hours per week for a total of 640 hours per year, as was the assumption for adolescents certified to apply RUPs. Further, EPA assumes that they apply RUPs 50% (320 hours per year) of the time that they are applying pesticides. The loaded average wage rate for noncertified applicators applying RUPs under the direct supervision of commercial applicators is $18.34 per hour for adults and $13.76 per hour for adolescents. Based on the difference in employment costs of noncertified applicators applying RUPs under the direct supervision of commercial applicators younger than 18 and those who are 18 and older, EPA estimates industry costs of the final revision at $6.1 million (Table 3.4-7). This substantial decrease from the proposal cost of about $12.8 million is due to more recent estimates of the number of adolescent non-certified applicators. However, this is still a large cost, due to several factors; a sizeable difference between adolescent and adult noncertified wages, a considerable number of applicators involved, and a substantial number of hours worked by adolescent noncertified applicators. However, the assumptions made here are conservative and overestimate the impact of the final revision.

*Minimum Age of Noncertified Applicators Applying RUPs under the Direct Supervision of Private Applicators*

The final revision requires all noncertified applicators applying RUPs under the direct supervision of private applicators to be at least 18 years old, with an exception. A noncertified applicator making application under the supervision of a private applicator who is an immediate family member must be at least 16 years old. EPA assumes that adolescent noncertified applicators, like adolescent certified applicators, apply RUPs about 56 hours per year. The loaded average hourly wage rate for noncertified applicators applying RUPs under the direct supervision of private applicators is $21.56 for adults, $12.94 for 16 and 17 year olds, and $10.78 for 14 and 15 year olds. Based on the difference in employment costs of private applicators younger than 18 and those who are 18 and older, EPA estimates industry costs of the minimum age requirement to be $69 thousand (Table 3.4-7), a substantial decrease from the proposal cost of $1.1 million. This reduction in cost is due to a provision in the recently published Worker Protection Standard (WPS) rule, which prohibits adolescents, other than immediate family members, from mixing, loading, and applying pesticides on a crop farm, which greatly reduced the number of adolescents impacted by the final Certification rule.

### 3.4.6 Standards for Recertification of Certified Applicators

Recertification of private and commercial applicators ensures that certified applicators maintain competencies and keep pace with the changing technology of pesticide application. This, in turn, ensures that the general public, the environment and applicators are protected from

misapplication and misuse. Recertification requirements include trainings, exams or a combination of both and are to be determined by the certifying authorities.

Since the changes to the rule were proposed, EPA received many public comments regarding the recertification requirements. Based on the comments received, EPA is modifying the requirements for recertification standards in the final rule. The proposal required that applicators were to be recertified at least every three years. Commercial applicators would have been recertified in the core competency areas and in each category by examination or training consisting of at least six Continuing Education Units (CEUs) for each area (or similar training). Recertification of private applicators would have required an examination or six CEUs (or similar training) for the general certification and an exam or three CEUs (or the equivalent) in any application-specific category. In the final rule EPA requires a recertification period of 5 years or less. Given the large differences in existing state programs, EPA is not specifying requirements for examinations or training; rather, certifying authorities must provide information to EPA describing how the quantity, content, and quality of their continuing education program ensures that a certified applicator continues to demonstrate the level of competency required by the rule. The submitted plan must include the amount of continuing education required by the plan, the content that is covered and how the certifying authority ensures the required content is covered, the process used to approve programs and how the certifying authority verifies the applicator's successful completion of the course or event, and how the certifying authority ensures the continued quality of the program. These standards allow the certifying authorities more flexibility to meet the requirements for a recertification program, but the requirements for the certifying authorities to meet the standards are less clear than in the proposed rule. Because of these changes, EPA estimates that most certifying authorities will have minimal costs to comply with the recertification standards in the final rule; the remaining certifying authorities will incur costs, including additional continuing education training.

For the proposed rule, EPA's estimate of costs was based primarily on additional hours of certified applicator time to meet the new standards of CEUs and the recertification interval. This allowed a relatively easy calculation of the additional number of hours per year per applicator, valued at the loaded wage rate for applicators. This was multiplied by the number of applicators by state to yield an incremental cost for each state. For the certifying authorities with programs that were already at or above the standards for CEUs proposed by EPA, the incremental costs were zero. For the certifying authorities that needed changes to their recertification program to meet the proposed requirements, EPA estimated that incremental cost.

Because the recertification requirements in the final rule are not stated quantitatively, for example by using CEU standards as in the proposed rule, it is not possible to define exactly what certifying authorities will need to do to comply with the final rule and its cost is similarly difficult to assess. To estimate the cost, the CEU standards from the proposal (EPA 2015b) are still used with the assumption that the certifying authorities that had the highest cost to come into compliance with the recertification proposal may be the certifying authorities that need to do the most to come into compliance with the final rule. The proposed standards would require private applicators to be recertified by exam or completion of six CEUs and by exam or completion of three CEUs for each category recertification. Commercial applicators were required to be recertified by exam or six CEUs for core competency, and by exam or training for each category

recertification. There are some concrete differences between the proposed recertification requirements and the requirements in the final rule. The final rule sets the recertification period to 5 years or less, modified from the proposed 3-year cycle. For estimating the incremental costs for the final rule, we assume the same requirements as the proposed rule, but on a five-year interval, instead of a three-year interval. This revision alone brings the majority of the jurisdictions into compliance with the final recertification requirements. Other than the use of the recertification cycle from the final rule, the use of the requirements from the proposed rule likely results in an over-estimate of the cost for recertification, because the final rule requirements for recertification programs are flexible and expected to accommodate many existing programs.

To estimate the incremental costs for private applicator recertification, EPA chose 11 jurisdictions (Georgia, Arkansas, Mississippi, Missouri, South Dakota, Louisiana, Maryland, Kentucky, Tennessee, Puerto Rico, and tribes and other territories) that have the lowest per-applicator recertification cost in the baseline, and thus the higher incremental cost. The incremental cost is estimated as the difference between the baseline cost and the cost of the requirements in the proposed rule. The incremental per-applicator costs in these jurisdictions are multiplied by their respective number of applicators to generate the jurisdiction-level costs, the present values are computed, summed across the 11 jurisdictions, and annualized to obtain the national-level cost as described in section 3.2.1.

For recertification of commercial applicator competency, 39 states are already in compliance with the proposed requirements, so the estimated incremental costs for recertification compliance were zero. The remaining 13 jurisdictions (Colorado, Ohio, Maine, Missouri, Mississippi, South Carolina, Arkansas, Nebraska, Nevada, Wisconsin, Georgia, Puerto Rico, and tribes and other territories) had a baseline cost was lower than the per applicator cost of the proposal. These jurisdictions are used to estimate the incremental costs for commercial applicator recertification, using the requirements in the proposed rule. The incremental per-applicator costs are multiplied by the respective number of applicators to generate the jurisdiction-level costs, the present values are computed, summed across the jurisdictions, and annualized to obtain the national-level cost as described in section 3.2.1.

Table 3.4-8 presents the national-level annualized costs for the final requirements, baseline, and incremental costs for recertification of commercial and private applicators. The table is followed by a brief description of the costs. Details on the estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-8: Cost of Establishing Standards for Recertification [1]**

| Requirements used for cost estimates | Type of Cost | National Cost of Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Commercial Applicators | | | | |

| Requirements used for cost estimates | Type of Cost | National Cost of Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Commercial recertification: Exam or six-hour training for core and for each existing category (every five years) | Industry costs | 108,429 | 106,524 | 1,905 |
| | State costs: administer recertification exam or training | 3,303 | 2,748 | 555 |
| Exam or six-hour training for commercial aerial category recertification (every five years) | Industry costs | 2,374 | 1,914 | 289 |
| | State costs: administer recertification exam or training | 1,412 | 931 | 481 |
| Exam or six-hour training for commercial non-soil fumigation category recertification (every five years) | Industry costs | 933 | 776 | 157 |
| | State costs: administer recertification exam or training | 2,180 | 1,051 | 1,129 |
| Private Applicators | | | | |
| Exam or 6-hour training for private general competency recertification every five years | Industry costs | 10,152 | 7,199 | 2,952 |
| | State costs: administer recertification exam or training | 974 | 616 | 358 |
| Exam or 3-hour training for aerial category recertification every five years | Industry costs | 2 | 0 | 2 |
| | State costs: administer recertification exam or verify recertification training | 3 | 0 | 3 |
| Exam or 3-hour training for non-soil fumigation category recertification every five years | Industry costs | 245 | 150 | 95 |
| | State costs: administer recertification exam or verify recertification training | 235 | 102 | 133 |

[1] Source: EPA calculations using a three percent discount rate over a ten-year horizon.

Under the final rule, recertification of commercial applicators must take place every 5 years or less by satisfying the certifying authorities' recertification program, or by passing a written exam for core and each applicable category. Its incremental cost is estimated at $1.9 million annually for the applicators and $555 thousand for the certifying authorities. Under the final rule, EPA expects that the jurisdictions with currently low requirements for recertification (as measured by the difference between the levels of continuing education required under the current and the proposed requirements used in estimating the final cost), will likely bear the most costs. These jurisdictions include Colorado, Ohio, Main, Missouri, Mississippi, South Carolina, Puerto Rico, Arkansas, Nebraska, Nevada, Wisconsin, Georgia, and at least some within the Other Jurisdictions group.

The final requirements include training or examination options for commercial applicators seeking recertification in two of the additional categories (aerial and non-soil fumigation). The recertification cycle is 5 years or less. Aerial and non-soil fumigation category recertification will cost commercial applicators approximately $290 thousand and $160 thousand per year, respectively. Certifying authorities incur the costs ($480 thousand for aerial category and $1.1 million for non-soil fumigation category per year) of providing recertification training or examination to commercial applicators.

The final recertification requirement used to estimate the cost for private applicators requires completing 6 hours of training or by passing a written exam every 5 years or less. The requirement is costly (~$3 million) due to the substantial per-applicator costs (6 hours per applicator) and a large number of applicators that need to recertify.

Most private applicators currently do not have an aerial certification, and are not expected to have it under the final rule, which explains small costs for this category. In many certifying authorities, some private applicators conduct non-soil fumigation without category certification as their certifying authorities currently do not require one. These applicators will incur certification and recertification costs for the category under the final rule. The recertification cost for these applicators is estimated at $95 thousand (Table 3.4-8). Certifying authorities incur the costs ($133 thousand) of providing recertification training to these applicators.

## 3.4.7 Requirements for General Administration

There are several new requirements in the final rule that are administrative in nature, which will include recordkeeping requirements for industry, and costs for state and federal governments to implement the changes in the rule.

### *3.4.7.1 Dealer Recordkeeping*

The recordkeeping requirements for dealers of restricted use pesticides (RUPs) under the final rule requires dealers selling RUPs to private and commercial applicators to keep records of RUP sales, including information on what RUP was purchased and the date, the identity of the purchaser, as well as information verifying the applicator is certified. Recordkeeping is currently required by all states, and is also a standard business practice. EPA is merely clarifying and standardizing the current recordkeeping requirements, so does not anticipate any additional costs.

### *3.4.7.2 Certifying Authorities Administration of Plans*

Certifying authorities - States, Tribes, Territories, Federal Agencies, and EPA must update certification plans to comply with the changed requirements. Some States and Territories will need to make regulatory changes and work with their legislatures to change their rules. Tribes with plans need to update them to comply with the revised rule. EPA administers the certification plan in the Navajo Nation and the national certification plan for Indian Country, and will codify the changes for these entities. Finally, the federal agencies with approved certification plans must update their plans to meet the revised requirements and may have to change policies. All plans must be approved by EPA before they are implemented. The cost for these one-time

activities is provided in Table 3.4-9, below. The table is followed by a brief description of the costs. Details on estimation method, data, and assumptions are provided in Appendix A.

**Table 3.4-9: Costs of Final Requirements for Governmental Entities**

| Final Requirement | Type of Cost | National Cost of Final Requirement ($NC^P$) ($000) | National Cost of Baseline ($NC^B$) ($000) | National Incremental Cost (NIC) ($000) |
|---|---|---|---|---|
| Revise certification plans | Jurisdiction costs: implementation | 2,448 | 0 | 2,448 |
| Submit certification plans | Jurisdiction costs: implementation | 5 | 0 | 5 |
| EPA review of certification plans | EPA costs: implementation | 23 | 0 | 23 |
| Revise EPA-administered tribal plans | EPA costs: implementation | 2 | 0 | 2 |
| Develop exam/training materials | Jurisdiction costs: implementation | 95 | 0 | 95 |
| Update tracking databases | Jurisdiction costs: implementation | 1,247 | 0 | 1,247 |

Source: EPA calculations using a three percent discount rate over a ten-year horizon.

*Jurisdiction Implementation*

Many certifying authorities may have to rewrite their laws, regulations, and policies in order to update their certification plans as necessary to meet or exceed the final revisions. In the Economic Analysis of the proposed rule, EPA assumed that the effort to revise the plans would entail about 500 hours of work by state employees (including senior and junior technicians and clerical staff) over two years. The effort was assumed to be spread equally over two years. Based on the public comments on the proposed rule, EPA revised its estimate of this cost to about 10,000 hours or 5 full time employees, again spread equally over two years. The tribes, territories, and federal agencies found in the 'Other Jurisdictions' group have, combined, about the same number of applicators as a smaller state like Delaware or Maine and are assumed to expend, combined, 10,000 hours over two years. The final rule provides the jurisdictions with up to three years to revise their programs, but for the purpose of estimating the costs, EPA assumes the effort will be expended in two years in keeping with EPA's approach to estimate the cost to applicators (see Sections 1.5 and 3.2.1 for further detail on the EPA's rationale for using a two-year implementation period). The estimated annualized cost of revising plans is $2.45 million per year over 10 years (Table 3.4-9) compared to $2.41 million per year over 10 years

under a three-year implementation period. The former represents a slight overestimation compared to the latter, as noted in section 1.5.

The implementation of the final revisions may also necessitate certifying authorities to update their databases to improve tracking of the certification status of applicators. During the public comment period on the proposed rule, several states provided numerical estimates of such costs, and based on this information, EPA estimates the costs of updating tracking databases at $1.2 million per year over 10 years, assuming the full costs are borne in the first two years of the time horizon, see Appendix A for more detail. Another upfront cost that certifying authorities incur during the implementation period are the costs of developing exam and training materials, which are estimated at $95,000 per year. Note that these latter tasks can be conducted after revising and submitting the certification plans.

Note that the costs in Table 3.4-9 are the "upfront" costs (e.g., costs of revising state laws and regulations to update certification plans, costs of developing exam and training materials, etc) that jurisdictions incur during the implementation period and do not include the incremental costs of administering the certification program (e.g., costs to certifying authorities of proctoring certification exams or providing recertification trainings). These costs are estimated in Sections 3.4.1, 3.4.2, and 3.4.6.

*EPA Administration Costs*

EPA will have to review and possibly revise the two tribal certification plans it administers. The total incremental cost is estimated at $2 thousand. EPA will also have to review all the certification plans submitted by the states and other certifying authorities. This cost is estimated at $23 thousand per year (Table 3.4-9). As with the other jurisdictional costs, these costs will be incurred in the initial years of the time horizon.

## 3.5 Total Cost of Final Rule

The total cost of the final rule can be estimated by summing the costs of the components evaluated in the previous sections. EPA estimates that the present value of the incremental cost of the final rule over ten years to be $273 million, given a three percent discount rate. The annualized cost is about $31.3 million per year (Table 3.5-2). Using a seven percent discount rate yields a present value over ten years of $229 million, and an annualized cost of $29.8 million.

**Table 3.5-1. Summation of Costs**

| Component | Annualized Cost<br>Private Applicator | Annualized Cost<br>Commercial Applicator | Annualized Cost<br>Governmental Entities |
|---|---|---|---|

| | | | |
|---|---|---|---|
| | $1,000 | $1,000 | $1,000 |
| Private Certification (Table 3.4-1) | 4,348 | na | 75[a] |
| Aerial Certification (Tables 3.4-3 and 3.4-5) | 3.3 | 396 | 36[a] |
| Non-Soil Fumigation Certification (Tables 3.4-3 and 3.4-5) | 97 | 151 | 56[a] |
| Supervision of Noncertified Applicators (Table 3.4-6) | 861 | 6,475 | na |
| Noncertified Applicator Training Recordkeeping (Table 3.4-6) | na | 343 | na |
| Minimum Age-Certified Applicators (Table 3.4-7) | 172 | 300 | na |
| Minimum Age-Noncertified Applicators (Table 3.4-7) | 69 | 6,145 | na |
| Recertification (Table 3.4-8) | 3,050 | 2,351 | 2,658[b] |
| General Administration (Table 3.4-9) | na | na | 3,725 |
| **U.S. Total** | **8,600** | **16,161** | **6,549** |

[a] Costs of administering certification exams and exam development costs.
[b] Costs of providing recertification trainings.

Private applicators, as a group, will bear incremental cost of about $8.6 million per year, or 27 percent of the total cost of the final rule. Commercial applicators will be expected to bear costs of about $16.2 million per year, or 52 percent of the total cost of the final rule. Certifying authorities and other governmental entities that administer certification programs will bear annualized cost of about $6.5 million per year, but much of these costs will be borne immediately after the rule is finalized as they modify their programs to follow the new federal rules. Those immediate costs of the final rule are estimated to be about $3.8 million per year, with subsequent incremental costs in administering the certification programs to be around $2.7 million per year.

Table 3.5-2 presents the estimated costs of final regulatory requirements, baseline requirements, incremental costs, and annualized incremental costs, by jurisdiction, using a three percent discount rate. Variations in state cost depend on the current state requirements and the number of certified applicators in each state. See Appendix B for details.

**Table 3.5-2. Total Incremental Cost of Final Requirements, by jurisdiction**.

| Jurisdiction | PV($RC^P$) | PV($RC^B$) | PV(RIC) | Annualized RIC |
|---|---|---|---|---|
| | $1,000 | | | |
| Alabama | 28,238 | 24,820 | 3,398 | 389 |
| Alaska | 2,171 | 1,398 | 773 | 88 |
| Arizona | 37,163 | 32,895 | 4,267 | 486 |

| | | | | |
|---|---|---|---|---|
| Arkansas | 33,325 | 18,710 | 14,495 | 1,663 |
| California | 248,819 | 224,368 | 24,322 | 2,783 |
| Colorado | 23,244 | 18,622 | 4,598 | 526 |
| Connecticut | 11,308 | 9,961 | 1,346 | 153 |
| Delaware | 13,458 | 11,247 | 2,149 | 245 |
| Florida | 106,781 | 98,660 | 8,108 | 924 |
| Georgia | 47,076 | 28,185 | 18,788 | 2,150 |
| Hawaii | 6,936 | 5,243 | 1,693 | 193 |
| Idaho | 39,538 | 37,284 | 2,233 | 257 |
| Illinois | 77,248 | 74,347 | 2,772 | 330 |
| Indiana | 78,285 | 75,347 | 2,857 | 334 |
| Iowa | 86,768 | 85,283 | 1,485 | 169 |
| Kansas | 45,580 | 41,890 | 3,601 | 420 |
| Kentucky | 62,441 | 46,943 | 15,410 | 1,757 |
| Louisiana | 22,271 | 18,358 | 3,574 | 411 |
| Maine | 6,687 | 4,862 | 1,801 | 205 |
| Maryland | 18,509 | 16,644 | 1,845 | 212 |
| Massachusetts | 9,127 | 8,437 | 687 | 79 |
| Michigan | 104,845 | 101,174 | 3,633 | 418 |
| Minnesota | 43,295 | 41,915 | 1,379 | 157 |
| Mississippi | 23,150 | 18,667 | 4,255 | 489 |
| Missouri | 47,080 | 31,296 | 15,712 | 1,797 |
| Montana | 13,350 | 11,726 | 1,586 | 185 |
| Nebraska | 50,373 | 43,383 | 4,704 | 558 |
| Nevada | 8,828 | 7,366 | 1,460 | 166 |
| New Hampshire | 4,113 | 3,461 | 650 | 74 |
| New Jersey | 22,363 | 21,483 | 874 | 100 |
| New Mexico | 14,550 | 13,116 | 1,189 | 136 |
| New York | 73,563 | 69,323 | 4,204 | 483 |
| North Carolina | 73,099 | 67,847 | 5,157 | 598 |
| North Dakota | 34,768 | 29,145 | 5,228 | 607 |
| Ohio | 49,683 | 40,861 | 8,663 | 995 |
| Oklahoma | 80,279 | 70,765 | 9,479 | 1,083 |
| Oregon | 29,197 | 26,990 | 2,190 | 251 |
| Pennsylvania | 68,174 | 63,674 | 4,077 | 474 |
| Rhode Island | 3,389 | 1,891 | 1,493 | 170 |
| South Carolina | 22,529 | 17,489 | 4,364 | 499 |
| South Dakota | 39,525 | 26,664 | 12,861 | 1,464 |
| Tennessee | 65,390 | 54,672 | 10,696 | 1,220 |
| Texas | 180,460 | 175,194 | 5,163 | 599 |
| Utah | 22,019 | 19,777 | 2,201 | 251 |

| | | | | |
|---|---|---|---|---|
| Vermont | 3,875 | 2,742 | 1,130 | 129 |
| Virginia | 34,672 | 33,595 | 1,060 | 123 |
| Washington | 75,967 | 61,774 | 14,120 | 1,615 |
| West Virginia | 7,015 | 6,064 | 949 | 108 |
| Wisconsin | 53,146 | 42,269 | 10,797 | 1,238 |
| Wyoming | 14,420 | 11,232 | 3,129 | 359 |
| Puerto Rico | 33,283 | 25,523 | 7,671 | 884 |
| Other Jurisdictions | 8,833 | 6,176 | 2,673 | 304 |
| **U.S. Total** | **2,310,204** | **2,030,756** | **272,952** | **31,310** |

Source: EPA calculations using a three percent discount rate over a ten-year period. Columns may not sum due to rounding.

The states with the highest incremental costs are California, Georgia, Missouri, Kentucky, and Arkansas. The main driver in these states is the relatively large number of certified applicators. In California, commercial applicators will bear a relatively large proportion of the cost, because California will incur a large cost of training noncertified applicators under the direct supervision of commercial applicators under the final rule. For the other certifying authorities, the primary change will be in the initial certification of private applicators.

States with the lowest incremental costs include Alaska and the New England states where there are relatively few certified applicators. Other low-cost states, such as Iowa and Virginia have state requirements that largely meet or exceed the requirements in the final rule.

The changes in the certification requirements will be unlikely to have an impact on jobs. Most private applicators are self-employed. The annualized incremental cost of the final rule to private applicators will be about $25 per applicator, on average, and this will represent a small fraction of the cost of employing an applicator, even part time. The average annualized cost of the final rule to commercial applicators will be about $46 per applicator, on average, and is similarly a very small fraction of the cost of employing a part-time applicator. A full analysis of employment impact is presented in Section 3.6.

The changes are not expected to have a significant impact on a substantial number of small businesses. In most cases, incremental costs represent less than one percent of gross revenues for commercial enterprises or less than one percent of total sales of agricultural products for farming enterprises. Incremental costs in a few states could exceed two percent of total sales of agricultural products for farms with sales less than $5,000 per year. The number of farms facing such impacts is likely to be quite small, however. Perhaps a fifth of the farms affected by the final revisions to the certification requirements might also bear costs associated with the changes to the Worker Protection Standard. A full analysis of small business impacts follows in Section 3.7.

In the following sections, impacts of the requirements of the final rule on different sectors -- private applicators, commercial applicators, and governmental entities -- are presented.

### 3.5.1 Private Applicator Cost of Final Rule

The total cost of the final rule to private applicators can be estimated by summing the costs of the seven components evaluated in Section 3.4. Table 3.5-3 presents the PVs of costs for the final regulatory requirement, baseline requirement, incremental cost, and annualized incremental cost by jurisdiction. For private applicators, EPA estimates that the annualized incremental cost of the final rule over ten years to be $8.6 million, given a three percent discount rate. See Appendix B for details.

**Table 3.5-3 Private Applicator Cost of Final Rule**

| Jurisdiction | PV($RC^P$) | PV($RC^B$) | PV(RIC) | Annualized RIC |
|---|---|---|---|---|
| | $1,000 | | | |
| Alabama | 9,229 | 9,059 | 150 | 19 |
| Alaska | 235 | 229 | 5 | 0.63 |
| Arizona | 1,605 | 1,562 | 42 | 5 |
| Arkansas | 23,209 | 12,533 | 10,556 | 1,215 |
| California | 43,026 | 41,808 | 1,089 | 139 |
| Colorado | 7,122 | 7,014 | 84 | 12 |
| Connecticut | 925 | 923 | 1 | 0 |
| Delaware | 1,104 | 991 | 52 | 7 |
| Florida | 6,811 | 6,440 | 357 | 42 |
| Georgia | 22,776 | 10,574 | 12,099 | 1,389 |
| Hawaii | 1,230 | 1,211 | 18 | 2 |
| Idaho | 6,687 | 6,645 | 21 | 5 |
| Illinois | 33,301 | 33,082 | 89 | 25 |
| Indiana | 15,332 | 15,175 | 76 | 18 |
| Iowa | 32,093 | 31,954 | 139 | 16 |
| Kansas | 21,640 | 21,423 | 129 | 25 |
| Kentucky | 23,045 | 11,273 | 11,743 | 1,340 |
| Louisiana | 8,048 | 6,474 | 1,541 | 179 |
| Maine | 2,025 | 1,989 | 33 | 4 |
| Maryland | 3,364 | 2,806 | 539 | 64 |
| Massachusetts | 2,898 | 2,891 | 4 | 1 |
| Michigan | 26,198 | 26,113 | 48 | 10 |
| Minnesota | 18,462 | 18,366 | 96 | 11 |
| Mississippi | 16,631 | 14,112 | 2,475 | 287 |
| Missouri | 23,915 | 12,805 | 11,038 | 1,264 |
| Montana | 6,385 | 5,770 | 577 | 70 |
| Nebraska | 22,460 | 20,496 | 103 | 35 |
| Nevada | 1,000 | 996 | 3 | 0 |
| New Hampshire | 1,131 | 1,128 | 2 | 0 |
| New Jersey | 3,053 | 3,017 | 30 | 4 |

| | | | | |
|---|---|---|---|---|
| New Mexico | 3,734 | 3,351 | 138 | 16 |
| New York | 10,851 | 10,746 | 69 | 12 |
| North Carolina | 17,960 | 17,730 | 135 | 26 |
| North Dakota | 17,980 | 17,266 | 607 | 81 |
| Ohio | 18,420 | 18,216 | 125 | 23 |
| Oklahoma | 24,648 | 24,191 | 423 | 52 |
| Oregon | 8,944 | 8,879 | 48 | 7 |
| Pennsylvania | 19,013 | 18,503 | 88 | 20 |
| Rhode Island | 186 | 177 | 5 | 0.61 |
| South Carolina | 9,840 | 9,028 | 205 | 26 |
| South Dakota | 24,427 | 13,572 | 10,855 | 1,235 |
| Tennessee | 9,944 | 6,619 | 3,303 | 378 |
| Texas | 96,606 | 96,193 | 310 | 47 |
| Utah | 7,061 | 7,017 | 39 | 5 |
| Vermont | 864 | 845 | 17 | 2 |
| Virginia | 15,775 | 15,650 | 108 | 14 |
| Washington | 18,202 | 17,577 | 553 | 71 |
| West Virginia | 1,910 | 1,874 | 34 | 4 |
| Wisconsin | 20,079 | 19,433 | 565 | 73 |
| Wyoming | 6,759 | 5,440 | 1,293 | 150 |
| Puerto Rico | 15,840 | 14,503 | 1,245 | 152 |
| Other Jurisdictions | 1,115 | 998 | 115 | 13 |
| **U.S. Total** | **735,100** | **656,667** | **73,417** | **8,600** |

Source: EPA calculations using a three percent discount rate over a ten-year period.

The states with the highest incremental costs for private applicators include Georgia, Kentucky, Missouri, South Dakota, and Arkansas. The main drivers in these states are the high incremental costs of obtaining and maintaining a private applicator license under the final rule, because their state plans only meet the baseline. At the national level, initial certification and recertification costs account for nearly 90 percent of the total cost to private applicators (Figure 1).

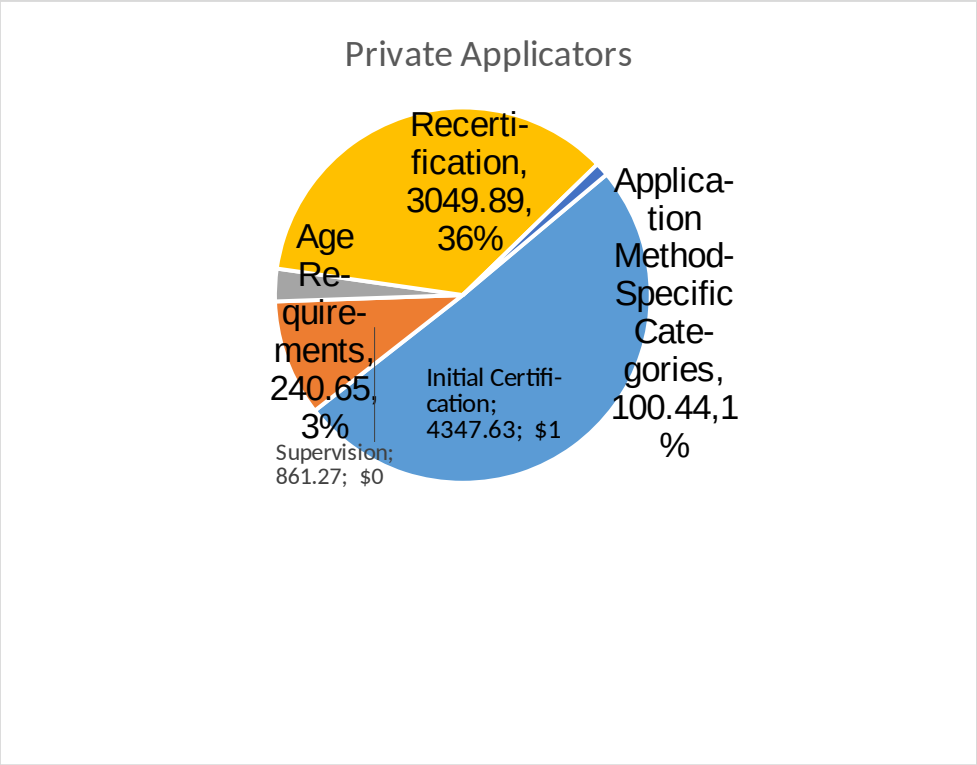


**Figure 1. Private Applicator Costs by Rule Area**

### 3.5.2 Commercial Applicator Cost of Final Rule

The total cost of the final rule to commercial applicators can be estimated by summing the costs of the six components evaluated in Section 3.4. Table 3.5-4 presents the PVs of costs for the final regulatory requirement, baseline requirement, incremental cost, and annualized incremental cost by jurisdiction. For commercial applicators, EPA estimates that the annualized incremental cost of the final rule over ten years to be $16.2 million, given a three percent discount rate. See Appendix B for details.

**Table 3.5-4 Commercial Applicator Cost of Final Rule**

| Jurisdiction | PV($RC^P$) | PV($RC^B$) | PV(RIC) | Annualized RIC |
|---|---|---|---|---|
| | $1,000 | | | |
| Alabama | 17,777 | 15,312 | 2,466 | 281 |
| Alaska | 1,282 | 1,128 | 153 | 17 |
| Arizona | 33,881 | 30,428 | 3,453 | 393 |
| Arkansas | 8,496 | 5,853 | 2,644 | 301 |
| California | 195,938 | 175,788 | 20,150 | 2,293 |
| Colorado | 14,857 | 11,424 | 3,433 | 391 |
| Connecticut | 9,584 | 8,915 | 669 | 76 |
| Delaware | 11,343 | 9,955 | 1,388 | 158 |

| | | | | |
|---|---|---|---|---|
| Florida | 91,709 | 87,228 | 4,481 | 510 |
| Georgia | 22,141 | 16,815 | 5,326 | 606 |
| Hawaii | 4,766 | 3,804 | 962 | 109 |
| Idaho | 31,158 | 29,918 | 1,241 | 141 |
| Illinois | 41,901 | 40,052 | 1,849 | 210 |
| Indiana | 59,216 | 57,331 | 1,886 | 215 |
| Iowa | 50,228 | 49,903 | 325 | 37 |
| Kansas | 22,096 | 20,101 | 1,995 | 227 |
| Kentucky | 37,113 | 34,805 | 2,249 | 256 |
| Louisiana | 12,720 | 11,668 | 745 | 85 |
| Maine | 3,802 | 2,718 | 1,064 | 121 |
| Maryland | 12,791 | 12,739 | 52 | 6 |
| Massachusetts | 5,395 | 5,370 | 25 | 3 |
| Michigan | 75,640 | 73,054 | 2,586 | 294 |
| Minnesota | 22,593 | 22,264 | 329 | 37 |
| Mississippi | 5,299 | 4,393 | 722 | 82 |
| Missouri | 21,051 | 17,944 | 3,107 | 354 |
| Montana | 6,059 | 5,758 | 301 | 34 |
| Nebraska | 25,584 | 22,257 | 2,903 | 330 |
| Nevada | 6,952 | 6,186 | 766 | 87 |
| New Hampshire | 2,234 | 2,234 | 0 | 0 |
| New Jersey | 17,963 | 17,963 | 0 | 0 |
| New Mexico | 9,807 | 9,503 | 304 | 35 |
| New York | 60,739 | 57,464 | 3,275 | 373 |
| North Carolina | 52,949 | 49,313 | 3,636 | 414 |
| North Dakota | 14,339 | 10,722 | 3,329 | 379 |
| Ohio | 29,108 | 21,970 | 7,058 | 803 |
| Oklahoma | 52,952 | 45,205 | 7,747 | 882 |
| Oregon | 18,825 | 17,583 | 1,242 | 141 |
| Pennsylvania | 46,712 | 44,066 | 2,647 | 301 |
| Rhode Island | 2,506 | 1,687 | 819 | 93 |
| South Carolina | 11,387 | 8,185 | 3,133 | 357 |
| South Dakota | 13,208 | 12,488 | 720 | 82 |
| Tennessee | 53,236 | 46,963 | 6,272 | 714 |
| Texas | 78,539 | 74,812 | 3,727 | 424 |
| Utah | 13,807 | 12,317 | 1,453 | 165 |
| Vermont | 2,305 | 1,828 | 477 | 54 |
| Virginia | 17,375 | 17,375 | 0 | 0 |
| Washington | 54,488 | 43,023 | 11,465 | 1,305 |
| West Virginia | 4,252 | 4,083 | 169 | 19 |
| Wisconsin | 31,510 | 22,362 | 9,148 | 1,041 |

| | | | | |
|---|---|---|---|---|
| Wyoming | 6,752 | 5,567 | 1,152 | 131 |
| Puerto Rico | 16,157 | 10,765 | 5,392 | 614 |
| Other Jurisdictions | 6,649 | 5,091 | 1,558 | 177 |
| **U.S. Total** | **1,469,170** | **1,325,675** | **141,992** | **16,161** |

Source: EPA calculations using a three percent discount rate over a ten-year period.

The states with the highest incremental costs for commercial applicators include California, Washington, and Wisconsin. For example, under the final rule, commercial applicators in California will bear a large cost of training noncertified applicators under their direct supervision. At the national level, the costs associated with age requirements and supervision of noncertified applicators under the direct supervision of a certified applicator account for about 80 percent of the total cost to commercial applicators (Figure 2).

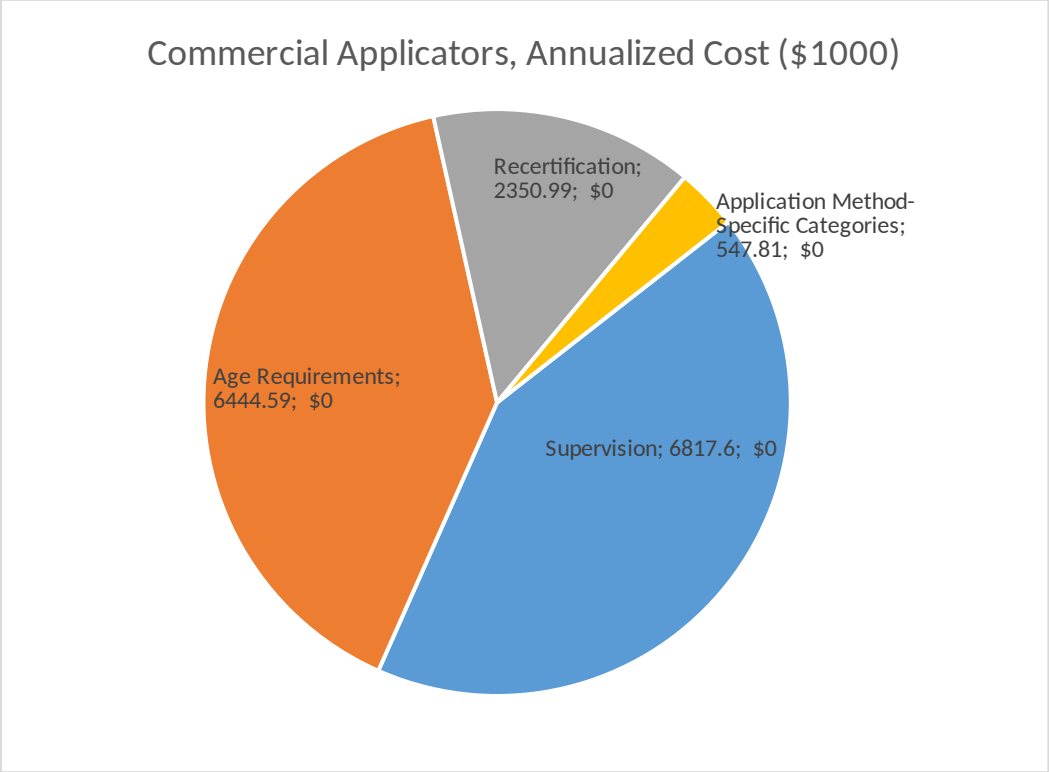


**Figure 2. Commercial Applicator Costs by Rule Area**

### 3.5.3 Cost to Certifying Authorities of Final Rule

The total cost of the final rule to certifying authorities (States, Tribes, Territories, Federal Agencies, and EPA) can be estimated by summing the costs of the individual requirements evaluated in Section 3.4. Table 3.5-5 presents the PVs of costs for the final regulatory requirement, baseline requirement, incremental cost, and the annualized incremental cost by jurisdiction. For these entities, EPA estimates that the annualized incremental cost of the final rule over ten years to be $6.5 million given a three percent discount rate. See Appendix B for details.

2676
2677 **Table 3.5-5 Cost to Certifying Authorities of Final Rule**

| Jurisdiction | PV($RC^P$) | PV($RC^B$) | PV(RIC) | Annualized RIC |
|---|---|---|---|---|
| | $1,000 | | | |
| Alabama | 1,231 | 449 | 782 | 89 |
| Alaska | 654 | 40 | 614 | 70 |
| Arizona | 1,677 | 905 | 771 | 88 |
| Arkansas | 1,619 | 324 | 1,295 | 147 |
| California | 9,855 | 6,772 | 3,083 | 351 |
| Colorado | 1,265 | 184 | 1,081 | 123 |
| Connecticut | 799 | 122 | 677 | 77 |
| Delaware | 1,010 | 301 | 709 | 81 |
| Florida | 8,261 | 4,991 | 3,270 | 372 |
| Georgia | 2,159 | 795 | 1,363 | 155 |
| Hawaii | 940 | 228 | 712 | 81 |
| Idaho | 1,692 | 720 | 972 | 111 |
| Illinois | 2,046 | 1,213 | 833 | 95 |
| Indiana | 3,737 | 2,841 | 896 | 102 |
| Iowa | 4,447 | 3,426 | 1,021 | 116 |
| Kansas | 1,844 | 366 | 1,477 | 168 |
| Kentucky | 2,283 | 865 | 1,418 | 161 |
| Louisiana | 1,503 | 215 | 1,288 | 147 |
| Maine | 860 | 155 | 704 | 80 |
| Maryland | 2,355 | 1,100 | 1,255 | 143 |
| Massachusetts | 835 | 176 | 659 | 75 |
| Michigan | 3,007 | 2,008 | 999 | 114 |
| Minnesota | 2,240 | 1,285 | 955 | 109 |
| Mississippi | 1,221 | 163 | 1,058 | 120 |
| Missouri | 2,115 | 547 | 1,568 | 178 |
| Montana | 905 | 198 | 708 | 81 |
| Nebraska | 2,328 | 631 | 1,698 | 193 |
| Nevada | 876 | 184 | 692 | 79 |
| New Hampshire | 748 | 99 | 648 | 74 |
| New Jersey | 1,348 | 503 | 845 | 96 |
| New Mexico | 1,008 | 261 | 747 | 85 |
| New York | 1,972 | 1,112 | 860 | 98 |
| North Carolina | 2,190 | 804 | 1,386 | 158 |
| North Dakota | 2,450 | 1,157 | 1,293 | 147 |
| Ohio | 2,155 | 676 | 1,479 | 168 |
| Oklahoma | 2,679 | 1,370 | 1,309 | 149 |
| Oregon | 1,428 | 528 | 900 | 102 |

| | | | | |
|---|---|---|---|---|
| Pennsylvania | 2,448 | 1,106 | 1,342 | 153 |
| Rhode Island | 696 | 27 | 669 | 76 |
| South Carolina | 1,302 | 276 | 1,025 | 117 |
| South Dakota | 1,889 | 604 | 1,286 | 146 |
| Tennessee | 2,211 | 1,090 | 1,121 | 128 |
| Texas | 5,315 | 4,190 | 1,126 | 128 |
| Utah | 1,151 | 443 | 709 | 81 |
| Vermont | 706 | 69 | 637 | 72 |
| Virginia | 1,522 | 570 | 952 | 108 |
| Washington | 3,277 | 1,174 | 2,102 | 239 |
| West Virginia | 852 | 106 | 746 | 85 |
| Wisconsin | 1,558 | 475 | 1,083 | 123 |
| Wyoming | 909 | 225 | 684 | 78 |
| Puerto Rico | 1,286 | 255 | 1,034 | 118 |
| Other Jurisdictions | 1,069 | 87 | 1,000 | 114 |
| **U.S. Total** | **105,934** | **48,414** | **57,542** | **6,549** |

Source: EPA calculations using a three percent discount rate over a ten-year period.

EPA received many public comments on the costs that the certifying authorities would incur in complying with the proposed changes to the current Certification rule. The comments indicate that for many states, these rule changes would require costly revision of state laws and regulations. To address these comments, EPA revised the requirements and also these costs in associated with the Economic Analysis of the final rule (Table 3.5-6). The comments also indicate that EPA underestimated the cost of travel to training or exam sites for applicators and state employees. The travel costs are incurred as part of the costs of obtaining or providing certification and recertification exams and/or trainings (the costs of administering exam/training in Table 3.5-6), and the revision of travel costs in the Economic Analysis of the final rule significantly increased the incremental costs to certifying authorities. The comments also pointed out the need to update certifying authorities' tracking databases to comply with the rule changes, which is estimated in this analysis.

**Table 3.5-6 Breakdown of Cost of Final Rule to Governmental Entities**

| Component | Annualized Cost ($1000) | % of total cost |
|---|---|---|
| Revise and Submit certification plans (Table 3.4-9) | 2,453 | 38% |
| EPA costs (Table 3.4-9) | 25 | 0.4% |
| Exam/training material development (Table 3.4-9) | 95 | 1.4% |
| Update tracking database (Table 3.4-9) | 1,247 | 19% |
| Administer exam/training [1] | 2,730 | 41% |
| **Total** | **6,549** | **100%** |

Source: EPA calculations using a three percent discount rate over a ten-year period.

[1] Tables 3.4-1, 3, 5, and 8.

*State Enforcement Cost:*

States and other certifying authorities are responsible for enforcing the Certification rule, which they do through a combination of outreach to employers and inspections of employers. Typically, some inspections are done randomly while others are made as a result of complaints or as a response to incidents. Revisions to the Certification rule should not change the total number of inspections over time although they may change the way inspections are conducted on an establishment. Some revisions made to the rule, such as the recordkeeping requirements of noncertified applicator training, may add to the list of items an inspector will check. However, the revisions should not substantially extend the time required for a typical inspection.

In the short term, EPA anticipates states and other lead agencies may need to redirect resources planned for outreach and training of inspectors as a result of revisions to the Certification rule. That is, agencies may plan to highlight certain aspects of the rule in programs for employers and/or inspectors each year. State agencies may choose to alter some planned programs in order to focus on changes to the Certification. However, EPA does not anticipate that agencies will need additional resources for enforcement activities. There will be an implementation phase for the new requirements, which will allow time for certifying authorities to prepare for the changes utilizing existing resources.

## 3.6 Impact on Employment

Executive Order 13563 directs federal agencies to consider the effect of regulations on job creation and employment. Labor is an important input into production and changes in the cost of labor may cause farms and firms to adjust employment levels. If farms and commercial pesticide services bear the cost of changes in certification requirements, by, for example, paying for training or allowing employees to prepare for exams during working hours, there would be an increase in the cost of employing a certified applicator and, potentially, a reduction in the demand for certified applicators. On the other hand, if the applicator bears the cost of changes in certification requirements, because training and exams are taken outside working hours as a means of increasing skills and employment opportunities, increased costs of obtaining and retaining certification may lead to a reduction in the supply of certified applicators.

Thus, an important consideration is the impact the revisions to the Certification requirements will have on employment. The magnitude of the incremental per-applicator cost, relative to the cost of employment or return to employment, provides a measure by which EPA can evaluate the impact on jobs. The average incremental cost per applicator can be calculated as simply the total annualized incremental cost of the rule, for each jurisdiction, divided by the number of applicators. This incorporates the cost of obtaining certification, the cost of recertification, and the costs of the new categories and supervision of noncertified applicators, as well as the impacts of the minimum age provisions. That is, the average overstates the basic costs of obtaining and maintaining certification, but underestimates the cost to an individual who obtains certification in a new category and/or who supervises noncertified applicators.

The incremental per-applicator cost also includes potential fee increases for certification and recertification exams and training courses that may occur as a result of the final rule. The fee increases could result from certifying authorities passing the increased costs of operating their certification programs due to the revised requirements on to the applicators. Based on the public comments on the EPA's proposed rule, many state certification programs are mostly financed with such fees collected from the applicators, and certifying authorities may have to increase these fees to cover the increased costs from the final rule.

The fee increase for applicators due to the final rule are estimated as follows. EPA assumes that all jurisdictions pass the entirety of increased costs of operating the certification programs on to applicators. The computation of fee increase is illustrated for private applicators, but it applies to commercial applicators as well. The private applicator cost of the final rule, for example, about $1.2 million for Arkansas (Table 3.5-3), is divided by the total number (about 20,900) of private applicators in Arkansas to obtain the average per-applicator cost of about $58 for Arkansas private applicators (Table 3.6-1). This represents the direct impact of the final rule on Arkansas private applicators. The total incremental cost to the state of Arkansas, estimated to be $147,000 per year (Table 3.5-5), represents the increased costs of operating certification programs due to the final rule. This total cost is assumed to be passed on to applicators as the fee increase. Thus, dividing $147,000 by the total number of private and commercial applicators (25,043) in Arkansas yields the average fee increase per applicator of just under $6 per year. The latter is added to the $58 per-applicator for Arkansas private applicators to obtain the average total impact of $64 per applicator (Table 3.6-1) for Arkansas private applicators due to the final rule. The same procedure applies to other jurisdictions and to commercial applicators as well, with a range of fees from a low of just over $2 in Texas to a high of almost $119 in Alaska. This assumes that applicators absorb the incremental costs to certifying authorities in addition to facing the incremental costs imposed directly on them from the final rule. Because for some certifying authorities the funds for operating certification programs may come from sources (e.g., the general revenue) other than the fees collected from applicators, the fee increase estimated under the EPA's assumption is conservative, and the per-applicator costs reported in Tables 3.6-1 and 3.6-2 are likely to be overestimates of the impacts of the final rule on applicators.

***Private Applicators***

Table 3.6-1 presents the estimated annualized cost for private applicators (from Table 3.5-3), the total number of private applicators, and the average cost per private applicator including the fee increase, by jurisdiction.

**Table 3.6-1. Annualized Per-Applicator Costs, by Jurisdiction, Private Applicators.**

| Jurisdiction | Annualized RIC ($1,000) | Number of private applicators | Cost ($) per private applicator | Cost ($) per private applicator, including fee increase |
|---|---|---|---|---|
| Alabama | 19 | 5,546 | $ 3.49 | $ 12.72 |
| Alaska | 0.63 | 78 | $ 8.16 | $ 127.02 |

| | | | | |
|---|---|---|---|---|
| Arizona | 5 | 447 | $ 11.05 | $ 22.06 |
| Arkansas | 1,215 | 20,879 | $ 58.19 | $ 64.08 |
| California | 139 | 18,516 | $ 7.49 | $ 13.84 |
| Colorado | 12 | 5,329 | $ 2.30 | $ 15.43 |
| Connecticut | 0 | 542 | $ 0.45 | $ 23.36 |
| Delaware | 7 | 713 | $ 9.35 | $ 39.84 |
| Florida | 42 | 3,987 | $ 10.57 | $ 28.90 |
| Georgia | 1,389 | 18,977 | $ 73.18 | $ 78.35 |
| Hawaii | 2 | 420 | $ 5.12 | $ 55.09 |
| Idaho | 5 | 3,535 | $ 1.35 | $ 15.74 |
| Illinois | 25 | 16,842 | $ 1.48 | $ 4.43 |
| Indiana | 18 | 12,713 | $ 1.40 | $ 5.92 |
| Iowa | 16 | 22,514 | $ 0.70 | $ 3.90 |
| Kansas | 25 | 14,773 | $ 1.67 | $ 9.72 |
| Kentucky | 1,340 | 13,221 | $ 101.34 | $ 107 |
| Louisiana | 179 | 7,606 | $ 23.55 | $ 35.43 |
| Maine | 4 | 1,163 | $ 3.53 | $ 31.99 |
| Maryland | 64 | 3,290 | $ 19.32 | $ 37.32 |
| Massachusetts | 1 | 1,104 | $ 0.74 | $ 23.38 |
| Michigan | 10 | 7,499 | $ 1.30 | $ 6.49 |
| Minnesota | 11 | 17,225 | $ 0.63 | $ 4.54 |
| Mississippi | 287 | 10,496 | $ 27.32 | $ 36.24 |
| Missouri | 1,264 | 21,293 | $ 59.38 | $ 65.49 |
| Montana | 70 | 6,133 | $ 11.42 | $ 20.79 |
| Nebraska | 35 | 21,597 | $ 1.61 | $ 7.74 |
| Nevada | 0 | 305 | $ 1.53 | $ 40.45 |
| New Hampshire | 0 | 502 | $ 0.66 | $ 41.71 |
| New Jersey | 4 | 1,761 | $ 2.32 | $ 11.34 |
| New Mexico | 16 | 2,633 | $ 6.25 | $ 23.04 |
| New York | 12 | 6,871 | $ 1.74 | $ 5.57 |
| North Carolina | 26 | 15,878 | $ 1.65 | $ 6.17 |
| North Dakota | 81 | 11,622 | $ 6.99 | $ 15.60 |
| Ohio | 23 | 14,574 | $ 1.60 | $ 7.66 |
| Oklahoma | 52 | 12,863 | $ 4.04 | $ 10.27 |
| Oregon | 7 | 4,189 | $ 1.78 | $ 13.03 |
| Pennsylvania | 20 | 18,019 | $ 1.13 | $ 5.59 |
| Rhode Island | 0.61 | 182 | $ 3.34 | $ 94.46 |
| South Carolina | 26 | 6,468 | $ 3.98 | $ 13.52 |
| South Dakota | 1,235 | 16,448 | $ 75.11 | $ 81.67 |
| Tennessee | 378 | 10,633 | $ 35.59 | $ 40.96 |
| Texas | 47 | 43,392 | $ 1.08 | $ 3.11 |

| | | | | |
|---|---|---|---|---|
| Utah | 5 | 1,855 | $ 2.67 | $ 15.18 |
| Vermont | 2 | 572 | $ 3.88 | $ 49.54 |
| Virginia | 14 | 6,505 | $ 2.19 | $ 9.89 |
| Washington | 71 | 13,846 | $ 5.14 | $ 13.18 |
| West Virginia | 4 | 1,224 | $ 3.32 | $ 29.06 |
| Wisconsin | 73 | 13,740 | $ 5.35 | $ 9.84 |
| Wyoming | 150 | 4,591 | $ 32.69 | $ 44.66 |
| Puerto Rico | 152 | 17,498 | $ 8.70 | $ 13.66 |
| Other | 13 | 320 | $ 41.40 | $ 66.64 |
| **U.S. Total** | **8,600** | **482,925** | **$ 17.81** | **$ 25.05** |

Source: EPA calculations using a three percent discount rate over a ten-year period. Columns may not sum due to rounding.

In the following discussions, the cost per applicator refers to the average incremental cost per applicator, *including* the fee increase, unless otherwise noted. The average cost per private applicator across the United States is estimated to be about $25.05 per year (Table 3.6-1). There is substantial variation across states, however. Average incremental cost per private applicator is estimated to be less than $10 per year in 14 states while applicators in five states – Arkansas, Georgia, Kentucky, Missouri, and South Dakota – are expected to bear incremental cost of over $64 to $107 per year. High costs for Rhode Island ($94 per year) and Alaska ($127 per year) are because the total increase in state costs is divided by a small number of certified applicators to find the per applicator cost.

The average cost per applicator can be influenced by the turnover in applicators. For example, Georgia, Kentucky, and Tennessee have very similar requirements for certification and recertification, but the average per-applicator cost in Kentucky is higher because they have a higher proportion of first-time applicators obtaining certification, who face much higher incremental costs than do applicators obtaining recertification. Compared to current state requirements, the revised certification requirements will increase the cost of initial certification in those states by about $620 per applicator. Two things should be noted. Initial certification is a one-time cost, not an annual cost, and this increase in cost largely brings the cost of certification in these states in line with the cost to applicators in other certifying authorities.

As to the impact on jobs, it is important to note that most private applicators are self-employed as the owner or operator of a farm or livestock operation. Some operations, however, would employ a pesticide applicator and he or she may need to be certified. A closer examination of the incremental costs to applicators may be revealing; we use Kentucky as an example. Kentucky has the second highest per-applicator costs and is therefore the place most likely to see an impact. Alaska is actually the state with the highest average per-applicator cost, but Alaska private applicators may not represent a typical private applicator (usually a farmer) for the U.S. Consider a farm in Kentucky that may need to use an RUP and therefore employs a private applicator. Let us assume that there is a 20 percent chance over a ten-year time horizon that an initial certification is needed while 80 percent of the time the holder may need recertification.

This represents the likelihood of turnover in employees, where newly certified applicators in Kentucky make up nearly 20 percent of the total number of applicators.

According to wage data from BLS (2016a), a private applicator earns about $35.17 per hour and costs the employer about $51.45 per hour, including non-monetary benefits. Employing an applicator 40 hours per week for a six-month growing season would therefore cost about $53,500. Kentucky is the place most likely to see an impact, with the second highest per-applicator cost of $107 per year (Table 3.6-1). This represents 0.2 percent of the cost of employing the applicator. For the applicator, a 40-hour week for six months implies a take-home pay of just over $36,600. A per-applicator cost of $107 per year represents about 0.3 percent of the typical salary for a certified applicator. Given this analysis, EPA concludes that the revisions to the Certification requirements will not negatively impact employment for private applicators in Kentucky. Because Kentucky is a state with one of the highest incremental costs, employment effects are unlikely in other states, also.

***Commercial Applicators***

For commercial applicators, we estimate the average incremental cost per applicator to be about $46 per year, ranging from $6 in Iowa to about $234 per year in Rhode Island (Table 3.6-2). The average fee increase per commercial applicator is identical to that for private applicators.

**Table 3.6-2. Annualized Per-Applicator Costs, by Jurisdiction, Commercial Applicators.**

| Jurisdiction | Annualized RIC ($1,000) | Number of commercial applicators | Cost ($) per commercial applicator | Cost ($) per commercial applicator, including fee increase |
|---|---|---|---|---|
| Alabama | 281 | 4,104 | 68.38 | $ 77.60 |
| Alaska | 17 | 511 | 34.15 | $ 153.01 |
| Arizona | 393 | 7,531 | 52.19 | $ 63.19 |
| Arkansas | 301 | 4,164 | 72.26 | $ 78.15 |
| California | 2,293 | 36,730 | 62.44 | $ 68.79 |
| Colorado | 391 | 4,043 | 96.65 | $ 109.77 |
| Connecticut | 76 | 2,819 | 27.01 | $ 49.92 |
| Delaware | 158 | 1,935 | 81.63 | $ 112.11 |
| Florida | 510 | 16,329 | 31.23 | $ 49.55 |
| Georgia | 606 | 11,073 | 54.75 | $ 59.91 |
| Hawaii | 109 | 1,203 | 91.04 | $ 141.00 |
| Idaho | 141 | 4,148 | 34.04 | $ 48.43 |
| Illinois | 210 | 15,325 | 13.73 | $ 16.68 |
| Indiana | 215 | 9,866 | 21.75 | $ 26.27 |
| Iowa | 37 | 13,773 | 2.68 | $ 5.89 |

| | | | | |
|---|---|---|---|---|
| Kansas | 227 | 6,128 | 37.06 | $ 45.11 |
| Kentucky | 256 | 14,289 | 17.92 | $ 23.78 |
| Louisiana | 85 | 4,737 | 17.90 | $ 29.78 |
| Maine | 121 | 1,653 | 73.23 | $ 101.70 |
| Maryland | 6 | 4,643 | 1.27 | $ 19.27 |
| Massachusetts | 3 | 2,207 | 1.27 | $ 23.91 |
| Michigan | 294 | 14,415 | 20.42 | $ 25.61 |
| Minnesota | 37 | 10,576 | 3.54 | $ 7.45 |
| Mississippi | 82 | 2,990 | 27.47 | $ 36.40 |
| Missouri | 354 | 7,931 | 44.58 | $ 50.69 |
| Montana | 34 | 2,469 | 13.87 | $ 23.23 |
| Nebraska | 330 | 9,920 | 33.31 | $ 39.44 |
| Nevada | 87 | 1,718 | 50.76 | $ 89.68 |
| New Hampshire | 0 | 1,297 | 0 | $ 41.05 |
| New Jersey | 0 | 8,906 | 0 | $ 9.01 |
| New Mexico | 35 | 2,430 | 14.24 | $ 31.03 |
| New York | 373 | 18,740 | 19.89 | $ 23.71 |
| North Carolina | 414 | 19,066 | 21.70 | $ 26.22 |
| North Dakota | 379 | 5,465 | 69.33 | $ 77.94 |
| Ohio | 803 | 13,198 | 60.87 | $ 66.93 |
| Oklahoma | 882 | 11,059 | 79.73 | $ 85.96 |
| Oregon | 141 | 4,911 | 28.79 | $ 40.04 |
| Pennsylvania | 301 | 16,277 | 18.51 | $ 22.96 |
| Rhode Island | 93 | 654 | 142.57 | $ 233.69 |
| South Carolina | 357 | 5,764 | 61.86 | $ 71.40 |
| South Dakota | 82 | 5,873 | 13.96 | $ 20.51 |
| Tennessee | 714 | 13,144 | 54.31 | $ 59.68 |
| Texas | 424 | 19,713 | 21.52 | $ 23.55 |
| Utah | 165 | 4,592 | 36.02 | $ 48.53 |
| Vermont | 54 | 1,015 | 53.48 | $ 99.15 |
| Virginia | 0 | 7,575 | 0.00 | $ 7.70 |
| Washington | 1,305 | 15,937 | 81.88 | $ 89.91 |
| West Virginia | 19 | 2,076 | 9.26 | $ 35.00 |
| Wisconsin | 1,041 | 13,742 | 75.76 | $ 80.25 |
| Wyoming | 131 | 1,911 | 68.61 | $ 80.57 |
| Puerto Rico | 614 | 6,240 | 98.35 | $ 103.31 |
| Other | 177 | 4,187 | 42.36 | $ 67.60 |
| **U.S. Total** | **16,161** | **420,999** | **38.39** | **$ 45.63** |

Source: EPA calculations using a three percent discount rate over a ten-year horizon. Columns may not sum due to rounding.

Seven states are expected to see incremental costs of over $100 per year. Note, however, that this cost includes the costs of training noncertified applicators and additional labor costs associated with age requirements for noncertified applicators, which would not be considerations in an employer's decision to hire a certified applicator. Without these costs, the national average cost per commercial applicator would be about $15 per year. Absent these costs, the incremental cost per applicator is $119 (that of Alaska) or less in all jurisdictions, even accounting for the possibility of obtaining certification in one of the new, application method-specific categories.

The unloaded wage rate for commercial applicators is $14.74 per hour while the loaded wage rate is $21.56 per hour, according to BLS data (2016a). Even assuming part-time employment of about six to eight months, a commercial applicator would cost an employer around $22,400 to $29,900 per year. An incremental cost of $119 per year due to the rule would be 0.4 to 0.5 percent of employment costs. The applicator's take-home pay would range from $15,300 to $20,400 for six to eight months and an incremental cost of $119 per year would represent 0.6 to 0.8 percent of his or her salary. It is unlikely that such modest changes will impact employment.

## 3.7 Potential Impacts on Small Businesses

This section presents estimates of the impact the final revisions to the requirements for the certification of pesticide applicators may have on small entities. The Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996, requires regulators to assess the effects of regulations on small entities, including businesses, nonprofit organizations, and governments. In some instances, when significant economic impacts on a substantial number of small entities are expected, agencies are also required to examine regulatory alternatives that may reduce adverse economic effects on significantly impacted small entities.

The RFA does not define the terms "significant" or "substantial" with regard to the extent of the economic impact and number of small entities affected. EPA has often characterized annual incremental compliance costs of three percent or more of annual revenue as significant, costs less than one percent of annual revenue as not significant, and costs between one and three percent of revenue as inconclusive. If costs are likely to be greater than one percent of annual revenue, EPA considers both the number of significantly affected small firms and their proportion of all affected small firms to determine if a substantial number of small firms would be impacted.

Consistent with previous analyses on the farm sector (Atwood et al., 2015; Wyatt, 2008, EPA, 2015c), we set the following thresholds at which the number of impacted entities is not considered "substantial" for impacts greater than one percent of annual sales:

- Fewer than 100 small entities may be affected, provided the number represents less than 30 percent of all small entities;
- Between 100 and 1,000 small entities may be affected, provided the number represents less than 20 percent of all small entities; or
- More than 1000 small entities may be affected, but the number represents less than ten percent of all small entities.

If the estimated impacts exceed three percent, or if impacts cannot be quantified, the thresholds at which EPA concludes a substantial number of small entities would not be affected are as follows:

- Fewer than 100 small entities may be affected, provided the number represents less than 20 percent of all small entities;
- Between 100 and 1,000 may be affected, but account for less than ten percent of all small entities; or
- More than 1000 small entities may be affected, but the number represents less than five percent of all small entities.

For firms employing commercial applicators, we utilize lower thresholds for the number of impacted small entities considered substantial because there are fewer firms than there are farms. For impacts greater than one percent of gross revenues, the number of impacted entities is not considered substantial if:

- Fewer than 20 small entities may be affected, provided the number represents less than 30 percent of all small entities;
- Between 20 and 200 small entities may be affected, provided the number represents less than 20 percent of all small entities; or
- Between 200 and 1000 small entities may be affected, provided the number represents less than ten percent of all small entities.

To determine the magnitude of any potential adverse impact, the annualized incremental costs on a per-company basis is compared to the annual revenue for small businesses to develop cost-to-sales ratios.

In the next section, we explain the methodology for estimating the average cost per entity of the final rule. Section 3.7.2 estimates the per-entity cost for small businesses (farm) employing or operated by private applicators. We also present a profile of the affected industry, including estimates of per-entity revenues and calculate the impacts. In Section 3.7.3, we present the same information for small business employing commercial applicators.

Based on this analysis, EPA certifies that there will not be a significant impact to a substantial number of small businesses. Agricultural establishments may be owned or operated by private applicators or may employ private applicators. Average impacts to small crop producing enterprises, those making less than $750,000 in annual sales of agricultural products, are estimated to be less than 0.1 percent of annual sales. Even in the most heavily impacted regions, the estimated impacts on most small agricultural operations are less than one percent of average annual sales. Small entities with commercial applicators, including agricultural pesticide services, extermination services, and landscaping services, are estimated to face impacts of 0.3 percent or less of annual revenue.

### 3.7.1 Methodology

The basis for this analysis is the results from Section 3.6, cost per applicator. The methodology requires the determination of the number of applicators (certified and noncertified applicators under the direct supervision of a certified applicator) for representative entities, and the impacts are measured in terms of the incremental cost to small entities relative to their sales revenues.

## 3.7.2 Private Applicator Establishments

Private applicators are largely employed by or operate establishments in agricultural production. EPA has identified a number of specific types of establishments. The SBA specifies a revenue threshold to distinguish small entities, as shown in Table 3.7-1.

**Table 3.7-1. Private Applicator Establishment NAICS Codes with Small Business Thresholds (Annual Revenue)**

| Farming Sector[1] | NAICS Code | Large Business Threshold |
|---|---|---|
| Crop Farming | 111 | $750,000 |
| Animal Farming | 112 | $750,000 |
| Feedlots | 112112 | $7,500,000 |

Source: SBA, 2014

[1]See the first line of Table 3.7-3 for the magnitudes of impacts for these farm types.

While farms may be allocated to different NAICS based on their primary source of revenue, most are mixed crop and livestock operations. For example, over 40 percent of livestock operations also produce crops (NASS, 2014c). Thus, the impacts of changes to certification requirements are unlikely to differ substantially across the two sectors. Certification needs could differ, however, across specialties within farming, given different pest problems and agricultural practices. Producers of field crops such as soybean and grain farmers, for example, may require aerial certification and/or a certification for commodity (non-soil) fumigation. Nut, fruit, and vegetable farms may need soil fumigation certification. Livestock operations are less likely to need application-specific certifications, but might produce field crops. While many farms produce multiple types of crops, generally speaking, a small farm would be unlikely to need more than one application-specific certification. Moreover, the rule imposes similar training or exam requirements for each category certification. Impacts on individuals and individual entities are more likely to be a function of the state or region, given the variability in current certification requirements, than to vary by farm type.

***Profile of Private Applicator Establishments***

The National Agricultural Statistics Service (NASS) of the Department of Agriculture conducts a census of agriculture every five years. A farm is defined as "any place from which $1,000 or more of agricultural product were produced or sold, or normally would have been sold, during the year of the census (NASS, 2014c)." According to the 2012 Census of Agriculture (NASS, 2014c), there are over 2.1 million farms in the United States, roughly half of which are classified as livestock operations (NAICS 112), including about 430,000 farms with less than $1,000 in total sales of agricultural products. Excluding the latter farms, which do not strictly meet the definition of 'farm' and, moreover, are extremely unlikely to utilize RUPs, there are between 1.5

and 1.6 million farms classified as "small" by the SBA criterion. The publicly available Census data reports that about 76,000 farms have annual revenue between $500,000 and $999,999, whereas the SBA criterion for a small farm is sales less than $750,000. We therefore have a range for farms and average revenue. Revenue includes sales of agricultural products and government payments, but does not include farm-related income, such as crop and livestock insurance payments, rental income, and income from agricultural services.

To better understand the impacts and the distribution of impacts on small farms, EPA identifies three categories of small farms. We define 'small-small' farms as those with annual sales between $1,000 and $10,000, medium-small farms as those with annual sales between $10,000 and $100,000, and large-small farms as those with annual sales between $100,000 and $750,000. Table 3.7-2 provides the distribution of small crop and animal farms across these various categories. The table also provides similar data from the 2007 Census of Agriculture (NASS, 2008b), for which a special tabulation distinguished farms with annual revenue of $750,000 or less. The number of small farms and average revenues for each category are consistent over time.

**Table 3.7-2. Number and Average Revenue of Small Farms.**

| | **All Small Farms** [1] | **Small-Small** ($1,000 - $10,000/year) | **Medium-Small** ($10,000 - $100,000/year) | **Large-Small** ($100,000 - $750,000/year) |
|---|---|---|---|---|
| 2012, Number of Farms | 1,521,271-1,598,833 | 716,505 | 567,438 | 237,328-314,890 |
| Average Revenue | $52,775-$85,030 | $4,178 | $34,600 | $242,948-$359,877 |
| 2007, Number of Farms | 1,622,838 | 771,855 | 566,898 | 284,085 |
| Average Revenue | $67,093 | $4,072 | $34,182 | $301,182 |

Source: USDA NASS, 2008b and 2014c.

[1] The criterion for small farm is that sales are less than $750,000 per year. The lower bound is for farms with sales less than $500,000 and the upper bound includes farms with sales less than $1,000,000. Does not include operations with less than $1,000 in total sales.

Not all farms utilize pesticides every year, however; thus some farms may not need a private applicator. EPA obtained a special tabulation of data from the 2007 Census of Agriculture to identify those farms that use pesticides (NASS, 2008b). The likelihood that a farm will use pesticides is inversely related to size; around eighty percent of large and large-small farms use pesticides while only about 25 percent of small-small farms use pesticides. Overall, about 53 percent of small farms used pesticides in 2007. Assuming a similar proportion used pesticides in 2012, about 820,000 small farms might be affected by this rule. The number of small farms that use of RUPs will be even lower. According to proprietary pesticide market research data (2008 – 2013), RUPs account for less than 20 percent of agricultural pesticide treatments, by acreage. Data of use by farm is not available, however. Many farms, even small farms, use pesticides occasionally and may, therefore, obtain and maintain certification in order to have the capacity to use an RUP if needed. Thus, EPA assumes that most small farms would be affected by changes to the certification requirements at some point.

***Costs per Small Entity, Private Applicators***

In Section 3.6, EPA estimated the total incremental cost to private applicators of changes in the Certification requirements will average $25.05 per private applicator per year (Table 3.6-1). This includes the costs associated with requirements for certification, recertification, noncertified applicators under the direct supervision of a private applicator, and the fee increase explained in Section 3.6. This cost per private applicator is also a reasonable estimate of the cost per small entity, as it will represent the owner/operator of a small farm or animal operation who may, at least occasionally, employ or use a family member to apply a pesticide under his or her supervision. Note that since the majority of the U.S. farms are small, the average per-applicator cost of $25.05 represents the average impact on all small farms (see Table 3.7-3 below).

All farms will bear the incremental costs associated with changes to the requirements for initial certification, recertification and the labor costs associated with the minimum age provision for private applicators, which make up about $7.5 million of the total costs of the rule (see Table 3.5-1). Across 483,000 private applicators, the average cost is about $15.80 per applicator per year, or about $23.10 per applicator per year including fee increases to offset the additional costs to certifying authorities. Costs associated with noncertified applicators total about $930,000 per year including supervision costs and labor costs associated with the minimum age requirement for noncertified applicators. EPA estimates there are about 80,600 noncertified applicators (Table 3.3-8). Assuming there is one noncertified applicator under the supervision of a private applicator on a small farm, there would be an additional cost of $11.50 per applicator per year, for a total impact of $34.60 per farm per year. However, most noncertified applicators applying RUPs under the supervision of a private applicator would be employed on relatively larger farms. Application specific certifications for private applicators are associated with $197,000 per year, including both certification and recertification requirements (Table 3.5-1). EPA estimates that about 4,200 private applicators will need either a certification in aerial application or in non-soil fumigation (Table 3.3-7), for an average cost per applicator of $46.90. Therefore, if a small farm were to need an application specific category certification, it would bear costs of about $70.00 per year. It would be highly unlikely that these applicators would be found on the small-small farms. If a small farm were to also have a noncertified applicator under the supervision of the private applicator, the total incremental cost increase would be about $81.50 per year. It is unlikely that a small-small or medium-small farm would have both a new category certification and a noncertified applicator.

We previously considered, in more detail, a farm in Kentucky, which has one of the highest average estimated costs per private applicator, that may need to use an RUP and therefore needs to employ a private applicator. A similar scenario could describe a small farm where the owner or operator is the private applicator. Incremental costs in Kentucky are driven almost totally by changes in the requirements for certification and recertification; costs for new categories, supervision, and minimum age provisions are low (see Appendix B). Thus, the average cost per applicator of $107 per year (Table 3.6-1) represents the impact to most small farms in the state.

***Impacts per Small Entity, Private Applicators***

Given the range of costs estimated to be imposed on small farms and the revenues of these farms, EPA calculates the impacts as a percentage of annual sales revenue. Results are shown for the average impact and the high impact state Kentucky in Table 3.7-3.

**Table 3.7-3. Impact per Small Entity, Private Applicator.**

| Type, Level of Impact [1] | All Small Farms<br>$52,775-$85,030 | Small-Small<br>$4,178 | Medium-Small<br>$34,600 | Large-Small<br>$242,948-$359,877 |
|---|---|---|---|---|
| Average impact; $25/year | 0.03-0.05% | 0.60% | 0.07% | 0.007-0.01% |
| Kentucky; $107/year | 0.13-0.20% | 2.57% | 0.31% | 0.03-0.04% |

Source: EPA calculations.

[1]These represent the magnitudes of impacts for the three farm types in Table 3.7-1 (crop farming, animal farming, and feedlots).

As shown in Table 3.7-3, the impact on the average small crop farm would range from 0.03 to 0.2 percent of average revenue, even for very high impacts. However, an average impact of $25 per year would be about one percent or more for a farm making about $2,500 per year or less. High impacts, as in states which currently require only two hours of training for initial certification of private applicators, would be greater than one percent of sales revenue for small-small farms, *i.e.*, those with revenues averaging less than $10,000 per year. Impacts might exceed three percent of revenue for farms making less than $3,600 per year.

EPA considers the number of small farms that may face impacts greater than one percent of annual revenues. According to the 2012 Census of Agriculture (NASS, 2014c), there are 236,500 farms with revenues of $1,000 to $2,500 per year or less, averaging about $1,660 annually. A conservative estimate for the proportion of farms using pesticides, based on farms with revenue up to $10,000 per year, would be 25 percent (NASS, 2008b), or fewer than 60,000 farms. Of those, perhaps 20 percent would use RUPs, based on the percent of acres treated, or about 12,000 farms. In one high-impact state, Kentucky, there are another 21,100 farms with annual revenue of $2,500 to $10,000, a range where impacts could be over one percent of annual revenue. Of those, an estimated 1,000 might use RUPs. In total, therefore, around 13,000 farms may face impacts of one percent or more of annual revenue. These farms comprise less than one percent of all small farms and less than two percent of all small farms that use pesticides, which may be affected by the rule.

As for farms that may face impacts greater than three percent of annual revenue, there are less than 20,000 farms in Kentucky earning less than $5,000 of which EPA estimates less than 1,000 use RUPs. Including roughly 200 applicators in Alaska and Rhode Island, the other relatively high-cost jurisdictions, implies only around 1,200 small entities might face impacts in excess of three percent of annual revenue.

Most of the impact of the final revisions on states that only meet the current requirements is a result of increased requirements for initial certification and recertification. Kentucky already requires noncertified applicators to be trained and EPA anticipates only about 40 private applicators to obtain certification in non-soil fumigation. It should be noted that private applicators in other states are currently obtaining and maintaining certifications under requirements very similar to the requirements in the final rule, and this is why impacts are smaller in most states (Table 3.6-1).

An additional factor to consider is the final Worker Protection Standard (WPS) rule that recently published, which updates requirements for agricultural establishments hiring labor which perform certain agricultural tasks must meet when pesticides are used on the establishment. Under the WPS, "hired labor" covers workers outside the immediate family who receive compensation for their work. The WPS requirements include providing pesticide safety training for workers that will be entering treated fields and notifying employees when applications have been made so that they can take proper precautions. A subset of the farms using RUPs, who are impacted by revisions to the certification requirements, will also employ workers and will also be impacted by the revised WPS.

EPA estimated that, on average, small farms would face costs of about $130 per year from the final changes to the WPS. These costs would essentially be additive to the estimated costs of changes to the certification requirements for farms that have a certified applicator and hire labor to work in the field or handle pesticides. The average establishment in Kentucky would have combined costs of around $240 per year with impacts of less than one half of one percent of average gross revenues of small farms.

The number of small-small farms affected by both rules is likely to be small. According to data from the 2007 Census of Agriculture (NASS, 2008b), there were about 316,000 small-small farms that used any kind of pesticide. Of those, fewer than 60,000 farms also employed labor, or less than 20 percent, and might bear some impacts from the final changes to the WPS. If, as above, about 20 percent of farms using pesticides use RUPs and rely on a certified applicator, then perhaps around 12,000 small-small farms in the U.S. might face impacts from changes to both the WPS and to the certification requirements. This is around 0.8 percent of all small farms in the U.S. and less than four percent of small-small farms that use pesticides.

### 3.7.3 Commercial Applicator Establishments

Commercial pesticide applicators are employed by businesses that provide pest control services to a broad array of activities, including agricultural sites, urban and residential sites, and industrial sites. The Small Business Administration (SBA) uses a variety of criteria in sizing commercial applicator establishments depending on a firm's primary industry (as classified by its NAICS code). The relevant criterion for small business designation may include revenue or the number of employees.

Table 3.7-4 presents the SBA small-business thresholds, by NAICS code, used to determine the size of each firm in the commercial applicator establishments for small business impact analysis.

EPA expects these industries to be most heavily impacted by the final revisions to the certification rule. There are other sectors such as water supply and irrigation systems and wood preservation that will be impacted by the rule, but many firms in these sectors will hire applicators employed by firms in the four we discuss so the impacts would be indirect.

**Table 3.7-4. Commercial Applicator Establishment Small Business Thresholds**

| NAICS Code | NAICS Sector Description | Sizing Criterion | Small Business Threshold |
|---|---|---|---|
| 115112 | Soil Preparation, Planting, and Cultivating | Revenue | $7,500,000 |
| 115210 | Support Activities for Animal Production | Revenue | $7,500,000 |
| 561710 | Exterminating and Pest Control Services | Revenue | $11,000,000 |
| 561730 | Landscaping Services | Revenue | $7,500,000 |

Source: SBA, 2014.

Existing category certifications cover different sites. In addition to agricultural certifications, there are categories, such as rights-of-way, which is relevant to utility companies; aquatic sites, which is relevant to water supply and irrigation systems and other activities; and ornamental/turf sites, which would be required for landscaping services. The new certification categories are application type focused and will be required by different types of services. For example, power transmission systems may need to hire applicators with aerial certification to reach some of their rights-of-way and some exterminators would likely need certification in structural fumigation.

***Profile of Commercial Applicator Establishments***

For this analysis, EPA focuses on entities providing pest control services, rather than the broader array of entities that may require pest control services. In particular, we narrow the analysis to Agricultural Pesticide Services, within NAICS codes 115112 and 115210, Exterminating and Pest Control Services (561710), and Landscaping Services (561730). Table 3.7-5 presents the number of small establishments and financial and employee information, based on information obtained from the Dunn and Bradstreet (D&B, 2014) database of U.S. commercial establishments. The small firms account for over 99 percent of the firms in these sectors. Compared to the small business size thresholds of the Small Business Administration, which range from $7.5 million to $11 million annually, the average annual revenues shown here would seem to represent some of the smallest firms.

**Table 3.7-5. Size Distribution of Establishments that Employ Commercial Applicators**

| Entity | Number of small establishments | Average Revenue | Average Number of Employees |
|---|---|---|---|
| Agricultural Pesticide Services | 22,760 | $160,700 | 3 |

| | | | |
|---|---|---|---|
| Exterminating and Pest Control Services | 23,807 | $256,100 | 4 |
| Landscaping Services | 120,213 | $205,800 | 4 |
| **Total** | | | |

Source: D&B, 2014

***Costs per Small Entity, Commercial Applicators***

In Section 3.5, EPA estimated the total incremental cost of the final rule to commercial applicators to be $16.4 million annually. The rule will impact an estimated 419,400 commercial applicators for a per-applicator cost of $46.38 per year. This includes the costs associated with requirements on noncertified applicators under the direct supervision of a commercial applicator, assuming that most commercial applicators supervise two or three noncertified applicators.

Per-applicator incremental costs vary across the different jurisdictions of the country, depending on the baseline certification and recertification requirements of the jurisdiction, including category certifications. See Table 3.6-2 for estimates of the total incremental cost, number of commercial applicators, and average per-applicator cost, by jurisdiction. Costs range from about $6 per year in Iowa, where the current state requirements are similar to the requirements of the final rule and noncertified applicators are not allowed to apply RUPs, to $234 per year in Rhode Island, which does not currently have an aerial certification category and where EPA estimates that there are about five noncertified applicators for every commercial applicator. As explained in Section 3.3, the number of noncertified applicators is subject to considerable uncertainty. In the case of Rhode Island, the number of noncertified applicators is estimated by taking BLS employment figures for those involved in 'pest control' and subtracting the number of commercial applicators.

Given the average number of employees shown in Table 3.7-5, small entities providing pesticide application services could have one to two certified applicators, including the owner of the service, with two to three noncertified applicators working under their direct supervision. The per-applicator cost estimates in Table 3.6-2 represent the costs for one commercial applicator supervising up to five noncertified applicators. On average, there are 2.2 noncertified applicators for every commercial applicator, leading to the national average incremental cost of $45.63 per applicator. Thus, EPA anticipates the cost to be $45.63 to $91.27 per year for the average small entity, which would be one to two commercial applicators and up to four noncertified applicators implying three to six employees. For a small entity in a state such as Rhode Island, we estimate costs from $234 to $467, representing one or two commercial applicators and five or ten noncertified applicators under their direct supervision in Rhode Island, which would be larger than the average small entity.

***Impacts per Small Entity, Commercial Applicators***

Given the range of costs estimated to be imposed on small firms and the revenues of these firms, EPA calculates the impacts as a percentage of annual revenue. Results are shown in Table 3.7-6.

**Table 3.7-6. Impact per Small Entity, Commercial Applicator.**

| Entity | Average Revenue | Average Impact ($46-93/year) | High Impact ($474/year) |
|---|---|---|---|
| Agricultural Pesticide Services | $160,700 | 0.03-0.06% | 0.29% |
| Exterminating and Pest Control Services | $256,100 | 0.02-0.04% | 0.18% |
| Landscaping Services | $205,800 | 0.02-0.04% | 0.23% |

Source: EPA calculations.

The impacts to commercial pesticide application services are estimated to be less than one percent of average revenues for both the average and high cost scenarios.

### 3.7.4 Conclusion

On the basis of this analysis, EPA concludes that there will not be a significant impact to a substantial number of small entities.

For private applicators, average impacts of the rule represent less than one percent of annual sales revenue for the average small farm and even to small-small farms with sales of less than $10,000. Impacts to the smallest farms, especially in high-impact states, could exceed one percent of annual sales revenue but the number of farms facing such impacts is small relative to the number of small farms affected by the rule.

For commercial applicators, average impacts of the rule represent less than 0.1 percent of annual revenue for the average small firm. The impacts are expected to be around 0.3 percent of annual revenue even for the high cost scenarios. This is well below the one percent threshold that EPA set for significant impact.

# Chapter 4. Benefits of the Rule

Certification standards for applicators ensure that certified applicators are competent in the use of RUPs. The key goals of the rule changes are to: improve the competency of certified applicators of RUPs; implement better protections for noncertified applicators who apply RUPs under the direct supervision of a certified applicator; and reduce the potential risk to human health and the environment from the use of RUPs. Competent applicators possess the skills and knowledge necessary to apply pesticides properly to avoid unintended exposures to people and the environment.

EPA anticipates that the rule changes will produce benefits to applicators, the public, and the environment. The rule changes will ensure that certified applicators are competent in the application of RUPs, and that noncertified applicators working under the direct supervision of certified applicators are well supervised and protected. When used in accordance with label restrictions, RUPs can be safely applied; however, if the applicators are not competent, then RUPs have the potential to pose unreasonable risks of damage to humans, terrestrial and aquatic ecosystems, non-target animals, plants, and surface water. Ensuring that applicators are competent will prevent these unwarranted exposures. The quantified estimate of benefits from reduced RUP poisonings that can be quantified are estimated to be between $13.2 and $24.3 million dollars through reduced acute illnesses from RUPs. Underreporting would affect this estimate. If only 20% of incidents were reported, the estimated benefits are between $65.9 million and $121.7 million, (see Section 4.5). If 50% of incidents are reported, then the quantified estimates of the rule would be between $26.3 and $48.7 million annually. There are benefits to the rule that cannot be quantified, as well. These include reduced health effects to certified applicators and their families from long-term low-level RUP exposure and reduced environmental impacts from the rule changes.

The remainder of this chapter will discuss the benefits of the rule to certified applicators, their families and employees, and the public at large and the environment.

The next section discusses who is at risk from RUP exposure, followed by a discussion of the possible effects of acute exposure and chronic exposures to certified applicators and to their families. Section 4.4 provides information on the benefits from reduced ecological damage from RUPs, Section 4.5 estimates the benefits of reduced pesticide exposure to the extent these benefits can be quantified. Section 4.6 discusses the potential long-term effects that may result from chronic pesticide exposure which, by their very nature, are unlikely to be reported to surveillance databases, but are potentially important to human health, and may be reduced by the rule.

## 4.1 Who is at Risk?

### 4.1.1 Occupational Exposure

Certified pesticide applicators, noncertified applicators working under the direct supervision of certified applicators, agricultural workers, and pesticide handlers may be occupationally exposed to pesticides and pesticide residues. EPA estimates that there are about 900,000 certified applicators in the United States (see Chapter 3), and about 1 million noncertified applicators working under the direct supervision of a certified applicator. A small number of adolescents are certified applicators, and there are about 6,700 adolescents under 18 estimated to be working under the direct supervision of a certified applicator (see Chapter 3.3). All of these people face potential harm from occupational exposure to RUPs.

RUPs are commonly used in agriculture, so a large portion of the agricultural workforce is potentially exposed. This includes the approximately 1.8 million workers that are hired by agricultural establishments, who are potentially exposed to the risks of adverse health effects from pesticide exposure (EPA, 2015c) if they work on farms that use RUPs. Agricultural workers do not handle RUPs directly, but they may be exposed to agricultural-plant pesticides either through contact with residues on treated plants, soil, or water or through accidental contact from drift or misdirected application. The agricultural workforce is occupationally exposed to RUPs and pesticide residues can potentially face significant long and short term health risks. EPA conducted an extensive review of the data from incident reporting systems and epidemiologic evidence published in the peer-reviewed literature and found strong evidence that pesticide exposure contributes to adverse human health outcomes. This evidence is discussed and referenced in detail in the sections that follow.

### 4.1.2 Children and Families

Young and unborn children may be particularly sensitive to pesticide exposure. Children may experience different exposures than adults due to behavioral differences like crawling on the floor and putting objects into their mouths (EPA, 2008b), and they can be more sensitive to these exposures because their organ systems are still developing, and they have relatively low body weights (Curwin *et al.,* 2007, Beamer *et al.,* 2009, Vida and Moretto, 2007). Children in the families of certified applicators may be incidentally exposed to pesticides and there is the potential for negative health effects from this pesticide exposure. Prenatal exposures (discussed below) may be particularly important for long-term development.

Children and adolescents are at various stages of growth and development, leading to “windows of susceptibility” where certain chemical exposures may have different toxicological consequences compared to adults. The same chemical exposure in different developmental stages may result in different health impacts. Because children’s metabolic systems are not fully developed at birth, continue to develop through childhood and adolescence, and are not uniform across developmental stages, children metabolize pesticides and chemicals differently than adults metabolize pesticides and other chemicals (EPA, 2008b). The changes to the certification rule include enhanced training to reduce incidental, take-home exposures to families and to reduce bystander exposures resulting from improperly applied RUPs. The changes to the certification rule also cover direct exposures by including restrictions on allowing adolescents to work with RUPs. These changes are important because adolescents are more apt to make poor decisions about pesticide risks, which is also discussed below.

Non-occupational exposure pathways for pregnant women and children may include spray drift from nearby agricultural areas, misapplication of non-agricultural RUPs, or from pesticide residues taken home on the clothing or in the cars and trucks of certified and noncertified applicators. Curwin *et al*. (2005) compared 25 farm and 25 non-farm households in Iowa, testing for pesticide contamination inside the homes. Although not a study strictly of certified applicators, the pesticides for which they tested included RUPs. When compared with non-farm households, they found significantly higher levels of atrazine and metolachlor (which only have agricultural uses) in farm households. The distribution of the samples in the various rooms of the house (higher levels in the agricultural worker changing area and the laundry area) suggest that the pesticides are being transported home on farmers' clothing and shoes. There were also higher levels of agricultural pesticides in home vehicles for farm families. Lozier et al. (2012) concludes the take-home pathway is an important route of exposure for commercial pesticide applicators, based on higher levels of atrazine contamination in the parts of homes where applicators entered the home and where they removed their clothing. Atrazine levels were three times higher for applicators that changed shoes inside compared to those who removed shoes outside, and bedroom levels were six times higher for those who changed clothes in the bedroom compared to those who did not. Lu *et al.* (2000) collected samples from steering wheels and boots of agricultural families, the floors of their houses, as well as wipe and urine samples from the family members. Farm families had higher exposure to the pesticides tested than the non-farm controls, and the positive samples in vehicles, on clothing and in the home in families not in proximity to farm fields indicated the take-home pathway was responsible for exposure to these families. These studies are consistent with studies based on farmworker family exposure that identify take-home exposure as a problem (Thompson *et al.*, 2014; Coronado *et al.*, 2006; Curl *et al.*, 2002; McCauley *et al.*, 2003; Rao *et al.*, 2006).

*Occupational Exposure to Adolescents*

EPA is establishing a minimum age for certified applicators and noncertified applicators working under the direct supervision of a certified applicator to reduce the risk of exposure to adolescents. There is evidence that adolescents and children do not make risk management decisions with the same judgment, maturity, and reason as adults. Adolescents are more prone to accidents than the population at large. For example, the fatality rate for drivers between 16 and 19 is four times the rate for all adults (Institute for Highway Safety, 2008). In an agricultural context, adolescents working on farms have shown awareness of safety issues, rules, and the risks of injury on farms, but they behave according to their own perception of risk, and take more risks while playing on the farm; the play often uses farming equipment and occurs during work time (Rowntree *et al.*, 1998). In a study of adolescents engaged in high-risk tasks on farms in Kentucky, Iowa, and Mississippi, teens were surveyed on their use of protective equipment, work exposures, and symptoms related to farm work that included injuries (Reed *et al*., 2006). When teens were asked whether they used personal protective equipment when it was required, the median self-reported frequency for use of respirators and hearing protection was only four times out of the last ten occasions when its use was required. According to the authors, protective devices may be used less frequently when the teens did not perceive a high degree of risk or if they did not have an observed health problem attributed to that exposure. The authors also suggest that PPE may not properly fit female teens, leading to a decreased incidence of use (Reed *et al.*, 2006).

The cognitive development of adolescents affects behavior, particularly in the areas of judgment, risk-taking and decision making ability (Steinberg, 2005). The parts of the brain going through these maturation processes in adolescents are important for the perception of risk, evaluation of risk and reward, and regulation of emotion and behavior (Dayan *et al.*, 2010). In an international setting, Abdel-Rasoul *et al.* (2008) reported an association between cognitive deficits, neurological symptoms and pesticide exposure among child and adolescent agricultural pesticide applicators. This study cohort is from Egypt, which does not reflect use patterns or regulations in this country, but it does suggest risks when children and adolescents are exposed at high levels of pesticides.

According to Calvert *et al.* (2003), pesticide poisoning surveillance data shows that working youths were more likely than adults to suffer an occupationally related pesticide illness, attributed to lower levels of experience with pesticides, and greater sensitivity to pesticide toxicity. The literature shows that adolescents are more likely to engage in risky behavior than adults. Therefore, it is more difficult to be certain that they will make prudent risk management decisions. It is not certain why higher risk taking behavior is more common among adolescents, but it is a consistent finding. It seems that adolescents are aware of risks and tradeoffs between behaviors and consequences, and process the information available to them in ways very similar to adults, but take greater risks anyway (Steinberg and Cauffman, 1996; Dayan *et al*., 2010). The cognitive changes that occur during adolescence do not fully explain this phenomenon, which indicates that emotional development and surroundings are important parts of the risk taking process for adolescents. This picture of the adolescent development and behavior implies that more rigorous and frequent training, which are features of the final rule, would not protect adolescents to the degree they will protect adults. These potentially at risk adolescents do not

respond to information in the same way that adults do, so special protections, such as the establishment of minimum age for certain activities are warranted to ensure their safety.

### 4.1.3 Ecological Risks

In addition to the human health risks from RUP exposure, there can be environmental damage as well. EPA evaluates the environmental fate of pesticides, including RUPs, to determine the ways that pesticides can be applied to avoid unreasonable risk to the environment. If RUPs are not applied safely, however, they can cause a range of environmental damage to non-target organisms (EPA 2007). Almost any organism has the potential to be affected by RUP misapplication. Non-target wildlife can come in direct contact with pesticides by directly consuming pesticides, such as birds eating pesticide granules, or consuming treated material, such as plants with pesticide residues or drinking water from puddles in a treated area that has pesticide residues. They can also be exposed to pesticides by secondary poisoning, where they consume prey animals, either alive or dead, that have pesticide in their bodies (Whitford, *et al.*, undated). Fish and aquatic invertebrates can be exposed to pesticides that runoff into waterways (Capinera, 2011). Non-target beneficial insects and pollinators can be harmed by pesticide either in the treated area or nearby, or if they move in to a treated area while the pesticide is still active. Non-target plants, including crop plants can be affected by RUPs, either from drift to a nearby field, a poorly timed application, or an application that is harmful to the crop, such as using too high a rate.

## 4.2 What are the Risks?

This section will provide a brief introduction to some of the risks associated with pesticide exposure, including pesticide exposures that have reproductive effects or effects on children. Some of these effects may be lifelong, although they may be a result of either acute (in the case of developmental effects) or chronic exposures. A discussion of illnesses associated with chronic occupational pesticide exposure is provided in Section 4.5.

### 4.2.1 Acute Exposures and Human Health Effects

Because pesticides are specifically selected or designed to adversely affect biological systems, pesticides generally present risks to non-target organisms as well. Some pesticides are narrowly targeted to specific life forms or biological processes while others have effects across a broad spectrum of organisms, including humans. Exposures to some pesticides can result in a wide range of acute symptoms. The acute symptoms from overexposure to pesticides vary widely, and can range from mild skin irritation to death. Severity of symptoms depends largely on the dose and route of exposure. Exposure to organophosphate (OP) pesticides, for example, can result in headaches, fatigue and dizziness, nausea, cramps and diarrhea, impaired vision and other effects (Schulze *et al.*, 1997). Severe acute exposures can result in seizures, respiratory

depression and loss of consciousness (Reigart and Roberts, 2013). In rare cases, unintentional pesticide exposures result in death. These are just a few of the wide range of symptoms that can be caused by acute pesticide exposure; the *Recognition and Management of Pesticide Poisonings* manual lists almost 100 different symptoms that a medical professional could expect to see following an acute exposure to various pesticides (Reigart and Roberts, 2013). Although this brief discussion focuses on acute exposure, certified applicators also may suffer chronic exposures that are associated with many diseases, including several forms of cancer. These are discussed in more detail below, in Section 4.5.

Evidence that acute adverse effects of pesticide exposure occur is that pesticide-related illnesses can be observed. Although illness resulting from pesticide exposure is underreported (see below), there are peer-reviewed studies, based on pesticide illness reporting and surveillance initiatives that show evidence of illnesses. Calvert, *et al*. (2008) for example, finds that acute pesticide poisoning incidents in the agriculture industry "continues to be an important problem." This study looked at pesticide poisoning incidents among agricultural workers from 1998-2005, and analyzed 3,271 cases. Illness rates varied across time, age, and region, but for agricultural workers, risks of poisoning were an order of magnitude higher than for non-agricultural workers (except for farm owners (3% of the sample)). Das *et al*. (2001) identified 486 pesticide illness cases among California farmworkers for 1998-1999, based on a surveillance program with mandatory reporting by physicians. Das *et al*. found that about half of all occupational pesticide related illness cases in the California surveillance system were agricultural (the rest were in other industries). Over a quarter of the poisonings were to those mixing, loading or applying pesticides. The most common symptoms were dermatological (about 44%), neurological (about 39%), and gastrointestinal (about 38%), and the most common route of exposure was skin contact, followed by inhalation and eye contact.

Reports to surveillance programs rank incidents according to severity, such as low, medium, high, and death. The Calvert (2008) study finds that the majority of cases during the study period were low severity (87%), 12% were medium severity, and 0.6% were high severity, with one death. While it is encouraging that most cases were ranked as "low severity" in this study, it is important to note that the severity categories can be misleading. Even "low severity" cases can reflect significant morbidity, with the exposure resulting in health care treatment and the loss of work days. To be included in the SENSOR-Pesticides database used for the Calvert study (and which we use for the analysis in Section 4.4), at least two post-exposure symptoms must have been reported. Symptoms categorized as "low severity" include abdominal pain, cramping, nausea, vomiting, and fever. Symptoms like these and others severe enough to result in missing up to three days of work or hospitalization for up to a day are classified as "low severity" cases[7].

### 4.2.2 Acute and Chronic Exposures and Effects on Children and Families

This section discusses potential risks to families of certified applicators, as well as the families of others who may be exposed to RUPs. This is not a complete review of the epidemiological literature on the associations between RUP exposure and the health of children and families, but it provides an overview of the literature. The risks discussed here are just a subset of diseases that have been reported in the literature to have an association with pesticide exposure; many

[7] A table of symptoms by severity is here: http://www.cdc.gov/niosh/topics/pesticides/pdfs/pest-sitablev6.pdf

others, including some cancers, also have been reported by some to be associated with pesticide exposure. The discussion of chronic occupational pesticide exposure and cancers, in Section 4.5, primarily centers on occupational exposure because most of the available literature on pesticides and cancer outcomes is drawn from epidemiological studies that recruit cases who use pesticides occupationally.

*Reproductive Risks*

Female certified applicators, noncertified applicators working under the direct supervision of a certified applicator, farmworkers and women who reside nearby farms, greenhouses or nurseries that conduct routine pesticide applications may face exposure to RUPs while they are pregnant. Reviews have been conducted examining the effects of pesticide exposure during pregnancy on reproductive outcomes. Sanborn *et al*. (2007) found 59 peer-reviewed studies that examined the relationship between pesticides and reproductive outcomes between 1992 and 2003. A summary of their findings is found in Table 4.2-1.

**Table 4.2-1. Summary of Findings on the Association between Pesticide Exposure and Reproductive Risks from Sanborn *et al.*, 2007**

| Outcome Examined | Number of Papers Found | Number of Papers Found that Display an Association Between the Outcome Examined and Pesticide Exposure* |
|---|---|---|
| Birth Defect | 15 | 14 (+) |
| Time to Pregnancy | 8 | 5 (+) |
| Fertility** | 14 | 7 (-) |
| Altered Growth | 10 | 7 (+) |
| Fetal Death | 11 | 9 (+) |
| Other Outcomes | 6 | 6 (+) |

*The direction of the association is shown in parentheses.
** Fertility refers to the ability to become pregnant in 1 year, and includes male and female factors, such as semen quality and infertility.

As seen in Table 4.2-1, fourteen of the studies reviewed by Sanborn *et al.* (2007) reported an association between maternal pesticide exposure and an increased risk of birth defects. The specific birth defects examined in the review consisted of limb reductions, urogenital anomalies, central nervous system defects, orofacial clefts, heart defects, and eye anomalies. Nine out of eleven studies showed an association between pesticide exposure and fetal death, which includes "spontaneous abortion, fetal death, still birth, and neonatal death." When examining fetal death, preconception exposure was associated with early first-trimester abortions and post-conception exposure was associated with late spontaneous abortions (Sanborn *et al*., 2007). For most effects, half or more of the studies evaluated by Sanborn show an association between pesticide exposure and negative reproductive outcomes. These authors note three limitations to this review: epidemiology studies cannot prove cause-effect relationships, the difficulty of accurate exposure assessment, and possible publication bias in the studies included in the systematic review. Therefore, while these results are suggestive, they are not definitive or conclusive.

*Potential Health Effects in Children*

There is evidence to suggest that children who were exposed to pesticides while in utero (because their pregnant mother was exposed to pesticides in the home or at work) may suffer adverse health effects. Pre-natal exposure may have effects on the neurological development of children (see below). A meta-analysis of 31 studies concluded that there was an association between pre-natal exposure to pesticides and future childhood leukemia (Wigle *et al*., 2009). A different meta-analysis of 15 studies also reports positive associations between residential pesticide exposure and childhood leukemia (Turner *et al.*, 2009). As part of the registration process, applicants provide data that allow EPA to assess the developmental toxicity (*i.e.*, structural abnormalities, functional deficiencies, altered growth and fetal loss) and other potential health effects of the particular pesticide active ingredient, as well as potential exposure through the use of the pesticide. These developmental effects can result from an acute overexposure to agricultural pesticides during windows of susceptibility of fetal development during pregnancy. Through the registration process, EPA establishes conditions of registration intended to prevent developmental and other adverse effects. If these mitigation measures are not observed in the field, however, an overexposure to one of these pesticides could occur.

Children and adolescents are going through important developmental changes, and pesticide exposure can have a more deleterious effect on these developing physiological systems than on the systems in adults (Golub, 2000). Although adolescents' systems are more fully developed than those of younger children, there are important developmental processes that continue until adulthood. In particular, brain changes still continue, such as the final maturation of the cerebral cortex through synaptic pruning and myelination, an important physiological process that reduces excess neuron connections in the brain and encloses individual neurons in an insulating sheath, which increases the efficiency of information processing (Golub, 2000, Steinberg, 2005). These changes occur during adolescence, when the effects of toxicants like pesticides on the nervous system can be particularly harmful (Golub, 2000). Adolescents may be subject to incidental exposures by being in proximity to areas where pesticides are applied or from take home exposures via parents who work with pesticides, all of which can result in adverse health effects. In addition, adolescent workers can be subject to direct occupational exposure, which is a concern because acute exposure at important stages of development may cause significant health effects and also because employment at a younger age increases the chance and likelihood of chronic exposure, which may result in delayed health effects that are debilitating over a longer timeframe.

There are associations in the epidemiological literature between prenatal or early-life pesticide exposure (from occupational exposure to the family or incidental exposure in the home) and adverse health outcomes in children. These have reported delayed mental development associated with an increased exposure to organophosphate pesticides (Eskenazi *et al*., 2007, Rauh *et al*., 2006, Engel *et al*., 2007). Studies with rural and urban cohorts report associations between organophosphate pesticide exposure and abnormal reflexes in children (Engel *et al*., 2007, Young *et al*., 2005), and increased developmental disorders were reported in both the rural and urban cohorts (Eskenazi *et al*., 2007, Rauh *et al*., 2006, Lovasi, *et al*., 2011, Engel *et al*., 2011).

There are reported associations between organophosphate pesticides and the development of behavior related to attention deficit/hyperactivity disorder (ADHD), such as hyperactivity, inattention, and impulsivity. Marks et al. (2010) concluded that *in utero* levels of organophosphate metabolites, and, to a lesser extent, postnatal levels were associated with ADHD behaviors for five year old children from a rural cohort. Similar associations are reported in a study of the exposure of children to the organophosphate pesticide, chlorpyrifos and attention problems, attention-deficit/hyperactivity disorder problems, and pervasive developmental disorder problems at 3 years of age (Rauh, *et al*., 2006, Lovasi, *et al*., 2011, Engel *et al*., 2011). Using a national sample of 1,139 children, Bouchard *et al*. (2010), found an association between organophosphate metabolites and ADHD behaviors. In this study, compared to children with undetectable metabolite levels, children with levels higher than the sample median had almost twice the odds of having ADHD behaviors.

The biological mechanisms to cause such neurodevelopmental findings reported in these epidemiology studies are not well understood and thus far causality has not been established. However, when taken together, findings from the different cohorts show a potential link between pesticide exposure and neurodevelopmental effects. Specifically, these studies suggest that children with higher exposure to OPs may be at a higher risk of adverse neuro-developmental and neurobehavioral outcomes than children with lower exposures.

### 4.2.3 RUP exposure and Ecological Effects

EPA evaluates the environmental fate of pesticides, including RUPs, to determine the ways that can be applied to avoid unreasonable risk to the environment. If RUPs are not applied safely, however, they can cause a range of environmental damage (EPA, 2007). Sources of environmental exposure include drift from pesticide applications to other areas, runoff from applied pesticides that can move into waterways, and animals can move into treated areas. As with human exposures, there can be damage to wildlife from both acute and chronic exposures, but the wildlife can be exposed multiple ways (Whitford, *et al.*, undated), as mentioned in Section 4.1.3.

Acute exposure to pesticides can lead to illnesses and lethal effects in animals, just like with people. In most cases, these environmental effects would only be noticed if acute exposures lead to an observable animal deaths or plant damage. Chronic exposure to lower levels of pesticides can have a range of sublethal effects on non-target organisms, such as reproductive and developmental harm, weight loss, lowered disease resistance, or the inability to avoid predators in fish, increased mortality and endocrine disruption (Helfrich *et al.*, 2009; Capinera, 2011).

## 4.3 Which Benefits Can Be Quantified?

EPA expects the rule changes will result in benefits by reduced exposure to RUPs. However, not all benefits from reduced pesticide exposure can be quantified. This section provides a brief overview of the estimated benefits that can be quantified (from reduced acute occupational exposures) and those that cannot.

Benefits from the changes for this rule include reductions in adverse health effects by:

- avoiding RUP incidents resulting in acute pesticide exposure to certified applicators, noncertified applicators working under the direct supervision of a certified applicator, and others, such as farmworkers or bystanders who could be exposed to RUPs.
- avoiding non-occupational incidents by reducing exposures to the public.
- reducing chronic pesticide exposure to certified applicators and their families.

Some of the quantified benefits in this chapter are based on preventable pesticide exposures that have been reported to databases that count poisoning incidents; these only represent a portion of the benefits that can result from avoiding acute incidents.

Many potential health effects are not quantified in this analysis, however. Latent or delayed health effects, such as developmental effects resulting from acute exposures to pregnant women or to children and adolescents or health effects that result from repeated small exposures over time are unlikely to appear in pesticide poisoning surveillance databases, including the ones we use for developing the benefit estimates in this chapter.

Effects of longer term exposure and exposure to families, where the direct cause is unknown, are unlikely to be recorded. If they are reported, they may enter the database with uncertain causes, with little confidence that the incidents are related to a specific pesticide. Therefore, it is impossible to quantify all of the improvements in health from reduced pesticide exposure. These potential health benefits, which include those related to chronic pesticide exposure, and the effects of residues transported home, are described but cannot be quantified.

In addition to the harm to human health, misuse of RUPs has the potential to harm the environment, causing damage to non-target animals and plants, including agricultural crops, and pollinating insects, such as bees. Although there is some information on incidents of this nature which are described in this chapter (see Section 4.6), the benefits of reducing incidents like these are difficult to quantify.

## 4.4 Quantified Human Health Benefits of Reduced Acute Illness from Restricted Use Pesticides

EPA expects the changes to the certification standards to result in benefits by reducing exposure to certified pesticide applicators, their families and the public. The quantified estimate of benefits from reduced acute RUP exposure is between $13.2 and $24.3 million dollars through

reduced acute illnesses from RUPs. After adjustment for underreporting, the estimated benefits are between $65.9 million and $121.7 million, assuming that only 20% of pesticide incidents are reported (see Section 4.5). If we were to assume that 50% of pesticide incidents are reported, then the quantified estimates of the rule would be between $26.3 and $48.7 million annually. However, important non-quantifiable human health benefits are discussed later in the chapter, and important ecological but unquantified benefits are discussed in the Section 4.6. This section quantifies benefits from the reductions in adverse health effects associated with acute pesticide exposure.

### 4.4.1 Method and Data

We use a three-step process to estimate the benefits of the rule that accrue through avoiding acute effects. EPA first estimates the number of acute pesticide poisoning incidents that will be avoided through provisions in the rule. This is done by evaluating a sample of pesticide incident reports to identify the proximate causes of the exposure. EPA then determines whether the provisions of the rule address the causes to estimate the proportion of pesticide incidents that would be avoided. This proportion is applied to the total number of reported incidents to estimate the annual number of avoided incidents. As explained in Section 4.4.2.1, under-reporting is likely large, which will lead to a downward bias in the estimated benefits. This downward bias could be eliminated, if the amount of under-reporting was known. A discussion of under-reporting and the effect on estimated benefits is provided at the end of Section 4.4.5. Data for the first step in the estimation come from the Sentinel Event Notification System for Occupational Risks – Pesticides (SENSOR-Pesticides), administered by the National Institute for Occupational Safety and Health. SENSOR-Pesticides is a surveillance program that monitors occupational illnesses related to pesticide exposure. EPA also reviewed its own Incident Data System and annual reports from the American Association of Poison Control Centers to document unintentional deaths from RUPs over time.

The second step is to estimate the distribution of health impacts reported in the data. SENSOR-Pesticides data include information on the acute health outcomes of the poisoning incident, and we use this information to estimate the distribution of the severity of illnesses caused by RUP exposure.

The third step is to estimate the value of avoided incidents, given the severity of the effects. The estimates here are based on avoided medical cost and avoided productivity loss and thus will underestimate the true willingness to pay of an individual to avoid illness. Avoided deaths are valued using the value of a statistical life (VSL).

The value of avoided incidents is measured as avoided cost for treatment and lost productivity. Information on medical costs comes from two sources. Cost of inpatient care comes from the Healthcare Cost and Utilization Project (HCUP), which is a family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ)[8]. HCUP databases bring together the data collection efforts of state data organizations, hospital associations, private data

[8] More information on the Healthcare Cost and Utilization Project is available here: http://www.ahrq.gov/research/data/hcup/

organizations, and the federal government to create a national information resource of patient-level health care data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. Outpatient costs come from the Healthcare Common Procedure Code (HCPC) Criteria, which is a Centers for Medicare & Medicaid Services (CMS) classification system used for identifying medical services and procedures furnished by physicians and other health care professionals[9].

Finally, data to estimate the value of productivity loss avoided comes from a variety of reports from the Bureau of Labor Statistics. Details are presented in Section 4.4.4.

### 4.4.2 Pesticide Incidents Avoided

For estimating the proposal's effect on pesticide incidents we use a database from the National Institute for Occupational Safety and Health (NIOSH) called the Sentinel Event Notification System for Occupational Exposure (SENSOR-Pesticides). This database contains detail on the exposures that led to the incident report, their severity and their causes, although the data are not national in scope. SENSOR-Pesticides is a surveillance program that monitors occupational illnesses related to pesticide exposure. EPA obtained data for a four-year period, 2008 to 2011, during which time nine states (California, Florida, Iowa, Louisiana, Michigan, North Carolina, Oregon, Texas, and Washington) reported incidents involving RUPs to SENSOR-Pesticides (Fortenberry and Calvert, 2014). SENSOR-Pesticides reports generally contain sufficient detail to identify the type of pesticide involved in the incident to determine if it was an RUP and to evaluate the circumstances of the incident. These data are used to estimate the proportion of incidents that would be avoided under the rule. Although SENSOR-Pesticides data are available for earlier years, only data from 2008 – 2011 are used here. 2008 through 2011 are the most recent years for which the reporting states are consistent. In addition, for these four years SENSOR-Pesticides reports any contributing factor (also known as the "prevention code") identified for each incident. EPA initially focused this query on cases with prevention codes to draw upon the training and expertise of NIOSH and the SENSOR-Pesticides state surveillance coordinators who investigate and code these cases. However, while investigating deaths and high severity cases over time in SENSOR, EPA realized that some relevant incidents were not captured by the prevention code-based query because the prevention code was identified as "other" or "unknown" which are not specific enough to be accurately categorized in terms of prevention without closer examination of the case details.

EPA reviewed pesticide incident cases reported to SENSOR-Pesticides from 2008-2011 that involved a pesticide ingredient commonly associated with RUPs. EPA initially identified 478 possible unintentional cases involving RUPs, but 81 were removed from consideration, leaving 397 cases. Of the cases removed, 22 cases involved soil fumigants. Recent changes to soil fumigant labeling requiring increased training and safety equipment would probably have prevented those incidents. The proposed new soil fumigant category in the changes to the certification standards codifies the current label requirements, so we do not include those incidents here. Fifty-nine cases were not relevant to the rule, for various reasons. These reasons

[9] More information on the Healthcare Common Procedure Code system and codes is available here: http://www.cms.gov/Medicare/Coding/MedHCPCSGenInfo/index.html

included accidents during manufacturing or shipping, or further investigation revealed that the products involved were unlikely to be RUPs, such as an incident involved a residential application by a homeowner, which would not be covered by the revised certification standard.

There is uncertainty in the results of the incident analysis. Certified applicators must demonstrate a level of competency to ensure that an RUP can be used without causing these unreasonable adverse effects from RUP exposure. The basis of the existing certification program is that training and/or the knowledge acquired to pass an examination will result in fewer errors following often complex use directions than would be the case in the absence of the certification program. This rule enhances competency standards and accountability for certified applicators and improves qualifications and supervision of people using RUPs under the supervision of a certified applicator, which, by the same logic, will further reduce errors in applications, especially in new categories of certification and by noncertified applicators who previously may not have received training. However, when reviewing incidents, it is impossible to be certain that specific incidents will be prevented by specific provisions of the rule.

For the remaining 397 cases, EPA was able to identify the proximate causes of the exposure causing the incident using the pesticide incident reports from SENSOR-Pesticides including with the assigned prevention codes and additional information where available, such as from California's Pesticide Illness Surveillance Program. EPA reviewed the narrative description of these cases, the information identified in the SENSOR-Pesticide database and, additional information from the state if it was available for the cause of the incident and determined whether the provisions of the rule would mitigate the exposure that caused the incident. EPA's benefit estimates are based on the cases that were categorized as "preventable" or "possibly preventable." Other incidents were evaluated, and EPA determined there was either not enough information to determine if the incident would have been prevented by the rule changes, the rule would not have prevented the incident, or the incident was not relevant to the rule.

Categories were assigned using the following guidelines:

- Preventable Incidents: incidents where there was a clear link between the application/applicator and the effect and the information demonstrated an error by the applicator or applicator incompetency. There were 202 incidents classified as preventable.
- Possibly Preventable Incidents: incidents where there was a clear link between the application/applicator and the effect and an applicator error was possible but the available information did not identify any specific applicator errors. There were 73 incidents that were classified as possibly preventable.
- The remainder of the incidents could not be considered "preventable" or "possibly preventable." These are incidents where the available information does not indicate the rule changes would have prevented the incident. For example, incidents where there was a clear link between the application and the effect and where an applicator error was possible, but the available information did not identify any applicator errors, such as if an applicator was wearing all of the required PPE but still suffered exposure, or other purely accidental incidents. Cases that were determined to be not preventable include those where the available information does not indicate that rule changes would prevent the incident. Cases that were intentional poisoning, such as suicide attempts, were considered to be 'not preventable' unless

an error by a certified applicator or an RUP retailer could be identified, which only happened in one case.

There are 31 possibly relevant (32 total) incidents involving the herbicide paraquat that are treated differently than other RUP incidents. The Agency is currently pursuing separate risk mitigation specific to paraquat due to repeated and very severe incidents. The proposed risk mitigation includes updated labeling, enhanced training materials, elimination of application via handheld equipment, requirements of closed systems for material transfer, and only allowing application by certified applicator; application by noncertified applicators is not allowed, even under the supervision of a certified applicators.

These paraquat risk mitigations, if finalized, may reduce the number of incidents involving paraquat. Therefore, we exclude paraquat incidents from the estimation of the number of incidents. This is a conservative approach, because the final paraquat mitigation measures are not yet known, and because preventable accidents involving paraquat are likely indicative of wider problems with RUP storage and use that could be prevented by the rule changes. If the activities of applicators and non-certified applicators under the supervision of a certified applicator result in exposure and illness to paraquat, one of the pesticides with the greatest human health risks (Fortenberry *et al.*, 2016), then similar mistakes, such as pouring product into an unmarked beverage container for storage or use despite label instructions, are likely to occur when applying other pesticides. Of the 32 total paraquat incidents, six would have been classified as "preventable," 22 would have been classified as "possibly preventable," and 1 incident was "not preventable." There were two incidents that did not have enough information for classification, and one turned out not to be a relevant paraquat or RUP incident. All cases involving paraquat were excluded from consideration for estimating preventable or possibly preventable incidents.

There are some incidents that were deemed preventable or possibly preventable that involved pesticides with active ingredients that are no longer registered. These incidents involved the active ingredients endosulfan, carbofuran and azinphos-methyl, which are no longer available for sale. These incidents, like all of the incidents used for estimating benefits as well as some of the incidents that were excluded, are indicative of systematic problems in RUP application that could be prevented by the rule changes. If the actions of applicators and noncertified applicators under the supervision of a certified applicator using these RUPs resulted in exposure and illness, then similar mistakes are likely to occur when applying other pesticides. EPA's goal with chemical-specific mitigation, such as with paraquat and soil fumigants, is to lower exposure to humans and the environment when all use directions are followed. In contrast, this rulemaking is intended to enable and foster compliance with those use directions, thereby reducing or mitigating unintended exposures due to errors or failure to follow use directions. Cancellation only occurs when EPA and registrants cannot find a way to ensure that chemicals can be used without unreasonable adverse effects.

Incidents involving the cancelled RUPs still represent errors made by certified applicators or noncertified applicators under the supervision of a certified applicator when those RUPs were registered and legal to use. It is reasonable to assume that pesticide users have not ceased using RUPs completely; rather they have found other products that can be used instead of those that

have been cancelled, and could continue to make similar errors with different products if their competency is not adequate. EPA treated paraquat differently in the Economic Analysis for the final rule, because, unlike the cancelled active ingredients referred to by the commenter, the proposed paraquat mitigation measures were intended to specifically prevent incidents identified in our query of the SENSOR-Pesticides database (e.g., exposure to noncertified applicators or accidental ingestion of paraquat after it was improperly transferred to a beverage container). The number of avoidable incidents is likely underestimated because EPA only reviewed incidents associated with RUPs. However, certified applicators also non-RUPs and improving the competency of the applicator is likely to reduce or mitigate incidents with non-RUPs as well.

After excluding the paraquat cases, the soil fumigant cases, and the not relevant cases, there were 366 incidents determined to be relevant to the rule. The review of the SENSOR-Pesticides data identified 196 cases that were preventable under the changes to the rule, and another 51 cases were possibly preventable. Cases deemed "preventable" were used to calculate the low-end ratio of acute exposure cases to total unintentional pesticide incidents. Table 4.4-1 presents the results of the review of the SENSOR-Pesticides data. Given 366 incidents determined to be relevant to the rule, including those without enough information to determine whether the incident could be prevented, EPA concludes that 54 to 68 percent of RUP incidents would be preventable or at least possibly avoidable through the rule changes. The lower estimate is based on avoiding only cases similar to those deemed preventable due to the changes, as discussed above. The higher estimate is based on those cases, plus those deemed as possibly preventable after the changes. This approach implicitly assumes that 100% of the cases similar to those classified as preventable (for the low-end estimate) or possibly preventable cases (for the high-end estimate) would be prevented by the rule changes, which corresponds to 54 – 68% of cases relevant to the rule. EPA reviewed the available incidents carefully when determining preventability, and it should be noted that many incidents that were determined to be "not preventable" may have been classified otherwise if more information were available, which would tend to increase the number of prevented incidents. If the rule did not prevent some percentage of incidents that we have classified as preventable or possibly preventable, then the estimates of prevented incidents and quantified benefits would be lower. Although EPA was conservative in determining which incidents should be considered preventable or possibly preventable, it is possible that not all similar incidents would be prevented. There is further discussion of the sensitivity to this assumption in Section 4.4.5..

**Table 4.4-1: Estimated SENSOR-Pesticides Cases Avoided under the Rule Changes, 2008 - 2011**

| Likelihood of Being Avoided by the Rule | Number of Cases Avoided, 2008 - 2011 | Percent of RUP Cases (397 Cases) | Annual Avoidable Incident rate per 1,000 certified applicators | National Estimate of RUP Cases Avoided Annually |
|---|---|---|---|---|
| Preventable | 196 | 54% | 0.173 | 156.5 |
| Possibly Preventable | 51 | 14% | 0.045 | 40.7 |
| Both Preventable and | 247 | 68% | 0..218 | 197.2 |

| | | | | |
|---|---|---|---|---|
| Possibly Preventable | | | | |

Source: EPA estimates from SENSOR-Pesticides data. The incident rates are based on the estimate of 283,036 certified applicators in the SENSOR-Pesticides states and 903,726 certified applicators nationally (see Tables 3.3-1 and 3.3-5).
Note: The number of cases avoided is based on four years of information, while the final column is an annual estimate.

EPA identified 196 to 247 avoidable incidents over a four-year period, or about 49 to 62 incidents per year, in the states reporting to SENSOR-Pesticides. To estimate the annual national number of pesticide incidents avoided by this rule, we need to scale the data from the SENSOR-Pesticides states that reported RUP incidents to the national level. If we let $PI_{s,l}$ be the number of preventable incidents in the SENSOR-Pesticides states ($s$) for each likelihood ($l$ = preventable, possible, both), and $APP_s$ be the number of certified applicators in the SENSOR-Pesticides states, then we can define $RP_{s,l} = PI_{s,l}/APP_s$, which will be an estimate of the number of incidents per certified applicator in SENSOR-Pesticide states for each level of likelihood for the incident being avoided. We assume that the rate of preventable incidents per applicator nationally, $RP_{n,l}$, is equal to $RP_{s,l}$. Therefore, we can estimate the national level of preventable incidents by multiplying $RP_{n,l}$ by the number of certified applicators nationally.

Using the estimated number of certified applicators from Table 3.3-1 and 3.3-5 the average number of certified applicators in SENSOR-Pesticides states as 283,036. This number includes existing certified private and commercial applicators plus the number of new certified applicators in the SENSOR-Pesticides states. $RP_{s,l}$, the rate of preventable incidents per applicator, is estimated by taking the number of avoided incidents annually, and dividing it by the average number of certified applicators in the SENSOR-Pesticides states, and then scaling the result into preventable incidents per 1,000 certified applicators. The results indicate a reduction in incidents involving RUPs from 0.173 to 0.218 per 1,000 certified applicators (Table 4.4-1).

The estimated number of incidents avoided annually are presented for both preventable and possibly preventable illnesses, as shown in the table. For every 1,000 certified applicators in the SENSOR-Pesticides states, there are an estimated 0.218 RUP incidents that are preventable or possibly preventable by the rule. The final column in Table 4.4-1 shows the national estimate of avoided RUP incidents. The estimates in this column were calculated by multiplying the annual preventable incident rate per applicator ($RP_{n,l} = RP_{s,l}$) times the number of certified applicators nationally. Nationally the estimated number of certified applicators was 903,726 (see Table 3.3-1 and 3.3-5), which includes new and existing private and commercial applicators. These calculations yield an estimate of annual RUP incidents prevented by the rule of 157 on the low end, and 197 on the upper end. This estimate accounts only for reported incidents, which are likely to be a small proportion of the total number of incidents. In Section 4.4.3.1 below, we consider other sources for unreported deaths, which changes the upper estimate to 198.

#### *4.4.2.1 Under-reporting of RUP Incidents*

There is concern that pesticide incidents in general are underreported. At least four steps are necessary before a pesticide-related illness can be recorded by any counting system: (1) the exposed person must perceive that they have treatable symptoms; (2) the person must seek medical attention or call poison control; (3) the physician, nurse, or poison control specialist must identify a possible environmental or occupational exposure and determine that the symptoms could be pesticide related; and (4) the medical staff or the injured person must report the incident to the appropriate state entity if available, and the incident must be recorded as pesticide related. A breakdown at any of the steps would prevent a pesticide poisoning case from being tallied in surveillance databases (Das *et al*., 2001).

(1) The exposed person must perceive that they have treatable symptoms of an illness. Symptoms of acute pesticide poisoning illnesses and injuries are similar to common illnesses and not uniquely indicative of pesticide effects. Dermatologic and ophthalmologic effects, such as skin rashes and eye irritation, also have many other causes. Systemic poisoning by some of the more common pesticides results in flu-like or cold-like symptoms, such as headache, nausea, vomiting, dizziness, and a general feeling of malaise. Allergic effects may be either upper-respiratory problems that mimic hay fever symptoms, or dermatologic effects similar to those caused by exposure to poison ivy. When bystanders or other people beside the applicator are exposed, they may not perceive that their symptoms are related to pesticide exposures because they are not working directly with pesticides and may not realize that they were exposed to pesticide residues.

(2) The person must seek medical attention or contact a poison control center. Except in life-threatening emergencies, many pesticide-related acute health effects will gradually disappear without medical intervention. For example, the cholinesterase enzyme, when inhibited by pesticide exposure, causes some of the more common acute systemic poisoning symptoms. In many cases, this inhibition will gradually (depending on the family of pesticide, severity, and repetition of exposure) recover without treatment. Allergic, dermatologic, and ophthalmologic effects will gradually disappear when exposure to the causal pesticide diminishes. Therefore, many people with treatable symptoms may not seek physician care. A survey of California workers whose illnesses had been reported to a surveillance system showed that in 40% of the cases, other workers exposed in the same incidents did not seek medical treatment (Das *et al*., 2001), an example of cases that are underreported.

(3) The physician must diagnose the symptoms as being pesticide related. When medical treatment is sought, the treating medical personnel may not specifically diagnose the illness or injury as being caused by an occupational exposure to pesticides. Many signs and symptoms of such poisoning may be treated symptomatically or an occupational connection may not be drawn. It is unknown how often physicians mistake pesticide poisonings for other causes, but physicians may not associate vague symptoms with pesticide poisonings. The person seeking care may not know or identify the cause of the poisoning as a pesticide. In addition, there may not be laboratory tests to confirm suspicions of pesticide exposure, and physicians may be more concerned with treating symptoms rather than confirming the causes.

(4) The physician must report the incident to a recordkeeping system, and the incident must be recorded as pesticide related. Occupational diseases in general are more likely to be under-reported than occupational injuries. A 1991 study of farmworker health and safety in the State of Washington says: "Frequently, occupational diseases simply do not appear in workers' compensation records, even when clear-cut. This is due to reporting disincentives and inherent difficulties in health care providers recognizing conditions as work-related." (Washington State Department of Labor and Industries, 1991)

Barriers to accurate reporting by physicians include a lack of awareness of reporting requirements and opportunities, reluctance to engage in reporting that might result in legal or bureaucratic difficulties, and the time constraints on physicians that may prevent them from completing records and reporting incidents (Azaroff *et al*., 2002, Baker *et al*., 1998). For example, a report by the Arizona Office of the Auditor General found: "[S]ome physicians and healthcare officials suggest that cases may not be reported because healthcare professionals fear becoming involved in a lawsuit or occupational injury claim in which they might have to defend an uncertain diagnosis in court. Our review of literature on the subject corroborated this statement" (Arizona, 1990).

If any of the four steps needed for accurate recording of an occupational pesticide incident are not completed, then it will not appear in surveillance databases. There is evidence in the literature that occupational medical incidents, especially exposures to poisons, are underreported, although some of this is anecdotal. This may be even more likely in the agricultural sector, due to the nature of the workforce, which is less educated, less likely to speak English and less likely to be a citizen (Kandel, 2008). Exposures that do not cause immediate symptoms are unlikely to be reported. Several studies indicate that under-reporting of illness is common, both for occupational illnesses and for poisoning incidents, with an estimate of under-reporting ranging from 20 – 70%. These studies are summarized in Table 4.4-2, and a discussion of the importance on benefit estimates is provided below and quantified in Section 4.4.5.

| Table 4.4-2 Summary of Results from Underreporting Studies | | | |
|---|---|---|---|
| Date | Title | Goal of Study | Underreporting Estimate |
| 1990 | Treated vs. Reported Toxic Exposures: Discrepancies Between a Poison Control Center and a Member Hospital (Harchelroad *et al*., 1990) | Compare poison control center reports to actual toxic exposures presented to an urban area hospital | 74%[a] |
| 1983 | Patterns in Hospitals' Use of a Regional Poison Information Center (Chafee-Bahamon *et al*., 1983) | Observing usage patterns of a poison information center by hospital staff over a two-year period | "Sufficiently Large"[b] |
| 1987 | Interpretation and Uses of Data Collected in Poison Control Centers in the United States (Veltri *et al*., 1987) | Identifying the strengths and weaknesses of the American Association of Poison Control Centers National Data Collection System | 67% |
| 2006 | California Surveillance for Pesticide-Related Illness and Injury: Coverage, Bias, and Limitations (Mehler, *et al.*, 2006) | Evaluate the strengths and weaknesses of the California Pesticide Illness Surveillance Program | 47% of hospitalizations for agricultural workers, 84% of poison control reports for all occupational exposure |
| 2008 | Hidden Tragedy: Underreporting of Workplace Injuries and Illnesses (US House of Representatives, 2008) | Identifying issues involving the inclusiveness of reported workplace injuries and illnesses | 69% |
| 2008 | Examining Evidence on Whether BLS Undercounts Workplace Injuries and Illnesses (Ruser, 2008) | Identifying underreporting for the Bureau of Labor Statistics, and how they can be corrected | 20-70%[c] |
| 2008 | Acute Pesticide Poisoning Among Agricultural Workers in the United States, 1998–2005 (Calvert, *et al.*, 2008) | Identifying agricultural pesticide exposure incidents and estimate incident rates | 88% to 95%, when compared to the Department of Labor National Agricultural Workers Survey[d] |

Notes:
[a] The Emergency Medical Dispatcher evaluated found only 26% of cases were relayed to the regional Poison Control Center; resulting in underreport of 74%
[b] "Sufficiently Large" represents the authors' interpretation of the differences between hospital's poisoning reports and the hospital records, indicating a problematic discrepancy.
[c] Undercount estimates related to the Survey of Occupational Injuries and Illnesses, conducted by BLS
[d] Based on calculation in Calvert et al., 2008, comparing SENSOR-Pesticides to the National Agricultural Workers Survey

The Bureau of Labor Statistics conducts an annual Survey of Occupational Injuries and Illnesses (SOII), which provides a summary on the safety of the nation's workplaces. Ruser (2008) estimates that the SOII undercounts occupational illnesses, but the estimate range is wide, 20 to 70 percent. Although attempting to record injuries and illnesses on a national scale, the SOII omits some groups from the survey entirely. Self-employed, household and small-farm workers

are not recorded in the SOII. The BLS realizes the undercount of its SOII, noting that many conditions, notably those caused by exposure to carcinogens, are often difficult to associate to the workplace.

The House Committee on Education and Labor estimates that up to nearly 70% of illnesses and injuries may never make it to the often cited SOII (U.S. House of Representatives, 2008). According to experts, a major cause of under-reporting may be due to the fact that employers may have certain incentives to minimize reporting, because those operations with fewer injuries and illnesses are less likely to be inspected by the Occupational Safety and Health Administration.

There have been three studies on undercounts involving poison control data. The studies each focus on a specific region and compare cases reported to poison control centers with those poisonings for which there are hospital records. In all three cases, the studies indicate a substantial under-reporting of poisoning incidents. Note that these studies only estimate the under-reporting by physicians (*i.e.*, Step 4 in the chain of events for an event to be recorded) – poisoned people not seeking medical care or where the cause is misdiagnosed would not be counted in these studies.

Harchelroad *et al*. (1990) compared cases, reported to Poison Control Centers (PCC), of actual toxic exposure results documented by an emergency department to a member hospital. Of the 470 exposures that were observed by the emergency department, only 26% were ever documented and reported. The study suggests that lack of awareness or complacency to toxic exposure on the part of the potential callers are probably the major cause for non-reporting.

Chafee-Bahamon *et al*. (1983) investigated the variability of reporting by different hospitals. In similar regional hospitals, there were significant differences in the identification of poisonings among admitted patients. The authors doubt that the large difference between the documented hospitals is due to diagnostic practices alone. In particular, emergency room staff in rural hospitals or hospitals far from poison control centers were identified as being less likely to call poison control centers, so the cases were less likely to be recorded in poisoning databases.

The third study, by Veltri *et al*. (1987), noted problems with the reporting of diagnoses of illnesses and injuries. This study suggests that not only under-reporting but misreporting may occur. In this case, only about one-third of the cases evaluated at a regional medical center could be directly matched to respective poisoning reports. Misclassifications of illnesses and injuries are believed to be a frequent occurrence, which indicates that existing data on pesticide poisonings may be consistently low.

Calvert *et al.*, (2008), estimated incidence rates of agricultural pesticide poisoning, finding that, among agricultural workers annual pesticide poisonings occurred at a rate of 51 per 100,000 farmworkers. Calvert compares these to results from the Department of Labor's National Agricultural Worker's Survey (NAWS), which in 1999 survey farmworkers about pesticide exposure, illness and medical treatment. Calvert *et al.* report, based on the SENSOR-Pesticides data, that 0.07% of farmworkers suffer acute occupational pesticide poisonings annually. They compare that to the NAWS, which reports that 1.4% of agricultural workers suffered medical

symptoms as a result of pesticide exposure, and that 0.6% received medical treatment for illness from pesticide exposure. If these numbers are correct, it suggests that 0.53% (the difference between 0.6% and 0.07%) of farmworkers received medical treatment but were not reported to the pesticide illness surveillance system, and 1.33% (the difference between 1.4% and 0.07%) suffered symptoms that were not recorded in counts of pesticide incidents. These numbers suggest substantial underreporting: if 0.53% of the 0.6% were not recorded, that is an underreporting rate of 88%. If we were to think about incidents including those where medical treatment is not sought, then 1.4% of farmworkers had illness from pesticide exposure, but 1.33% were not recorded, which is an underreporting rate of 95%.

The literature on under-reporting shown in Table 4.4-2 specifically addressed under-reporting of occupational injuries or chemical poisoning incidents. However, a commenter on the Economic Analysis for the proposed rule pointed toward public health literature that contains different estimates or assumptions about under-reporting. Scallan et al., (2001) uses a range of estimates of under-reporting to estimate the number of food-borne illnesses annually, including 50% under-reporting of deaths and hospitalizations. This estimate is based on Mead et al., (1999), who doubled the number of reported deaths from food-borne illness to adjust for underreporting without explanation for that figure. EPA has revised this Economic Analysis to identify the impact of both the 50% and 80% under-reporting estimates.

There are additional reasons to think that pesticide incidents specifically are underreported. The OPP Report on Incident Information (EPA, 2007) lists several factors that cause pesticide incidents to be underreported, most of which are consistent with breakdowns in steps 3 and 4 above. According to the OPP Report on Incident Information, these include

- The lack of a universal, mandatory legal duty to report incidents;
- No central reporting point for all incidents;
- Symptoms associated with pesticide poisonings often mimic symptoms from other causes;
- Physicians may misdiagnose due to a lack of familiarity with pesticide effects;
- Incidents may not be investigated adequately to identify the pesticide that caused the effects;
- Difficulty in identifying and tracking chronic effects;
- Reluctance or inability to report by physicians; and
- Limited geographic coverage for individual poisoning databases.

EPA's attempt to quantify preventable poisoning cases also indicates that there are a substantial number of cases that do not get reported in the SENSOR-Pesticides database used for quantifying benefits here. Under-reporting is likely to vary across states. Some states, such as California, have robust reporting systems, with extensive follow-up on reported incidents by local officials and technical experts. States like California, or other states with extensive surveillance systems are more likely to have higher reporting rates than other states, including those who do not participate in the SENSOR-Pesticides surveillance programs, which expend fewer resources to track pesticide poisonings.

For the Economic Analysis of the Worker Protection Standard, EPA investigated SENSOR-Pesticides to determine if cases were relevant to the Worker Protection Standard (WPS) rule changes, and determine if they were preventable. EPA staff also evaluated the SENSOR-Pesticides incident reports and sought out additional information from the California Department of Pesticide Regulation (CDPR) surveillance database, the Pesticide Illness Surveillance Program (PISP) for those cases from California (EPA 2015c). The SENSOR-Pesticides data from the state of California are collected by staff at the California Department of Public Health. In conducting the case by case incident review, EPA staff learned that the SENSOR-Pesticides data from California did not capture many of the pesticide incidents that were identified in the CDPR PISP. This discrepancy in the counts of pesticide incidents reported in the State's two pesticide incident databases, despite frequent coordination among the two state entities, is a telling example of how incidents are often underreported. This analysis, which includes both incidents for the WPS rule and for RUP incidents used to estimate benefits for the certification rule, indicates substantial underreporting in SENSOR-Pesticides, which means the benefit estimates will be biased downward.

*SENSOR-Pesticides*

The primary source of pesticide exposure incidents that EPA uses in this analysis to estimate prevented acute illness is the SENSOR-Pesticides database. The SENSOR-Pesticides database reports data from 1998-2011, although reporting varies from state to state and from year to year. Cases of pesticide-related illnesses are ascertained from a variety of sources, including: reports from local Poison Control Centers, state Department of Labor workers' compensation claims when reported by physicians, reports from State Departments of Agriculture, and physician reports to state Departments of Health. Although both occupational and non-occupational incidents are included in the database, SENSOR-Pesticides focuses on occupational pesticide incidents, and is of particular value in providing that information. A state SENSOR-Pesticides specialist attempts to follow-up with occupational and high priority cases (high severity and multiple case events, for example) and obtains medical records to verify symptoms, circumstances surrounding the exposure, severity, and outcome. Using standardized case definition and list of variables, SENSOR-Pesticides coordinators at State Departments of Health enter the incident interview description provided by the case, medical report, physician and patient into the SENSOR-Pesticides system.

A case is considered by CDC/NIOSH to be reportable to SENSOR-Pesticides when any adverse health effect, resulting from exposure to a FIFRA-defined pesticide product, occurs. Cases, including all low severity cases, must report at least two symptoms to be included in the database. Cases must also be categorized as definite, probable, possible, or suspicious based upon a rigorous case classification matrix that takes into account the temporal relationship between adverse health effects and exposure, evidence of a causal relationship between symptoms and the pesticides. "Unlikely" cases are not reportable to SENSOR-Pesticides.

*California Pesticide Illness Surveillance Program*

The California Pesticide Illness Surveillance Program (PISP) maintains a database of pesticide-related illnesses and injuries. Case reports are received from physicians and via workers'

compensation records. The local County Agricultural Commissioner investigates circumstances of exposure. Medical records and investigative findings are then evaluated by DPR technical experts and entered into an illness registry.

PISP contains both residential and occupational pesticide incidents. PISP has limited coverage (only California) and is not particularly useful for national trend information. However, the incident information is entered by professionals with expertise in pesticides, with extensive follow-up on each reported case so there is a high level of confidence in the information provided for each reported incident. PISP is an active surveillance program.

*Comparison of SENSOR-Pesticides to PISP*

When comparing incidents in the two surveillance databases for the WPS rule, SENSOR-Pesticides, which is populated by the California Department of Public Health, did not capture many pesticide incidents that were identified in the CDPR PISP, which is an example of yet another (beyond the four discussed above) step in which exposure incidents can be underreported. The number of cases not captured in the SENSOR-Pesticides data but found in PISP help to characterize part of the underreporting. The number of SENSOR-Pesticides incidents found to be relevant for the WPS changes is substantially smaller than the potentially relevant cases in the PISP data. From 2008 – 2011, the PISP data showed that only 31% of potentially relevant PISP cases appear in SENSOR-Pesticides. EPA reviewed the subset of individual cases from 2008, where there were 324 cases in PISP. EPA selected 2008 as a reference year to investigate the differences between PISP and SENSOR-Pesticides because it was more likely that all relevant investigations had been concluded for the cases from 2008 compared to 2011. Only 78 of these cases (24%) were also in SENSOR-Pesticides. EPA identified the following reasons why the 246 remaining PISP cases were not included in our query of the SENSOR data:

- In 96 cases, the worker did not seek medical attention, which is a criterion for a case being included in SENSOR-Pesticides. This was also discussed earlier as a reason for an incident not being reported. For the 324 cases in PISP for 2008, these 96 workers account for 30% of the cases.
- For 21 of the cases, the worker only exhibited one symptom from the pesticide exposure. A case must include two or more symptoms to be included in SENSOR-Pesticides.
- Thirty-one cases involved drift of an agricultural pesticide into a residential area. While SENSOR-Pesticides does include some incidents like this, the focus of SENSOR-Pesticides is on occupational exposures. It is possible that these 31 cases were not included because they were not occupational exposures.
- There were 23 cases associated with an incident involving an antimicrobial pesticide, which may not have been identified as a pesticide and therefore not included.
- Twenty-one cases were not included for other reasons, including being part of a high profile incident that may not have been reported to the database at the time (because of the sensitivity), being based on an initial report but not final investigation, being identified for different years (e.g., 2007 in SENSOR and 2008 in PISP), and being entered into the system late.

- Finally, there were 54 cases where we could not identify a reason that the incident was not included in SENSOR-Pesticides.

As shown by the analysis of the 2008 cases, a number of factors could account for the difference in cases between SENSOR-Pesticides and PISP. As explained above, the two surveillance programs have different standards for case inclusion and ascertainment. In most of the cases, the incidents in PISP may not have met the standards to be included in SENSOR-Pesticides (e.g. there was only one poisoning symptom, or the victim was not evaluated by a health professional) or the incident may have seemed otherwise outside the scope of SENSOR-Pesticides (e.g., the incident did not involve occupational exposure or it did not seem to involve a pesticide). In other cases, particularly those that involve 5 or more people, the report in SENSOR-Pesticides may be based on an initial notification of an incident but not the final investigation summary that is in PISP, resulting in differences in the number of people injured. The active ingredient, enforcement response or other information may also be different, resulting in our inability to categorize an incident in SENSOR-Pesticides as relevant. CDPR also has the County Agricultural Commissioner investigate every case of illness exposure that is entered into PISP. Thus, the evaluation of the likelihood of the illness being associated with pesticide exposure is a combination of medical evaluation and information from the field. Finally, cases that are reported to DPR from poison control, County Agricultural Commissioner investigations, or tips and complaints from the general public may not get reported to CDPH and consequently to SENSOR-Pesticides. While the two state agencies invest considerable time in ensuring one uniform list of statewide occupational illnesses, differences remain. These figures indicate that many pesticide exposure incidents are not included in the data used for the quantified benefit estimates of this rule.

The analysis of the differences between PISP and California cases in SENSOR-Pesticides for 2008 can be used to estimate the underreporting that occurs at other points in the process than the estimates in the studies shown in Table 4.4-2. In particular,

- Seeking medical attention is discussed as the second of the steps identified by Das *et al.* (2001) that lead to underreporting. For the 2008 PISP data, the worker did not seek medical attention in 30% of the cases (96 cases out of 324 total cases). We assume that 30% of the cases are not reported because of this reason (or that 70% of the cases are reported).
- The studies discussed in Table 4.4-2 estimate the share of incidents that are reported by physicians into a recordkeeping system, which is discussed as step 4 by Das *et al*. (2001). Based on the information reported in those studies, we assume that 70% of cases are not reported for this step (or that 30% of the case are reported).
- For a variety of reasons, including not meeting the criteria for inclusion in SENSOR-Pesticides, possibly being outside the focus of SENSOR-Pesticides, and for logistical reasons other than those discussed above, known pesticide incidents do not appear in SENSOR-Pesticides. In addition to the 96 cases that did not seek medical care in the 2008 PISP data, there were 150 other cases that were in PISP but not SENSOR-Pesticides. This means that 46% of the cases (150 out of 324 cases) were not reported for other reasons, so we estimate that 46% of cases do not get into SENSOR-Pesticides (or 54% of the cases are reported).

Considering only the underreporting due to these three factors, EPA estimates that in California, about 11.3% of incidents in 2008 were reported to SENSOR-Pesticides. While this estimate may seem low, it is calculated by multiplying the percent of cases that are reported in each step: 0.7 (sought medical attention) * 0.3 (cases reported by medical staff) * 0.54 (made it into SENSOR-Pesticides by meeting the criteria, being in the scope of the database, etc.). While this analysis covered the incidents reported for only one year, it is important information because it deals specifically with cases involving occupational exposures to pesticides.

This is still a conservative estimate that does not quantify the impact of all of the reasons incidents may not be counted that are discussed in this section, such as step 1 (workers and handlers must perceive that they have treatable symptoms of an illness) and step 3 (the physician must diagnose the symptoms as being pesticide-related). The description of the SENSOR-Pesticide cases indicated that some workers or employers attributed their symptoms to other causes, such as a virus, general fatigue, heat, or something they ate. However, EPA does not have enough information to attempt to quantify this factor. We also do not have information available to attempt to identify the percent of incidents that are underreported by physicians diagnosing symptoms as being caused by something other than pesticides.

The limited available data for pesticide poisonings by RUPs are consistent with the conclusion that only a small fraction of the symptoms of pesticide poisoning are likely to lead to medical attention and possible diagnosis. The above estimate of 11.3% pesticide incidents reported was for a sample of incidents that were relevant for the WPS, which mainly feature farmworkers. This rule focuses on RUP safety and RUP incidents may be more likely to affect certified pesticide applicators, a different population than farmworkers. For the Economic Analysis of the WPS rule (EPA 2015c), based on the 11.3% reporting estimate above, EPA used 10% reporting as a baseline when discussing the impact of underreporting on the benefits estimates, but a higher estimate may be more appropriate here. Because the WPS rule was focused on farmworker protection, underreporting may be less severe for the RUP incidents that are targeted by the certification rule. Kandel (2008) describes the hired farmworker population as "… younger, less educated, more likely to be foreign-born, and less likely to be citizens or authorized to work in the United States." These attributes reflect a relatively disadvantaged workforce that may be less likely or able to seek medical care or report pesticide incidents to their employers or anyone else. The literacy, language, legal, economic and immigration status create challenges for workers who wish to seek medical care, which would be a primary route for pesticide incidents to be reported and available to be counted in poisoning databases. These factors may be less relevant for certified pesticide applicators, so underreporting may not be as severe. To be conservative, we use an estimate of 20% reporting as the baseline for discussion of underreporting of RUP incidents. Similar to the methodology used in Scallan et al (2001), this estimate represents an *ad hoc* assumed doubling of the reporting rate used as a baseline in the Economic Analysis for the WPS. When under-reporting is discussed elsewhere in this chapter we also consider 50% reporting, based on Scallan et al., (2011) and Mead et al., (1999). Both 20% and 50% reporting rates are presented to focus discussion; a range of estimates of underreporting and the impact on the benefits estimates is provided at the end of Section 4.4.5.

### 4.4.3 The Severity Distribution of Avoided Incidents

As explained in Section 4.4.1, EPA estimates the value of avoided incidents in terms of the medical costs avoided, the productivity losses avoided, and the reduction in premature mortality. Other, unquantifiable benefits are discussed in Section 4.5 and 4.6. The value of avoided incidents depends on the severity of the effect caused by the pesticide exposure. People suffering from more severe effects are more likely to seek medical treatment. More severe effects are more costly because they require more treatment, including hospitalization. Further, a more severe effect is likely to result in a longer period of recovery during which the victim is unable to work or engage in other activities.

The SENSOR-Pesticides data on RUP illnesses contains information about the severity of the illness for many of the incidents. We use that information about incident severity for preventable or possibly preventable pesticide incidents to estimate the distribution of severity effects from estimated preventable pesticide exposures.

The four severity categories in the SENSOR-Pesticides data are defined as follows (NIOSH, 2001):

- S-4 Low severity illness or injury
  This is the category of lowest severity. It is often manifested by skin, eye or upper respiratory irritation. It may also include fever, headache, fatigue or dizziness. Typically the illness or injury resolves without treatment. There is minimal lost time (<3 days) from work or normal activities

- S-3 Moderate severity illness or injury
  This category includes cases of less severe illness or injury often involving systemic manifestations. Generally, treatment was provided. The individual is able to return to normal functioning without any residual disability. Usually, less time is lost from work or normal activities (3-5 days), compared to those with severe illness or injury. No residual impairment is present (although effects may be persistent)

- S-2 High severity illness or injury
  The illness or injury is severe enough to be considered life threatening and typically requires treatment. This level of effect commonly involves hospitalization to prevent death. Signs and symptoms include, but are not limited to, coma, cardiac arrest, renal failure and/or respiratory depression. The individual sustains substantial loss of time (> 5 days) from regular work (this can include assignment to limited/light work duties) or normal activities (if not employed). This level of severity might include the need for continued health care following the exposure event, prolonged time off of work, and limitations or modification of work or normal activities. The individual may sustain permanent functional impairment

- S-1 Death
  This category describes a human fatality resulting from exposure to one or more pesticides.

As shown in Table 4.4-3, considering only the preventable and possibly preventable incidents, about 75% of the acute cases considered resulted in "low severity illness or injury", about 21% percent in "moderate severity illness or injury," under 3% in "high severity illness or injury," and under 1% in death. The majority of cases prevented are in the categories of low or moderate severity.

**Table 4.4-3: Severity of Symptoms from Preventable SENSOR-Pesticides Cases**

| Clinical Effect | Number of Cases | Share of Total |
|---|---|---|
| Category S-4: Low severity illness or injury | 185 | 74.90% |
| Category S-3: Moderate severity illness or injury | 53 | 21.46% |
| Category S-2: High severity illness or injury | 7 | 2.83% |
| Category S-1: Death | 2 | 0.81% |
| Total | 247 | 100.00% |

Source: EPA estimates from SENSOR-Pesticides data, 2008 – 2011.

Given the distribution of effects from the sample of pesticide incidents shown in Table 4.4-3 and the estimated number of cases avoided from Section 4.4.2, EPA estimates the distribution of preventable RUP incidents across the four severity levels. Table 4.4-4 shows the estimated number of national incidents that may be prevented by the rule for each severity level, based on the high and low estimates of cases prevented from Table 4.4-1.

**Table 4.4-4: Estimates of Annual Illnesses Prevented by the Rule, by Severity**

| Clinical Effect | Share of Total | Estimate of Number of Cases Prevented Annually | |
|---|---|---|---|
| | | Low End Estimate (51%) | High End Estimate (69%) |
| Category S-4: Low severity illness or injury | 74.90% | 117.2 | 147.7 |
| Category S-3: Moderate severity illness or injury | 21.46% | 33.6 | 42.3 |
| Category S-2:High severity illness or injury | 2.83% | 4.4 | 5.6 |
| Category S-1: Death | 0.81% | 1.3 | 1.6 |
| | | | |
| Total | 100.0% | 156.5 | 197.2 |

Source: EPA calculations based on the figures in Tables 4.4-1 and 4.4-3.
Note: Death estimates are later revised based on further investigation as discussed in Section 4.4.3.1.

#### *4.4.3.1 Additional Sources for Estimating Avoidable Deaths*

Because deaths from pesticide exposure are such infrequent events, there is concern that only using four years of data from one data set that covers only a subset of states will not be representative of the actual risk and benefit from preventing deaths. In addition to the estimates of preventable deaths presented in Table 4.4-4, there are other data sources available that can be used to document the number of unintentional fatalities over time.

In addition to the SENSOR-Pesticides data, there are two other sources with information on deaths from pesticide exposure: Annual reports prepared by the American Association of Poison Control Centers (AAPCC) and the EPA's Incident Data System (IDS). SENSOR-Pesticides data are also available beginning in 1999.

The National Poison Data System (NPDS) is the AAPCC's database management system used to compile poisoning information gathered by the AAPCC-certified poison centers[10]. There are currently 57 certified poison centers. Poison center staff are health care professionals and are available for advice about poisonings free of charge, 24 hours a day, 365 days a year. In addition to responding to calls from the general public, staff also field calls from health care professionals and the public health agencies. The poison centers collectively receive over 3.6 million call encounters annually. These are primarily consumer oriented incident calls rather than occupational "work related" incident calls (Bronstein *et al*., 2011). EPA does not have access to the raw data from the NPDS, and only summary information on pesticide events is available for incidents that did not result in deaths. However, for some poisoning incidents that did result in deaths, including pesticide incidents, the AAPCC annual reports include an appendix of case abstracts that provide more information on deaths, with a description of the scenario in which the poisoning occurred and the treatment received (American Association of Poison Control Centers, 1999 – 2015). These descriptions in the annual reports are not a full list of deaths reported to the AAPCC, because only a subset of fatal cases are chosen for reporting. Case abstracts presented in the annual reports meet a number of criteria by AAPCC report authors (e.g., completeness of therapy details, educational value of the incident, etc.). Therefore, the cases gathered from this source, while limited, provides EPA with a number of compelling incidents.

EPA/OPP's Incident Data System (IDS) contains reports of alleged human health incidents from a variety of sources, including mandatory Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) Section 6(a)(2) reports from registrants, reports from other federal and state health and environmental agencies and individual consumers. Case reports or "narratives" may be provided for the reported incidents, with varying levels of detail; however, there is no effort at validating or assessing how likely it is that the reported exposure is causally related to the reported outcome. This system receives information pertaining to occupational and consumer oriented incidents. OPP focused on incidents categorized at the highest severity level (death).

These two additional sources were investigated to determine if there was information that would shed additional light on the frequency of preventable deaths from RUPs. The data from the AAPCC annual reports were available from 1999 – 2014, and there were nine deaths that EPA

[10] More information about the data available from the NPDS is available here: http://www.aapcc.org/data-system/

staff determined were a result of an exposure to an RUP that could be prevented by certification rule. The EPA IDS was queried from 2008 – 2015, and showed a total of four RUP-related deaths that EPA staff classified as preventable. Because of the potential risk mitigation for paraquat, preventable incidents involving paraquat were excluded from this exercise to avoid counting incidents that would have been prevented by the paraquat mitigation. The final mitigation measures, if any, have not yet been determined, so this may be overly conservative. These figures do not include deaths resulting from exposure to paraquat, which were excluded from this exercise.

Table 4.4-5 shows a summary of the information on preventable deaths from the different databases. Also shown for comparison are the total number of pesticide related deaths over the same period. Note that these total deaths include all reported pesticide related deaths in the database, including intentional exposures and other that are not relevant for estimating the benefits of the certification rule.

**Table 4.4-5: Summary of Pesticide Deaths from Additional Data Sources**

| | SENSOR-Pesticides 2008 – 2011 (4 years) | AAPCC 1999 – 2014 (16 years) | EPA Incident Data System 2008 – 2015 (8 years) |
|---|---|---|---|
| Preventable RUP Deaths | 2 | 7 | 4 |
| Preventable RUP Deaths per Year | 0.5, extrapolated to 1.3 to 1.6 nationally | 0.44 | 0.5 |
| Total Deaths Reported | 13 | 308 | 500 |
| Total Deaths per Year | 3.3 | 19.3 | 55.6 |

Sources: EPA estimates from SENSOR-Pesticides data; EPA analysis of the AAPCC Annual Reports; EPA queries and analysis of the Incident Data System.
Notes: The Preventable RUP Deaths per Year from SENSOR-Pesticides is 0.5, from 2 deaths over four years in the surveyed states. The extrapolated estimate based on the number of certified applicators in those states and nationally is shown in Table 4.4-4.
Incidents involving paraquat were removed from the count of Preventable RUP Deaths. If paraquat deaths resulting from exposure to paraquat were included, the number of preventable deaths would total 3 for SENSOR-Pesticides, 15 for AAPCC, and 6 for IDS.

When using the SENSOR-Pesticides data set from 2008 – 2011 to create Table 4.4-4, we extrapolated from the SENSOR-Pesticides states to the national level by creating an index of incidents per certified applicator, which yielded an estimate of 1.3 to 1.6 preventable deaths per year. In contrast, AAPCC data would indicate 0.44 fatalities per year and the IDS data indicate 0.50 deaths per year. EPA considered several methods for combining the additional information from AAPCC and IDS to better estimate the number of deaths prevented by the rule annually, without any potential double counting of the information already available from SENSOR-Pesticides, or from earlier years of SENSOR-Pesticides data. These are summarized in Table 4.4-6.

The simplest way to estimate the number of deaths prevented by the rule is to look at the total number of preventable deaths across all the data sets for the years in which all are available,

without any scaling to the national level for SENSOR-Pesticides data. By using three different data sets and only using unique incidents, a reasonable estimate can be obtained without double counting. There are only four years for which all three data series were available, from 2008 to 2011. There were a total of five unique preventable deaths for those four years. Two were from SENSOR-Pesticides, one each in 2009 and 2010. The AAPCC data reported one preventable deaths in 2009, but the death was a duplicate of a death reported in SENSOR-Pesticides. There were two unique preventable deaths reported only in IDS for 2010 and one in 2011. Using the three data sources for only the four years 2008 – 2011 suggests that 1.25 deaths per year would be prevented from the rule, just outside the range of the extrapolation from the SENSOR-Pesticides data of 2008 – 2011 yielding 1.3 to 1.6 preventable deaths per year. As with using SENSOR-Pesticides data alone, however, this approach relies on only four years of data, the same as for SENSOR-Pesticides. The relative rarity of deaths gives an important reason to look beyond the four years available for all three data sets.

Another possible approach to estimating prevented deaths is using the maximum years available, from 1999 – 2015, over which time there were 11 unique preventable deaths, or 0.65 per year. The problem with this approach is that dividing by the total number of years yields a clear underestimate, because none of the data sets spans the entire range. That would not be as concerning if most of the incidents appear in all the data sets, but that is rare – there is surprisingly little overlap (2 cases), even for this most severe of outcomes.

To use the data available without double counting the incidents, one option is to combine the initial SENSOR-Pesticides estimate for deaths with new estimates from AAPCC and the IDS. The estimated rate for the nation estimated from SENSOR-Pesticides is between 1.3 and 1.6 preventable deaths per year. We exclude any deaths that were reported in AAPCC that were also reported in the SENSOR-Pesticides data from 2008 – 2011; there was one, leaving 6 unique preventable deaths reported by AAPCC between 1999 and 2014, or 0.44 per year. Finally, we consider the IDS cases reported from 2008 – 2015. There were three unique preventable deaths from IDS, or an estimated 0.38 per year. Because these estimates from the three different data sources only consider unique preventable deaths, they can be added together, which would yield between 2.05 and 2.35 estimated preventable deaths per year.

However, the estimate based on SENSOR-Pesticides data from 2008 – 2011 was extrapolated to the national level, and hypothetically, one of the cases from AAPCC or IDS could have been one of the cases accounted for by the extrapolation. For that reason, instead of using the estimate of preventable deaths from Table 4.5-4 as our starting point, we use only the reported estimates from SENSOR-Pesticides, not the extrapolated figures. Two preventable deaths from RUP exposure were reported in SENSOR-Pesticides from 2008 – 2011, or 0.50 per year. This is a conservative estimate because SENSOR-Pesticides only covers a few states, but we use it here. Combining that number with estimates from the unique incidents from AAPCC and IDS yields an estimate of 1.25 preventable deaths per year.

In Section 4.4.5, we report a range of estimates of the benefits from reduced pesticide poisoning, based in part upon the estimates of incidents prevented, including deaths. For the low end estimates we use the low estimate of 1.3 deaths prevented annually based on SENSOR-Pesticides data alone as shown in Table 4.4-4. For the high-end estimate, we make use of alternative

sources of preventable RUP deaths using the sources discussed in this Section. Using only death reports that are unique to each database in addition to the high estimate from SENSOR-Pesticides as shown in the last row of Table 4.4-6, our high end estimate is 2.4 prevented deaths per year.

| Table 4.4-6: Alternative Estimates for the Number of Preventable Deaths | | | | |
|---|---|---|---|---|
| Data Source for Preventable Deaths | Sensor | AAPCC | IDS | Preventable Deaths per Year |
| Years Analyzed | 2008 - 2011 | 1999 - 2014 | 2008 - 2015 | |
| Maximum Number of Years | 4 | 16 | 8 | |
| Total Preventable Deaths Reported[1] | 2 over 4 years | 7 over 16 years | 4 over 8 years | 1.4 |
| Preventable Deaths per Year | 0.50 | 0.44 | 0.50 | |
| Estimates from the maximum time range of 1999 – 2015 | | | | |
| Unique Preventable Deaths[2] | 2 over 17 years | 6 over 17 years | 3 over 17 years | 0.7 |
| Preventable Deaths per Year | 0.12 | 0.35 | 0.18 | |
| Estimates using 2008 – 2011 only, for all three data sets | | | | |
| Unique Preventable Deaths | 2 over 4 years | 0 over 4 years | 3 over 4 years | 1.3 |
| Preventable Deaths per Year | 0.50 | 0.0 | 0.75 | |
| Maximum Number of Years for Each Data Set, SENSOR-Pesticides not extrapolated to National Estimate | | | | |
| Unique Preventable Deaths | 2 over 4 years | 6 over 16 years | 3 over 8 years | 1.3 |
| Preventable Deaths per Year | 0.50 | 0.38 | 0.38 | |
| Maximum Number of Years for Each Data Set, Using SENSOR-Pesticides estimates from Table 4.4-4 | | | | |
| Unique Preventable Deaths | 2 over 4 years | 6 over 16 years | 3 over 8 years | 2.1 - 2.4 |
| Preventable Deaths per Year | 1.3 - 1.6 | 0.38 | 0.38 | |

[1]Total preventable deaths includes all death reports from that database that met EPA criteria; they were not adjusted to avoid double-counting of reports that were reported in multiple sources.
[2]Unique preventable deaths avoids double-counting, so that any incident reported in multiple sources is only counted one time.
Source: EPA calculations from deaths reported in SENSOR-Pesticides, AAPCC annual reports, and the EPA Incident Data System.

In addition to the preventable deaths in the three data sources, also shown in Table 4.4-5 is the total deaths from pesticides reported. These numbers include all deaths that were reported from

pesticide exposure, including non-RUP pesticides, intentional exposures, or other deaths that the final changes to the certification rule will not prevent.

### 4.4.4 Value of Avoided Incidents

As explained in Section 4.4.1, EPA estimates the value of avoided incidents in terms of the medical costs avoided, the productivity losses avoided, and the reduction in premature mortality. The value of avoided incidents depends on the severity of the effect caused by the pesticide exposure. People suffering from more severe effects are more likely to seek medical treatment. More severe effects are more costly because they require more treatment, including hospitalization. Further, a more severe effect is likely to result in a longer period of recovery during which the victim is unable to work or engage in other activities. Finally, we need to estimate the probability that an acute incident will prove fatal in order to estimate the value of a reduction in premature mortality.

In Table 4.4-4, estimates of the number of cases that may be avoided as a result of the rule were presented and categorized by the level of severity. The savings due to prevented cases are estimated here. These costs include avoided outpatient physician visits and inpatient hospitalizations, lost productivity, and premature mortality. For each severity level except "death," expected medical costs are estimated, based on the probability that medical treatment is sought, and the cost of that treatment. For each severity level except "death," the value of lost productivity is estimated. Valuing lost productivity is an attempt to value the time lost due to illness. Work time is obviously lost, but lost leisure and household time is considered as well. For each severity level, an average length of illness is multiplied by the value of time spent on work, household activities, and leisure.

Therefore, EPA estimates two quantifiable sources of value from avoiding pesticide incidents given the severity of effects. For fatal cases, the value of a reduction in premature mortality, is simply the value of a statistical life (VSL). The VSL is an aggregated estimate of the value of a small reduction in the risk of death over a large group of people. VSL estimates are derived from aggregated estimates of individual values for small changes in mortality risks. For example, if 10,000 individuals are each willing to pay, $500 for a reduction in risk of 1/10,000, then the value of saving one statistical life equals $500 times 10,000 – or $5 million. Note that this does not mean that any identifiable life is valued at this amount, but rather that the aggregate value of reducing a collection of small individual risks is worth $5 million in this hypothetical case. This analysis uses $9.91 million for the VSL (EPA 2016). This value is based on a distribution of values in 26 published estimates of VSL (EPA, 2010a), and then adjusted from the base value ($4.8 million in 1990 dollars) using the Consumer Price Index (EPA, 2010a). Only the VSL is used for poisonings resulting in death, because any medical value is dwarfed by the value of life itself, and lost productivity is included in the VSL.

For non-fatal cases, for each severity level *i*, the value of an avoided case is given by

$$V_i^{Av} = E[MedCost_i] + VPL_i$$

where $V_i^{Av}$ is the value of an avoided case, $E[MedCost_i]$ is the expected medical cost for the case, and $VPL_i$ is the value of productivity lost as a result of the case. We use the four severity levels described in the SENSOR-Pesticides database: Low Severity, Moderate Severity, High Severity, and Death.

*Direct Medical Costs*

Expected medical cost is given by

$$E\left[MedCost_i\right] = Prob\left(HCF|i\right) \times \left[OutPtnt_i + InPtnt_i\right]$$

where *Prob(HCF|i)* is the probability of visiting a health care facility, *Outptnt* and *InPtnt* are treatment costs, and *i* indicates the level of severity of the effect.

In order to determine the probability of visiting a health care facility for each severity level, we used the SENSOR-Pesticides information for those cases which deemed preventable or possibly preventable for 2008 - 2011. The SENSOR-Pesticides data has a variable which indicates whether medical care was sought, and we included those cases that were treated at a physician's office, an emergency room, or admitted to a hospital. This information is not available for all 247 observations from SENSOR-Pesticides shown in Table 4.4-3, but 220 of the preventable or possibly preventable incidents have information on the type of care received, 218 of which were not fatalities. Of these, 167 of the affected people sought medical through a doctor, emergency room or hospital. Table 4.4-7 presents the number of cases that were seen at a health care facility, the total number of cases over these years, as well as each category's percentage of the total by medical outcome (or severity level). As our measure of the probability of treatment at a health care facility *Prob(HCF|i)*, we use the share of cases from that were treated at a health care facility, in the final column of Table 4.4-7. It is not surprising that the share receiving medical care is so high, because to be included in the SENSOR-Pesticides database requires at least two reportable symptoms of pesticide exposure, and because the cases treated by medical professionals are more likely to be reported to SENSOR-Pesticides.

**Table 4.4-7: Health Care Sought for Preventable Pesticide-Related Acute Exposures, SENSOR-Pesticides 2008-2011.**

| Clinical Effect | Cases Seen at Health Care Facility | Total Cases | Share of Cases Seen at Health Care Facility |
|---|---|---|---|
| Category S-4: Low severity illness or injury | 114 | 162 | 70% |
| Category S-3: Moderate severity illness or injury | 48 | 50 | 96% |
| Category S-2: High severity illness or injury | 5 | 6 | 83% |
| Total | 167 | 218 | 77% |

Source: SENSOR-Pesticides data, 2008– 2011. Incidents from Category S-1, death, are not included, so the total number of preventable cases is 218.

Inpatient costs were obtained from the Healthcare Cost and Utilization Project (HCUP), specifically the cost for hospital stays from the HCUP 3 – Hospital Inpatient Statistics. For Diagnosis Related Group 16.243 (poisoning by non-medical substances) the average charges reported by Clinical Classifications Software was $41,549 in 2013.

Outpatient unit costs were estimated using data from physician visit benchmark fees for evaluation and management costs by Healthcare Common Procedure Code (HCPC) Criteria (a Centers for Medicare & Medicaid Services (CMS) classification system used for identifying medical services and procedures furnished by physicians and other health care professionals)[11]. Evaluation and management costs are available for the level of service required for both new and established patients. Outpatient unit costs are obtained for HCPC Criteria 99213, which describes a patient visit with an evaluation and management based on a focused problem. The average medical facility charge for outpatient visits that fall into this HCPC category was $73.08 for patients with an existing relationship with a doctor and $108.18 for new patients in 2014. Given an equal chance that the person exposed to a pesticide will have a doctor or not, the average cost of an outpatient visit is estimated to be $90.63. That cost seems low, but the data reflects the maximum allowable reimbursement that Medicaid has authorized for those services. This may be an underestimate, which would imply that the outpatient cost is underestimated, but there is no available data on additional treatment costs.

Expected medical costs, based on the probability of visiting a health care facility and the cost of treatment, are shown in Table 4.4-8.

[11]The average facility charge for all providers using the Medicare Physician Fee Schedule, from http://www.cms.hhs.gov/PFSlookup/02_PFSSearch.asp

| Table 4.4-8: Medical Cost by Severity of Effect | | | | |
|---|---|---|---|---|
| **Clinical Effect** | **Prob(HCF\|*i*)** | **Outpatient Cost** | **Inpatient Cost** | **Expected Medical Cost [1]** |
| Category S-4: Low severity illness or injury | 70% | $90.63 | $0 | $63.78 |
| Category S-3: Moderate severity illness or injury | 96% | $90.63 | $0 | $87.00 |
| Category S-2:High severity illness or injury | 83% | $90.63 | $41,549 | $34,699.69 |
| Source: EPA estimation.<br>[1]Calculated as Prob(HCF\|i)×[Outpatient Cost + Inpatient Cost]. | | | | |

*The Value of Lost Productivity*

The value of lost productivity is estimated as the value of various activities in which a person is typically engaged over the course of the day, but which he or she could not accomplish when ill. As noted above, we calculate this value as

$$E\left[VPL_i\right] = \left(\omega_w \, work + \omega_H \, housekeeping + \omega_L \, leisure\right) \times DUR_i$$

where *VPL* is the value of productivity lost, *work* is the time spent at work, *housekeeping* is the time spent in household activities, *leisure* is leisure time, ω is the value of time spent in each activity, and *DUR* is the duration of the effect.

BLS data were used to calculate the average number of hours spent on work, housekeeping, and leisure for a typical working adult. According to the Current Population Survey (BLS, 2016b), an employed person works an average of 38.6 hours per week or 5.51 hours per day over a seven-day week. According to the American Time of Use Survey (BLS, 2014), the average time spent by those over 16 in housekeeping is 1.77 hours per day. Leisure is calculated as the remaining time, assuming an average of eight hours of sleep, or 8.72 hours per day.

The hourly value of work is measured as the weighted average wage rate for adult private and commercial certified pesticide applicators, weighted using the number of certified applicators of each type in 2014 (see Section 3.3.2 of this Economic Analysis), or $35.48 per hour. This is an assumption made for simplicity, but the affected person may not be a certified applicator, and wages vary by occupation. This analysis assumes that workers work 40 hours a week. The value of housekeeping is the median hourly earnings for a personal/home care aide, $10.44 (BLS, 2015). This labor category was chosen as most closely representative, given the occupations available, for the value of housekeeping activities if an injured worker had to hire outside help. For this analysis, we calculate the value of leisure as the after-tax wage rate for certified applicators, because theoretically the take home pay is the rate at which work and

leisure are traded. The overall average tax rate in the United States is 30.2 percent (Tax Foundation, 2014), which leaves an after-tax return of $24.76 per hour for leisure.

Table 4.4-9 presents EPA's estimate of the value of a fully productive day, the parenthetical term in the equation for VPL, including work, housekeeping, and leisure activity. For each activity, Table 4.5-8 presents the average number of hours spent in the activity per day for a seven-day week and the estimated value of time spent in each activity. The sum over the three activities is estimated to be $429.94 per day.

**Table 4.4-9: Value of a Day of Full Productivity**

| Activity | Hours/Day | Hourly Value (ω) | Total Value per Day |
|---|---|---|---|
| Work | 5.51 [a] | $35.48 [c] | $195.63 |
| Housekeeping | 1.77 [a] | $10.16 [d] | $18.48 |
| Leisure | 8.72 [b] | $24.76 [e] | $215.83 |
| | | | |
| **Total Value of a Day of Full Productivity** | | | **$429.94** |

Sources:
[a] BLS, 2016b, Current Population Survey (CPS)
[b] Calculated by taking 24 hours per day times and subtracting the time known for work and housekeeping and assuming 8 hours per day for sleep
[c] EPA Estimates – see Chapter 3
[d] BLS, 2015: Calculated by taking the mean wage for personal/home care aides.
[e] Calculated as the wage rate less the overall tax rate for the nation (30.2%).

The SENSOR-Pesticides data do not report the duration of illness from the RUP incident, although the bounds of the duration can be inferred by the severity category. The definitions of the severity categories contain ranges of time lost from work (see Section 4.3.3). For the lowest severity category, time lost from work is less than three days, while for moderate severity incidents, between three and five days of work are lost. For high severity incidents, time lost from work is greater than five days, although the description of the category cautions that "[t]his level of severity might include the need for continued health care following the exposure event, prolonged time off of work, and limitations or modification of work or normal activities. The individual may sustain permanent functional impairment." This description indicates that the damage from an RUP incident could last substantially longer than five days. As shown in Table 4.4-10, for the moderate severity category, we use the low end (three days) and the high end (five days) of the range as the estimate of the time lost from the RUP exposure. For the low severity category, the high end (three days) is defined, but the low end is not, so we use the midpoint of the range between zero and three days, or 1.5 days. For the high severity category, the low end of the range is defined as five days, but the upper end is not defined, and could be permanent. For this analysis, we assume that the upper end is 30 days, which is somewhat arbitrary.

Table 4.4-10 shows the estimated average duration of clinical effects at each level of severity, with a high end and a low end estimate, as discussed above. The time of effects, measured in days, is multiplied by the value of a full day of productivity ($429.94) to yield high and low estimates of lost productivity for each severity level.

| Table 4.4-10: Average Clinical Effect Duration and Value of Lost Productivity by Clinical Effect | | | |
|---|---|---|---|
| **Clinical Effect** | **Scenario** | **Duration of Clinical Effect (Days)** | **E[VPL$_i$] [a]** |
| Category S-4: Low severity illness or injury | Low-End | 1.5 | $644.92 |
| | High-end | 3 | $1,289.83 |
| Category S-3: Moderate severity illness or injury | Low-End | 3 | $1,289.83 |
| | High-end | 5 | $2,149.72 |
| Category S-2: High severity illness or injury | Low-End | 5 | $2,149.72 |
| | High-end | 30 | $12,898.30 |
| Sources: EPA calculations<br>[a]The unit cost for lost productivity day by severity category was calculated by multiplying the average duration of clinical effect in days by the value of a full day of productivity ($429.94). | | | |

## 4.4.5 Estimated Benefits from Avoided Incidents

The estimates of the total cost avoided by the rule are given in Tables 4.4-11 and 4.4-12. For each level of severity *i*, cost is the sum of direct medical costs ($MedCost_i$), lost productivity costs ($VPL_i$), and the value of premature mortality (VSL) multiplied by the number of cases avoided. We then sum across all severity levels to estimate the total avoided costs for the rule. Table 4.4-11 shows the low end estimates, which are based on the low end estimates of costs and the low end estimate of the number of prevented cases, while Table 4.4-12 shows the high end estimates.

**Table 4.4-11: "Low-End" Estimate of Avoided Average Annual Costs from Changes to the Certification Rule**

| Clinical Effect | Avoided Cases per Year | Medical Costs per Case | Lost Productivity per Case | Premature Mortality per Case | Average Annual Total Cost Avoided |
|---|---|---|---|---|---|
| Category S-4: Low severity illness or injury | 117.2 | $63.78 | $644.92 | $0 | $83,059 |
| Category S-3: Moderate severity illness or injury | 33.6 | $87.00 | $1,289.83 | $0 | $46,262 |
| Category S-2: High severity illness or injury | 4.4 | $34,699.69 | $2,149.72 | $0 | $162,137 |
| Category S-1: Death | 1.3 | | | $9,910,000 | $12,883,300 |
| | | | | | |
| **Total** | 156.5 | | | | $13,174,458 |

Source: EPA calculations.

**Table 4.5-12: "High-End" Estimate of Avoided Average Annual Costs from Changes to the Certification Rule**

| Clinical Effect | Avoided Cases per Year | Medical Costs per Case | Lost Productivity per Case | Premature Mortality per Case | Average Annual Total Cost Avoided |
|---|---|---|---|---|---|
| Category S-4: Low severity illness or injury | 147.7 | $63.78 | $1,289.83 | $0 | $199,928 |
| Category S-3: Moderate severity illness or injury | 42.3 | $87.00 | $2,149.72 | $0 | $94,613 |
| Category S-2: High severity illness or injury | 5.6 | $34,699.69 | $12,898.30 | $0 | $266,549 |
| Category S-1: Death | 2.4 | | | $9,910,000 | $24,784,000 |
| | | | | | |
| **Total** | 198.0 | | | | $24,345,090 |

Source: EPA calculations.

The annual estimated benefits from avoiding acute effects of pesticide incidents range from $13.2 to 24.3 million. Over a ten year period of analysis, the present value of these benefits is between $112 million and $208 million when a 3 percent discount rate is applied and between $93 million and $171 million when a 7 percent discount rate is applied. Note that these estimates

are based on the number of deaths using additional sources of information to the SENSOR-Pesticides data, as described in Section 4.4.3.1. Other estimates of the deaths per year, as discussed in that section, would change the total estimates.

There are limitations to these estimates. Because of the substantial value associated with preventing a death from RUPs, the estimates are very sensitive to the estimate of deaths prevented, although we present two different estimates here. Also, as discussed above, we expect that a large proportion of accidental (acute) pesticide poisoning never get reported or investigated for various reasons. All indications are that under-reporting is substantial. Unreported cases are therefore not included in the poisoning surveillance databases and, hence, not included in this analysis. This under-reporting will bias estimates of acute benefits downward.

In Table 4.4-13, we show the effect of under-reporting at different rates on our monetized estimates of avoiding acute pesticide poisonings. With 100% reporting (or 0% under-reporting), the actual benefits of acute illnesses are equal to the estimated benefits. If there is under-reporting, then the actual benefits can be substantially higher. Table 4.4-13 shows a range of benefit estimates corresponding to different reporting rates (100%, 50%, 25%, 20%, and 10%), which provide a range of values and show the sensitivity to different assumptions about under-reporting. As an example, if only 10% of cases are reported, and under-reporting is equally likely in all poisoning cases across all severity levels, then the high-end estimate of the value of prevented poisoning due to the rule would be about $263 million per year, substantially higher than those reported above, which assume 100% reporting. The distribution of health effects associated with these unreported acute exposures are also not known. If reporting rates vary by severity, in such a way that more severe (and expensive) cases are more likely to be reported, then the effects of under-reporting would be correspondingly lower. In the Economic Analysis for the recent WPS rule, EPA's best estimate for a reporting rate was that about 10% of pesticide incidents might be reported, based on the studies reported in Section 4.4-3, and EPA analysis of reported incidents in SENSOR-Pesticides and California pesticide incident surveillance data. That incident review included non-RUP pesticides, and many incidents involving farmworkers for which the WPS rule was relevant. It is possible that underreporting is not as severe for RUP incidents, which may be more likely to affect certified applicators, those they supervise, and their families. If the reporting rate were 20%, double the 10% rate used for the WPS rule, this would yield annual estimated benefits from reduced RUP exposure of between $65.9 and $131.6 million. If the reporting rate were 50% for all incidents, similar to the rate for incidents that result in hospitalizations and deaths from food-borne illness suggested by Scallan *et al.*, (2011) and Mead *et al.*, (1999), the annual estimated benefits would be between $26.3 and $48.7 million annually.

The estimated cost of the rule is approximately $31.3 million per year, based on a 3% discount rate (see Chapter 3). If we assume that there is no under-reporting of RUP incidents, then the annual estimated benefits from the rule do not reach that level. Annual benefits of $31.3 million per year corresponds to a reporting rate of about 78% for the high-end estimates, or 22% of incidents not being recorded in the surveillance databases. It should be noted that we have made no attempt to measure the willingness to pay to avoid symptoms, which is likely to be

substantial; the estimates presented are based on the avoided costs in medical care and lost productivity only.

**Table 4.4-13: Sensitivity of Annual Quantified Benefit Estimates to Assumptions about Under-reporting**

| Share of Cases Reported | Low-End Estimate of Prevented Cases | Low-End Estimate of Benefits | High-End Estimate of Prevented Cases | High-End Estimate of Benefits |
|---|---|---|---|---|
| 100% | 156.5 | $13,174,458 | 198.0 | $24,345,090 |
| 50% | 313.0 | 26,348,915 | 396.0 | 48,690,180 |
| 25% | 626.0 | 52,697,831 | 792.0 | 97,380,359 |
| 20% | 782.5 | 65,872,289 | 990.0 | 121,725,449 |
| 10% | 1,565.0 | 131,744,577 | 1,980.0 | 243,450,898 |

Source: EPA Calculations

Note: As discussed in the text, if an additional 10% of the incidents would not be prevented, then with 100% reporting, the appropriate estimates in this table would be 10% lower, between $11.9 and 21.9 million annually. With 50% reporting, the estimates would be between $23.7 and $43.8 million annually, and with 20% reporting, between $59.3 and $109.6 million. Higher assumptions about the percentage of incidents not prevented would cause greater reduction in the benefit estimates.

The values shown in Table 4.4-13 assume that under-reporting is equal across all severity levels. It is plausible that deaths, for example, are less likely to be underreported than less severe events, although the lack of duplication in the available databases discussed above suggests this may not be the case. Because such a large portion of the overall value is from prevented deaths, different assumptions about reporting rates are important. For example, if 100% of deaths were reported, a reporting rate of non-fatal incidents of 20% yields high end estimates of about $26.6 million annually, while 50% reporting for non-fatal incidents would result in high-end estimates of about $26.0 million; both are slightly below the estimated cost of the rule. If 100% of the deaths are reported, then a reporting rate of about 7% for non-fatal incidents would yield acute benefits that exceed the cost of the rule.

As mentioned in Section 4.4.2, the estimates of prevented illnesses that underlie the quantified benefit estimates are based on review of poisoning incidents reported in SENSOR-Pesticides, given that the incidents are within the scope of the rule (e.g., involved an RUP). EPA reviewed the incident data and categorized incidents as “preventable,” “possibly preventable,” or “not preventable.” The analysis indicates that 54% of the incidents would be preventable by the rule changes and an additional 14% would be possibly preventable, or a range of 54% to 68% of the incidents for use in the quantified benefits estimates. Our approach may underestimate the benefits. However, it is possible that some of portion of the incidents EPA determined to be “preventable” or “possibly preventable” would not be prevented. If some percentage of the incidents were not prevented, then that would have a linear effect on the benefit estimates. That is, if an additional 10% of the incidents would not be prevented, then with 100% reporting, the appropriate estimates in Table 4.4-13 would be 10% lower, between $11.9 and 21.9 million annually. With 50% reporting, the estimates would be between $23.7 and $43.8 million

annually, and with 20% reporting, between $59.3 and $109.6 million. If 20% of those incidents would not be reported, then the difference would be twice as large, with 100% reporting between $10.5 million and $19.5 million; with a 20% reporting rate between $52.7 and $97.4 million annually; and, $21.1 and $39.0 million annually if reporting were only 50%.

The benefits estimated in this section are annual benefits, but the stream of benefits may not start immediately. It will take time to revise state plans, which will go into effect while EPA reviews them. States have three years to revise their plans, although it may not take all states that long; states can also begin implementation before the three years elapse. As explained in Section 3.4.7.2, for the purpose of estimating the costs of the final revisions, EPA uses a two-year implementation period for cost estimation because it better reflects the costs applicators and small firms will bear. Because of the delayed implementation will also delay the benefits to the rule; if the benefits from reduced acute illnesses do not begin until after the implementation, the annual benefit estimates are not directly comparable to the cost estimates. If the annual benefits are delayed, then the present value of those benefits can be calculated and annualized in the same manner as the cost estimates in Section 3.2.1. If the stream of benefits begins in year three to match the implementation schedule from the cost estimates, the annualized benefits based on the low estimated reported in Tables 4.4-11 are estimated to be about $10.2 million annually when using a 3% discount rate, and about $9.8 million annually when using a 7% discount rate. The high estimate, based on Table 4.4-12 yields annualized benefits of $18.9 million with a 3% discount rated and $18.1 million with a 7% discount rate. These estimates do not account for underreporting, however. Based on the estimates in Table 4.4-13 with 20% reporting, the annualized benefits based on the low estimate would be about $51.1 million at with a 3% discount rate, and about $48.9 million with 7%. With 20% reporting, the annualized high end estimate would be about $94.4 million with a discount rate of 3%, and $90.4 million with 7%. With 50% reporting, the annualized benefits based on the low-end estimate would be about $20.4 million at with a 3% discount rate, and about $19.6 million with 7%. With 50% reporting, the annualized high-end estimate would be about $37.8 million with a discount rate of 3%, and $36.2 million with 7%.

There is remaining uncertainty about when the rule will be fully implemented, and delaying the onset of benefits reduces the annualized benefit estimates. As an example, if the stream of benefits begins in year four, the low estimates of annualized benefits are estimated to be about $8.8 million annually when using a 3% discount rate, and about $8.3 million annually when using a 7% discount rate. The high estimate yields annualized benefits of $16.3 million with a 3% discount rated and $15.2 with a 7% discount rate. Assumptions about underreporting would change these estimates. With 20% reporting, , the annualized benefits based on the low estimate would be about $44.0 million with a 3% discount rate, and about $41.3 million with 7%. The annualized high end estimate would be about $81.4 million with a discount rate of 3%, and $76.2 million with 7%. With 50% reporting, the annualized benefits based on the low estimate would be about $17.6 million at with a 3% discount rate, and about $16.5 million with 7%. With 50% reporting, the annualized high end estimate would be about $32.5 million with a discount rate of 3%, and $30.5 million with 7%.

All quantitative benefit estimates presented in this section include only the effects of reduced illness from acute exposure – the effects of chronic exposure are discussed in the next section,

which will outline the potential risks of chronic pesticide exposures to workers, handlers and families, or acute exposures that have developmental effects. Other benefits that are not related to human health are discussed in Section 4.6.

## 4.5 Risks to Human Health from Chronic RUP Exposure

In the previous section, estimates of reduced illness from acute exposures to pesticides are presented. Although these estimates are based on the best available data, there are uncertainties reflected in the estimates, *e.g.*, potential under-reporting. In addition to these acute effects, there are chronic health effects that may be associated with chronic, generalized pesticide exposure. EPA anticipates that benefits from reduced chronic health effects would accrue primarily to commercial pesticide applicators, since they are most likely to face long-term minor exposures, but there may also be benefits from reduced exposure to applicators' families and those working under the direct supervision of a certified applicator. This section will describe the potential chronic health effects to commercial pesticide applicators from pesticide exposure.

This section presents evidence of well-documented associations between pesticide exposure and certain cancer and non-cancer chronic health effects in the peer-reviewed literature. It is important to note that EPA is not stating that there is a causal link between certain health outcomes and exposure to specific pesticides. Available data do not establish a causal link between these exposures and the health outcomes. However, information finding correlations between pesticide exposure and illness is compelling enough to suggest some of the observed statistical associations may at some point in future be determined to be causal in nature. Therefore, overall pesticide exposure reduction through changes to the certification rule may have substantial benefits that cannot be quantified at this time.

While there is limited epidemiological evidence of a definitive causal link between specific pesticide exposures and adverse chronic health outcomes at this time, this section presents evidence of well-documented associations between pesticide exposure and certain cancer and non-cancer chronic health effects in the peer-reviewed literature. Typically, several epidemiology studies conducted over time, using different study designs, and taking place within different study populations in addition to other streams of scientific evidence are required before researchers can move from a statistical association to a causal determination. The environmental epidemiology literature is growing rapidly in terms of both quantity and quality of pesticide epidemiology studies, and EPA expects additional causal links between pesticide exposure and adverse health outcomes in the human population will be provided over time. However, at this time, EPA is not making definitive causal connections between any one specific pesticide exposure and a specific adverse health outcome.

Even though there have been relatively few proven cause and effect associations between real world pesticide exposure and long-term health effects in human populations, many exposure-chronic disease associations have been tested in observational studies and critically evaluated in the scientific peer- reviewed literature, and research is ongoing. The breadth and depth of this collective research shows the significant interest in public health organizations worldwide on the issue of chronic, long-term health effects of pesticides. There is a large body of epidemiological

evidence and ongoing research on long-term health effects (such as cancer, neurological, respiratory, fertility, behavioral, and other long-term health effects) that may result from pesticide exposure, but the state of the science at this time yields few causal relationships to specific pesticides, which highlights the importance of reduced general pesticide exposure.

There are several ongoing studies with large agricultural cohorts funded by federal governments in the U.S. and abroad, and studies within these populations suggest several plausible hypotheses to link pesticide exposure to chronic health effects. The most notable of these is the Agricultural Health Study[12] funded by the National Cancer Institute (NCI), National Institute of Environmental Health Sciences (NIEHS), and co-sponsored by EPA, among other collaborating agencies. This is a study with 89,000 participants in Iowa and North Carolina, including private and commercial pesticide applicators and their spouses. The nature of this powerful epidemiologic study design allows investigators to examine many different adverse health outcomes within the study population, *i.e.*, pesticide exposure is ascertained at the beginning of the study and updated periodically, while health information is continually updated and/or collected over time. Another study cohort in Norway includes over 245,000 people to investigate links between cancer and other diseases and agricultural chemicals (Kristensen *et al*., 1996, Nordby *et al*., 2005). In France a large study is underway to investigate the links between agricultural work and cancer, with an emphasis on pesticides (Lebailly *et al*., 2006). The Korean Multi-Center Cancer cohort is collecting pesticide exposure data on tens of thousands of people as part of a large scale study of environmental and genetic factors associated with cancer risk (Yoo *et al*., 2002). These investigators have initiated a collaborative effort, AGRICOH, which is designed to encourage international collaboration. It encompasses 22 cohorts from nine countries pooling data to study cancer and other disorders that can result from pesticide exposure and other causes (Leon, *et al*., 2011).

A complicating factor when studying chronic health effects is that, over time, EPA and others, such as state governments, have implemented risk mitigation measures including increased requirements for the use of personal protective equipment, revised re-entry intervals, and at times the cancellation of pesticide products or specific pesticide uses. It should be noted that while studies published today contribute to the general body of scientific knowledge, not all epidemiologic research would necessarily have current regulatory relevance, *e.g.*, if the pesticide was already cancelled or withdrawn from the marketplace. Additionally, changes in pest pressure, agronomic practices, pesticide product formulation changes and other factors may have resulted in significant changes in the use of pesticides over the last several decades, which is the relevant period for investigating chronic effects with typically long latency periods such as cancer. As a result, studies which reflect past exposure scenarios must be interpreted with caution when applied to current use patterns.

Emerging research suggests that early exposure, either pre-natal or in early childhood, may be linked to chronic health outcomes later in life. These early life exposures may occur from pesticides that are on the bodies or clothes of commercial pesticide applicators and brought into the applicator home environment. A number of studies have shown the potential for "take

[12] More information on the Agricultural Health Study and partners can be found on their website, here: http://aghealth.nih.gov/

home" exposures, where a commercial applicator or an agricultural worker may bring pesticide residues home on their body or clothing (see Section 4.2.2).

These studies on chronic pesticide exposure and other scientific information are evaluated to determine the potential for individual pesticides to cause adverse long-term health effects in the applicator population and their families. When pesticides are identified as problematic, EPA takes action to mitigate the estimated risks of individual pesticides to human health. However, there are also instances in which there is cause for concern over generalized pesticide exposure (beyond those that can be modeled using aggregate and/or cumulative risk assessment practices). The rule changes are also designed to protect against commercial pesticide applicator exposures from all RUPs even when the causal link between individual pesticides and specific health outcomes is not demonstrated.

In this section, EPA summarizes research on potential chronic health effects that result from pesticide exposure. These case study examples are selected for discussion here because they meet EPA data quality standards, and due to either the relative strength and plausibility of the hypothesized link, the number of studies available, or the relatively high prevalence of either the health outcome or a particular pesticide exposure. Overall, the totality of reported findings suggests long term health benefits from the rule, but, due to the state of scientific research and measures of chronic exposure at this time, estimates of the quantitative benefits from the proposal are not possible.

### 4.5.1 Cancer Risks

Although only a small number of pesticides have been determined to be human carcinogens by various peer-review bodies, there is a wide range of literature demonstrating statistical associations between pesticide exposure and some anatomical cancer sites, with plausible biological mechanisms in experimental toxicology studies. Many studies have evaluated other possible links between pesticide exposure and cancer. While it is premature to state there is a causal association between the studied pesticides and cancer in the applicator population, EPA presents this information to demonstrate the growing body of knowledge as to possible chronic health effects of pesticide exposure.

Synthesizing across the studies of the carcinogenic potential of pesticide exposure, review articles and meta-analytic results indicate evidence of an association between various pesticide exposure and lymphohematopoetic cancers (non-Hodgkin's lymphoma (NHL) and leukemia specifically); among solid tumors (brain and prostate cancers); and, some evidence of pediatric cancer risk in association with either *in utero* exposure or parental pesticide occupational exposure (Bassil *et al*.; 2007; Blair and Beane-Freeman 2009; Koutros *et al*., 2010a; Van Maele *et al*.; 2011; Wigle *et al*., 2009; Turner *et al*., 2009; Alavanja and Bonner, 2012; and Alavanja *et al*., 2013). This section will discuss some of the evidence for the possible connection between pesticide exposure and these cancer effects.

Blair and Beane-Freeman (2009) provide a review of epidemiologic studies of cancer among agricultural populations. They report that meta-analyses of mortality surveys of farmers find

excesses of several cancers, including those of the connective tissue, NHL and multiple myeloma and cancers of the skin, stomach and brain and deficits for total mortality, heart disease, total cancer, and cancers of the esophagus, colon, lung and bladder. They reported that meta-analyses of studies of individual cancers show the importance of identifying specific exposures that lead to these cancers. It should also be noted, however, that these authors conclude factors other than pesticide exposures may partially explain the observed increased risk of cancer among those engaged in agriculture (Blair and Beane-Freeman 2009). Initial evidence of a possible association between various pesticide exposures and cancers of the lung, colon, prostate, bladder and pancreas have also been published by the AHS researchers (for example, Alavanja *et al*., 2004 for lung cancer, Lee *et al*., 2007 for colon cancer, Andreotti *et al*., 2009 for pancreatic cancer).

*Lymphohematopoetic Cancers*

Over time, evidence of a link between pesticide exposure and blood cancers has increased. For example, since the 1980s several studies have illustrated a possible link between pesticide exposure and various lymphohematopoetic cancers (Zahm and Ward, 1998, Zahm *et al*., 1997). Incidence of NHL and other blood cancers have increased between 1973 -1990, a time period coincident with an increased use of pesticides as well as other environmental chemicals (Hardell *et al*., 2003). While biological mechanisms remain to be determined (for example, Chiu and Blair 2009), the role of a particular chromosomal translocation (t14:18) has been implicated, possibly as a result of pesticide exposure; however, this is not known with certainty at this time. Comparing rates of new blood cancers among pesticide applicators relative to the general population, Koutros, *et al*. (2010a) reports higher incidence rates for multiple myeloma and lymphoma. Eriksson *et al*. (2008) reported elevated rates of NHL among herbicide users in a population-based case-control study in Sweden (Eriksson *et al*., 2008). There may be a link between pesticide exposure and these cancers; however, additional research is necessary to understand whether the link is causal in nature, and the degree to which pesticide exposures and other farm related exposures may contribute to the risk of these cancers.

In a review by Bassil *et al*. (2007), 14 out of 16 papers examining the association between leukemia and pesticides found a positive result. Of the 16 papers, 8 were case-control studies with statistically significant results. Several case-control studies looked at children that had been exposed to pesticides and found increased rates of all types of leukemia for children whose parents used insecticides on the garden and on indoor plants and from those mothers exposed while pregnant (Bassil *et al*., 2007). These authors note several limitations of each of the studies included in the systematic review, and note they were not able to assess whether publication bias was a factor in the results of this review.

In the Bassil *et al*. (2007) review, 27 studies met their criteria for inclusion into their review that examined the association between pesticide exposure and NHL, and 23 found an association. For the case-control studies in this review, 12 of 14 papers had positive associations and 8 of those associations were statistically significant. In one study that examined children's exposure to pesticides, elevated odds ratios for NHL were found in children who lived in homes where pesticides were used most days for professional home extermination, when children had direct

postnatal exposure or when children had parents that were occupationally exposed. The elevated risks found were over several classes of pesticides (Bassil *et al*., 2007).

Wigle *et al*. (2008) conducted a review of studies investigating links between occupational exposure to pesticides and leukemia in farmworkers' children. They found no evidence of a direct link between children's leukemia and all parents' occupational exposure, but they report an association between a mother's occupational exposure to general pesticides and insecticides and their children's risk of leukemia, with an association slightly higher for farm and other related exposures.

*Prostate Cancer*

For decades, studies have suggested an increased risk of prostate cancer among farmers. Farmers are generally more healthy than the overall population, with lower rates of cardiovascular disease, diabetes, mortality, etc. (Blair *et al.*, 2005). However, farmers have an increased risk of prostate cancer, which may be explained by pesticide exposure, or possibly by other farm- or non-farm related exposures. Comparing the incidence of prostate cancer in farmers with members of the general population, researchers have estimated that farmers have a roughly 20% increased risk of this cancer (Koutros *et al*., 2010a). Case-control analysis within the AHS suggest exposure to several organophosphate pesticides may be related to prostate cancer, but only among men with a family history of the disease (Alavanja *et al*., 2003). Additional follow-up within the AHS cohort corroborates this initial finding (Mahajan *et al*., 2006 and 2007; Christensen *et al*., 2010). The association of prostate cancer with exposure to certain pesticides varies by family history of prostate cancer, and molecular epidemiology studies are underway that may shed light as to the potential role of genetic variation in the association. This work is not yet complete. However, initial investigations recently released indicate that a genetic variation in genetic region *8q24* may partially explain the association between pesticide exposure and prostate cancer (Koutros *et al*., 2010b). Since these genetic variations do not fully explain the cancer relationships within a family, other shared environmental exposures may play an important role. Overall, however, across studies published, results are not consistent, possibly due to differing study designs used.

Recently, AHS researchers produced a new analysis of pesticide exposure and prostate cancer, this time focusing upon more aggressive cases of the disease (Koutros *et al*. 2012). For the purposes of this study, aggressive prostate cancer was defined as a distant stage (tumor tissue outside of prostate), and advanced grade (more poorly differentiated cell structure) indicative of a more advanced disease. Researchers observed an increased risk of aggressive prostate cancer among those who reported using higher amounts of four pesticides over their working lifetime. This work supports previous analyses noting links between specific organophosphate pesticides and prostate cancer. It also extends an understanding of the possibility of a link with the aggressive form of the disease, which is thought to have a different set of causal factors than slow-growing tumors. This is the first study on an aggressive disease, and more work is needed to distinguish clear causal pathways. However, the study is supportive of previous work concerning an apparent increased risk of prostate cancer among pesticide applicators enrolled in the AHS.

*Lung Cancer*

Alavanja *et al*. (2004), reported a positive association between four pesticides and pesticide exposure among the AHS cohort. In this study, exposure to these pesticides was associated with lung cancer risk in the cohort, despite the fact that, in general the lung cancer risk for the cohort is lower than the population as a whole. Other studies have also shown an association between pesticides and lung cancer in the AHS cohort (Beane-Freeman *et al.*, 2005; Lee *et al.*, 2004).

### 4.5.2 Non-Cancer Health Effects

Many epidemiological studies have reported associations between non-cancer chronic health problems and pesticide exposure; however, none have been determined to be causal in nature at this time. Preliminary investigations have identified elevated risks of respiratory and neurological effects; as these are preliminary investigations, other explanations for these effects cannot be eliminated at this time. However, some of the more plausible hypotheses involve a potential role of pesticide exposure and some neurological outcomes in adults such as Parkinson's disease and general neurological health (discussed below). To the extent that the changes to the certification rule reduce chronic exposure to pesticides, they may reduce the incidence of these chronic health effects as well.

*Neurological Function*

The possible connection between pesticide use and symptoms of Parkinson's disease has spurred a great deal of research. Using the AHS cohort, Kamel *et al*. (2007), investigated the hypothesis that Parkinson's disease is associated with pesticide exposure. Study participants included licensed private pesticide applicators and spouses, enrolled in the AHS from 1993 through 1997 and contacted for a follow-up study from 1999 through 2003. They report a positive association of Parkinson's disease in those who reported ever using pesticides, and a "strong association" with Parkinson's disease for those who personally applied pesticides. Cumulative lifetime days of use was associated with a dose-response relationship in cases diagnosed after the beginning of the study, but there was no association with a dose-response function and cases diagnosed prior to the study. This study has recently been updated with physician-diagnosed cases of Parkinson's disease, as opposed to participant self-reporting of Parkinson's disease, and authors reported statistically significant 2.5-fold increased odds of Parkinson's disease if participants used either paraquat or rotenone (Tanner *et al*., 2011).

In a review study on the non-cancer effects of pesticides mentioned earlier, Sanborn *et al*. (2007) evaluated prior work on the association between Parkinson's symptoms and pesticide exposure, and reported a positive association in 15 out of the 26 studies reviewed. The authors conclude that these studies "provide remarkably consistent evidence of a relationship between Parkinson's disease and past exposures of pesticides on the job."

Sanborn *et al*. (2007) examined the non-cancer health effects of pesticides in a review, and found most (39/41) studies displayed an increase in one or more neurological abnormalities in association with pesticide exposure. These outcomes ranged from neurodevelopmental effects in preschool children, general malaise and mild cognitive function, minor psychological morbidity, depression, suicide and death from mental disorders (Sanborn *et al*., 2007). Kamel *et al*. (2007), using the AHS cohort, found associations between neurological symptoms and lifetime pesticide exposure, with the greatest association for organophosphate pesticides.

Research on the neurological effects of pesticide exposure continues. Three recent studies (Rauh *et al.*, 2011; Engel *et al.*, 2011; and Bouchard *et al.*, 2011) have investigated the relationship between prenatal exposure to organophosphate pesticides and neurological effects in children through the age of 7 years. Another recent study (Rohlman *et al*., 2011) reviews the possible relationship between adult occupational exposure to pesticides and adverse neurological symptoms. Despite the associations reported in the reviewed literature, the authors acknowledge uncertainties present in the data at this time which limit causal inference including a clear biologically plausible mechanism of action, among other study characteristics.

*Respiratory Function*

Several studies have shown associations between pesticide exposure and both permanent and transitory (but chronic) respiratory effects. Asthma is a temporary inflammation of the lungs, often caused by an environmental trigger, which leads to coughing, wheezing and shortness of breath. Although the symptoms of asthma last for minutes or days, being susceptible to asthma attacks is a lifelong problem, and several studies have shown an association between pesticide exposure and asthma. Hoppin *et al*. (2008) reported an association between exposure to a range of pesticides and asthma in farm women, despite the fact that growing up on a farm reduced the likelihood of asthma attacks. This study focuses on the spouses of pesticide applicators and may show an important effect from generalized agricultural pesticide exposure to families, rather than exposure as a pesticide applicator. An association has been reported for children, as well. Salam *et al*. (2004) describe a range of risk factors related to childhood asthma. Among those risk factors were pesticides, and other farm exposures. The effects were largest for children with early onset asthma. An international study on childhood exposure to pesticides in Lebanon (Salameh *et al*., 2003) also reports a relationship between exposure and respiratory symptoms.

Chronic bronchitis is an inflammation of the air passages of the lungs. While acute bronchitis usually has symptoms over a short term, chronic bronchitis is a recurring chronic obstructive pulmonary disease that makes it difficult to breathe for months at a time, with coughing that expels sputum from the airways. Hoppin *et al*. (2007) reports a statistically significant association between eleven pesticides and chronic bronchitis among the AHS cohort – an association that was stronger among those with a high pesticide exposure event.

### 4.5.3 Summary of Risks from Chronic Exposure and the Benefits of Reduced Exposure

In Section 4.4, a quantified estimate of the benefits from reduced human health incidents due to the rule changes is provided, but these quantified estimates are based only on the value of reduced illness from acute occupational RUP exposure. The quantified estimates are limited to these effects because sufficient data on illness from acute RUP exposure exists to make a reasonable estimate. The estimates, however, do not quantify many real health benefits that may result from the rule, but for which sufficient data are not available to estimate the monetary value of these benefits. Such non-quantifiable benefits may result from a reduction in the effects described in prior sections that are not easily observed and reported. Because of insufficient information on the rates of illness, the reduction in exposure that would result from the rule changes, and the dose/response relationship between exposure and illness, the value of reducing pesticide exposure that may have reproductive effects for women is difficult to quantify. Acute exposure to pregnant women or chronic exposure to families could result in lifelong developmental, neurological, and behavioral effects in children, and it is challenging to quantify the benefits from the rule changes that may reduce these effects. Overall, the epidemiological or human study data discussed in the Section 4.5 do not suggest a clear cause-effect relation between specific pesticide exposure and certain chronic health outcomes. However, the totality of national and international research efforts showing positive associations between pesticide exposure and certain chronic health outcome in conjunction with plausible hypotheses, taken together, suggest that pesticide exposure may result in chronic adverse health effects beyond those identified through a review of incidents involving acute illness.

The changes to the certification rule are designed to reduce occupational exposure to all RUPs, as well as reduce non-occupational exposure to the families of certified applicators and the general public. There is sufficient evidence in the peer-reviewed literature to suggest that reducing pesticide exposure would result in a benefit to public health through reduced chronic illness. In general, while there is sufficient evidence to suggest associations between exposure and illness, the literature does not provide sufficient data to quantify health effects of specific pesticides for use in a benefits analysis. The totality of findings suggests the rule changes are a way to reduce overall pesticide exposure, which will result in an overall benefit to health.

The health effects potentially caused by occupational pesticide exposure can have dramatic effects on the health and welfare of those who suffer these diseases. These illnesses do not only affect those who become ill, but they also may require extensive caregiving by family members or others. It is also important not to underestimate the effects on those stricken with illness. Parkinson's disease, for example is a progressive disease characterized by tremors, rigidity and stiffness of the limbs, instability and falling, all of which result in difficulty performing everyday functions (Parkinson's Disease Foundation, 2011). Non-Hodgkins lymphoma is a cancer that starts in the immune system, with symptoms of swollen lymph nodes, weight loss, fever, weakness, respiratory distress, drenching night sweats, and pain. Treatment for NHL, has a range of side effects that can also generate substantial symptoms (National Cancer Institute, 2007). In addition to the symptoms of NHL and the treatment, the disease is often fatal. The five year survival rate for NHL is only 70.2%, meaning that almost 30% of people diagnosed with NHL in 2003 died within five years (National Cancer Institute, 2011).

Because of the uncertainties in the number of chronic illnesses that may be caused by, and therefore prevented by reduced pesticide exposure, it is impossible to derive quantified estimates

of pesticide-specific benefits from illness reduction. In the U.S., health care costs for chronic disease are high, in addition to the direct human cost of illness mentioned in the previous paragraph. As examples, the additional medical costs for a patient suffering from Parkinson's disease have been estimated at over $10,000 annually (Huse *et al*., 2005). NHL treatment costs have been estimated at over $5,800 monthly for aggressive NHL, and over $3,800 monthly for slower-growing NHL (Kutikova, *et al.*, 2006). For prostate cancer, average cost of treatment over 5 and half years of the study was over $42,500 (Wilson *et al*., 2006). These costs are only treatment costs, which is an underestimate of the true cost of illness.

EPA's preferred approach for valuation of reduced risk is to use an estimate of "willingness to pay" (WTP) to reduce the risk of experiencing an illness (EPA, 2010). As described in Freeman (2003), this measure consists of four components:

- "Averting costs" to reduce the risk of illness;
- "Mitigating costs" for treatments such as medical care and medication;
- Indirect costs such as lost time from paid work, maintaining a home, and pursuing leisure activities; and
- Less easily measured but equally real costs of discomfort, anxiety, pain, and suffering.

WTP represents the amount of money that an individual or group would pay to receive the benefits resulting from a policy change, without being made worse off. There are other values excluded by using WTP as the metric. WTP is usually characterized as a WTP for improved health outcomes for oneself, which is true here, as well. This does ignore that people may also value the health of others, and place some value on seeing others protected.

As with the estimated value of prevented acute illness in Section 4.4, we are unable to use the WTP to value prevented chronic illnesses, but the WTP for these serious chronic illnesses is surely much higher than the cost of illness estimates provided above. This indicates that prevention of these illnesses would have substantial value.

## 4.6 Non-Quantified Benefits of Avoiding Ecological RUP Incidents

In Section 4.4, quantified estimates of the value of reduced illnesses from acute pesticide exposure. In Section 4.5, Other non-quantifiable benefits to human health from reduced chronic exposures were presented. In this section, EPA concludes the rule benefits discussion with non-quantifiable ecological benefits from reduced RUP exposure to non-target plants and animals.

In addition to the benefits to human health, the changes would also be expected to reduce environmental damage associated with RUP use by reducing the incidents of RUP misuse and other errors. This section will discuss the harm that RUP misuse and other errors can cause to non-target animals, wild plants and crops, and the ways which the changes would reduce the environmental costs of misuse and other errors.

It is difficult to get an accurate picture of how much damage to plants, animals and crops is caused by RUP misuse and misapplication. Although EPA maintains databases of pesticide-related incidents, these data are insufficient to reliably estimate the number of incidents that may

be prevented by the rule. In addition, the available information is generally insufficient to reliably estimate the cost of incidents, even when they have been reported. Because of these inadequacies, we will use the available data to provide a qualitative discussion of the kind of environmental incidents that are caused by misuse of RUPs, and whether the incidents can be prevented by the rule.

*Data*

Ecological incident data are used by EPA's Office of Pesticide Programs (OPP), as a line of evidence (in a weight-of-evidence approach) for making risk conclusions in pesticide risk assessments. Incident data can provide important information on what can happen to non-target plants and wildlife when a pesticide is used in the 'real world', and they can help support or refute risk predictions based on laboratory data.

The primary sources of ecological incident information available to EPA for this analysis are the Incident Data System (IDS) and the Ecological Incident Information System (EIIS), both databases that are maintained by EPA[13]. These databases contain information from pesticide incident reports from a variety of sources. Some are submitted directly to OPP by pesticide registrants, the public, and state, federal, and local government agencies, and others are from information available through other sources, such as the United States Geological Survey's Contaminant Exposure and Effects – Terrestrial Vertebrate Database, the American Bird Conservancy's Avian Incident Monitoring System, the open literature and media accounts.

The IDS database includes all pesticide incidents involving humans, wildlife, pets, and other domestic animals of which OPP is aware. IDS is primarily used by OPP to track the total number of all incidents (human, wildlife, etc.) that may have been caused by a pesticide. The EIIS database contains information on pesticide incidents involving primarily plants, non-domesticated birds and mammals, fish, and honey bees. Information from ecological incident reports is only included in the EIIS if the reports contain, at a minimum, information on a specific pesticide, the effects, and the identity of the wildlife or plants involved in the incident. For this analysis, EPA uses the EIIS database, because information on the specific pesticide (and whether it was an RUP) and the specific events are essential to understanding the circumstances of an incident and whether or not it would be preventable.

Incidents in the EIIS are given a certainty index classification [i.e., 'unrelated', 'unlikely', 'possible', 'probable', 'highly probable'– and the relatively new classification of 'exposure only' (residues detected but no effects noted)]. The certainty level indicates the likelihood that a particular pesticide caused the observed effects. In general, "highly probable" incidents require residues and/or clear circumstances linking the exposure to the effects. "Probable" incidents include those where residues are not available and/or circumstances are slightly less conclusive than for "highly probable." "Possible" incidents are those where there was exposure to multiple chemicals, and it is not clear which one was the primary causal factor, although circumstances surrounding the incident and toxicological properties of the pesticide suggest a possible causal

[13] These databases are not generally available to the public. More information about these databases is available in OPP Report on Incident Information (EPA 2007): http://www.epa.gov/pesticides/ppdc/2007/oct2007/session10-finalrpt.pdf.

relationship. “Unlikely” incidents are those for which evidence suggests that another pesticide or another stressor was the primary cause of the effect, but contribution by the given chemical cannot be completely ruled out. Finally, “unrelated” incidents are those in which evidence clearly indicates that another stressor besides the given pesticide caused the effects. Each incident in the EIIS is also given a legality of use classification [‘registered use’ (the label directions were followed), ‘misuse’ [label directions were not followed; for example, the application involved (accidental or intentional) higher than labeled rates, non-labeled application sites, or the intentional targeting on non-labeled species], or ‘unknown’ (it is not known whether or not the label directions were followed)].

As with most reporting of pesticide incidents, ecological incidents are subject to under-reporting. Ecological incident data are not systematically collected, and, thus, they may not be representative of unreported incidents. The collection of incident data is largely opportunistic, and reported incidents represent a very small portion of the actual incidents that likely occur (Vyas, 1999). The following steps typically need to occur for OPP to receive information on a pesticide incident involving wildlife:

Step 1: Seeing an Incident:

For one, damage from misuse of an RUP, such as a dead animal or plant damage, must be seen to be reported. Many animals that are sick and/or dying will hide as a predator-avoidance response, making it more difficult to find their remains if they die while hidden. If an affected animal is killed by a predator, it is often consumed immediately. Carcasses of animals not killed by a predator and not consumed immediately can be removed fairly quickly from the environment (within hours of death) by scavengers and/or more slowly (within days of death) via decomposition. Therefore, it can be surprisingly difficult to find dead animals and most animals that die (for any reason), are likely not ever seen by someone before they are scavenged or they decompose. Carcass recovery efficiency rates, even for trained individuals searching for carcasses in a known, limited area, are often well below 100% (Madrigal et al., 1996 reported recovering only about two-thirds of bird carcasses placed in the study zone). Although plants do not move or disappear from the environment the same way that animals do, any damage to non-target plants must be noticed, which may be rare. Damage to crop plants is more likely to be noticed, since they are monitored by farmers.

Step 2: Reporting an Incident:

Even when an incident is noticed, it is unlikely to be reported to anyone. There are several reasons why incident reporting is unlikely. For example, the incident observer may not realize the importance of reporting the incident or they may not know to whom to report it. Motivation can be an important consideration for someone reporting an incident. People may be more likely to report an incident if the effects impact them economically (e.g., if the incident involves crop damage or a bee kill) or personally (e.g., it involves a pet or plants in their yard) than if it involves a wild animal. Additionally, if only one or two dead animals are found, it may be assumed that the animals simply died from natural causes.

Step 3: Linking an Incident to a Pesticide:

For an incident to be considered a pesticide incident, it must be linked to a pesticide exposure. Incidents are most likely to be associated with a pesticide if the effect is close in time and space to an application. For slower acting chemicals, affected animals may move from the site of exposure and likely will not die near the pesticide application site (Stroud and Kuncir, 2005), making it difficult to link the deaths to a specific pesticide. Typically, only severe acute toxic effects are observed (principally mortality) and chronic effects (e.g., effects to reproduction or growth) usually are not observed. Weakened and sick animals may be preyed upon, hit by cars, die of disease, etc., and their deaths may not necessarily be attributed to a pesticide, even if it is a major factor in their deaths. Additionally, with the exception of honey bees and crayfish, effects to invertebrates are not typically reported. Because incident investigations can be very complex and resource intensive (Stroud and Kuncir, 2005), even if a dead animal is reported, and the death is suspected to be caused by a pesticide, the incident may not be investigated due to limited resources.

Step 4: Submitting an Incident Report to OPP:

Incidents reported to local or municipal authorities or independent wildlife rescue organizations are unlikely to ever be forwarded to OPP. Some state agencies and some wildlife rescue organizations routinely report incidents to OPP (for example California and New York), but most do not. Therefore, even if a carcass is found and reported to local authorities, and an investigation concludes that the death was due to a pesticide, the incident report may not be submitted to OPP. Reporting by non-registrants is completely voluntary and information on ecological incidents can be gathered by a wide variety of government agencies (e.g., federal, state, and local) and private organizations (e.g., toxicology laboratories and wildlife rehabilitation centers). Not all of these agencies/organizations may know to submit information on ecological incidents to OPP; may not know how to submit the information to the OPP; or may simply choose not to submit the data to OPP (especially if it involves a case going through litigation or some enforcement action).

Although pesticide registrants are required to report adverse effect incidents under FIFRA, a registrant cannot report incidents it is unaware of, or that do not appear related to its pesticides. Furthermore, the reporting requirements defined in FIFRA[14] allow registrants to aggregately report all 'minor' ecological incidents. Incidents that can be aggregately reported include incidents that involve fewer than 200 birds or 5 mammals. The aggregate incident reports lack details including information on effects, specific taxa involved, and descriptions of use; therefore, aggregate incident reports are not included in the EIIS, but they are included in the IDS.

Overall, because of the many ways that reporting of an incident to OPP can fail, it is likely that only a small fraction of the pesticide ecological incidents that occur are ever recorded. Because the incident data in the EIIS are not systematically collected and likely represent a very small

[14] The reporting requirements can be found in the Code of Federal Regulations in Title 40, Section 159.184(c)(5)(iii), which can be found in the Electronic Code of Federal Regulations here: http://www.ecfr.gov/cgi-bin/text-idx?SID=100c94cd811a48658e383a956da0ef65&node=40:24.0.1.1.10.2.1.13

fraction of the incidents that actually occur, these data are likely an underestimate of damage from misuse and other errors by certified applicators. For these reasons, no attempt is made to quantify the benefits from reduced ecological damage caused by RUPs for the rule; the discussion here will be qualitative. Incident data, however, do provide evidence that exposure from misuse of RUPs can result in field-observable effects.

*Method*

To characterize the potential value of reduced RUP incidents, even qualitatively, requires classifying the EIIS data to retain only those incidents that the rule changes would prevent. First, a team of OPP staff compiled a list of all RUP pesticides products and active ingredients. Many active ingredients have some pesticide products that are RUPs and others, with different use patterns or concentrations that are not. The EIIS database was searched for incidents in which one of the RUPs active ingredients was identified as the causal agent for the years 2009 - 2013. In some cases, the pesticide product was identified, so a definite determination about whether the incident involved an RUP could be made. If the causal agent was only identified as an active ingredient, the incident was included if a majority of the products containing it were RUPs, if information about the intended use made it clear that the product used was an RUP, or if the pesticide was applied by a certified applicator. Once the incidents related to RUPs were identified and available information gathered, EPA staff reviewed the cause of the incidents and by consensus determined whether they would have been likely or probably prevented by the rule. The main reason EPA expects the rule to prevent incidents like these is that raising the standards for initial certification and more frequent training would ensure that applicators and those under their supervision would more carefully follow pesticide label instructions, take proper care to prevent harm, and generally have a higher level of competency. The team of OPP staff classified the RUP- and certified applicator-related incidents into the following categories:

- Preventable incidents: Incidents where there was a clear link between the application/applicator and the effect and the information demonstrated an error by the applicator or applicator incompetency.
- Possibly preventable incidents: Incidents where there was a clear link between the application/applicator and the effect and there was a significant impact so an applicator error seemed likely but the available information did not identify any applicator errors.
- Incidents where there is not enough information: Incidents where there was a clear link between the application/applicator and the effect and an applicator error was possible but the available information did not identify any applicator errors.
- Not preventable incidents: Incidents that did not meet any of the above criteria, such as incidents where there was no clear link between the application/applicator and the effect, incidents where there was no evidence of applicator error or if there just was not enough information.

Only incidents that were definitely related to RUP use and considered preventable or possibly preventable are reported below. The incidents often do not have sufficient information to quantify the damage. For example, some of the incidents reported damage to a crop from misuse or misapplication, but the information is insufficient to determine the actual loss to growers. Even when damage to crop plants may result in total yield loss, the response by the grower to the

problem has not been identified. They could choose to accept the yield loss, or replant the crop, or to plant another crop, which might reduce the losses below those of total yield loss. In the narrative about the incident, the crop damage is described (e.g. stunting, reduced yields, bleaching, leaf burn, etc.), but even when the information has been confirmed by agronomists or other experts, the actual yield loss has not been quantified.

For the non-crop damage, such as the deaths of wild animals, in addition to the difficulty in identifying the numbers of animals affected, it is very difficult to provide a value for the potential losses. For example, if a substantial number of bald eagles are killed in a preventable incident (as we see in the data), to quantify the value of preventing that incident, we would need to know the value of those eagles to society, which is difficult to determine.

Loosely speaking, environmental amenities can have multiple sources of value. Economists often categorize some of these as a "use value," where people gain value from somehow using or interacting with the resource, such as visiting a beach, catching a fish, or observing wild birds. Another category is "non-use value," because these environmental goods have value to society beyond their use to people. These non-use values for the preservation of environmental goods have several sources, including that people may want the option to have the goods available in the future, or the value that people place on maintaining the good for future generations, or value placed by society for the mere existence of environmental goods. Non-use values may comprise a substantial fraction of total values for some wildlife species – especially for charismatic species, threatened or endangered species, or species that are not popular targets for hunting or wildlife viewing – that have been harmed by misuse of RUPs, and these values are difficult to estimate. A standard approach would be to use a stated-preference method, like contingent valuation (EPA 2010a) to estimate the societal willingness to pay to preserve the animals or plants that were harmed in preventable RUP incidents. This is not done for this analysis because a high-quality contingent valuation study is very time consuming and expensive, and more importantly, the environmental damage here is very diffuse, involving different types of plants and animals in all parts of the country, whereas the most reliable contingent valuation work involves very concrete choices in a specific location.

An alternative is benefits transfer, where the benefits of preserving environmental goods have been estimated in one context, and we can adjust or apply those benefit estimates for the relevant context. In our case, we are unable to find specific values for the many incidents that can be used for benefits transfer. As an example, consider the loss of a bald eagle. There are estimates of the societal value of preserving bald eagles. Two studies from the literature (Stevens *et al.*, 1991, or Boyle and Bishop 1987) report household estimates that range from $21.11 to $42.21 in 2006 dollars. This indicates substantial societal value for eagles, and aggregated across households in a region or the United States would result in a very large number ($34 billion for the 115 million households in the US). However, the values that are reported, and which were estimated using the underlying contingent valuation studies was a willingness to pay to maintain the existence of eagles in a specific state; no attempt was made to estimate the value of protecting individual eagles, as we have here.

However, we could use these estimates, after adjusting them to transform estimates for eagles as a whole into estimates for individual eagles. The non-use value for eagles could be defined as:

$$\text{Non-use value} = \Delta \frac{N * \Delta P}{\Delta N} * WTP_X * H_{region}$$

Where $\Delta N$ is the number of eagles saved per year, $\Delta P/\Delta N$ is the change in extinction probability for the population per the number of saved eagles per year, $WTP_X$ is the willingness to pay to prevent the (local) extinction of the species, and $H_{Region}$ is the number of households in the region. Incident reports may shed light on $\Delta N$, but of course the ability to account for under-reporting is important, and we have no information on under-reporting. $WTP_X$ for eagles and a handful of other species in the incident data may be gleaned from the literature, but estimates $\Delta P/\Delta N$ would be at best speculative.

Because of the challenge of providing reliable estimates of the value of preventing ecological damage from RUP incidents, we make no attempt to quantify them here. Below we provide information on the types of incidents that can be prevented by changes to the Certification standards, based on the incident data that are available.

*Incidents*

The EIIS data were queried in two passes, the first for the period 2009 – 2010, because it matched the period used for the human incident data, and later for 2011 – 2013, to see whether the data were similar, and to have a larger sample if the incidents varied significantly from year to year. There were total of 245 incidents returned when the EIIS was queried for incidents that were probably related to an RUP. The incidents that are described here are those that EPA staff determined were related to an RUP (some active ingredients have RUP and non-RUP products), and the incident was deemed "preventable" or "possibly preventable" by the rule changes using the above criteria. As shown in Table 4.6-1, there were a total of 68 RUP incidents recorded in EIIS deemed preventable or likely preventable. There were 16 preventable or possibly preventable incidents involving fish or other aquatic animals, such as crayfish, 5 involving birds, 12 involving mammals (dogs, coyote, and fox), 7 incidents involving damage to bee colonies, and 28 involving crop damage. The table also shows the number of organisms affected by the incidents. There were more incidents related to RUPs available, but these were either determined to be unlikely to be prevented by the rule, or there was not enough information to make a determination. It is worth mentioning that these are the incidents remaining after the screening process, and that there is likely significant under-reporting of ecological incidents.

| Table 4.6-1. Preventable Incidents from the EIIS Database, 2009 – 2013 | | |
|---|---|---|
| Affected Organism | Number of Incidents Reported | Quantity Affected |
| Fish and Aquatic Animals | 16 | 23,633 Killed |
| Birds | 5 | 504 Killed |
| Mammals | 12 | 23 Killed |
| Bees | 7 | 394 Colonies Killed |
| Crops | 28 | 6,637 Acres Damaged |
| Source: EPA EIIS Database; EPA staff determined preventability. | | |

As shown in Table 4.6-1, there were 28 reported preventable or possibly preventable incidents involving crop damage. As mentioned above, because we do not know how the damage ultimately affected yield, we are unable to determine the value of preventing incidents like these. These crop incidents typically involve applicator error that more frequent training on the importance of following label requirements would be able to prevent. The type of errors found include applying pesticides when weather conditions are not appropriate for the pesticide, contamination or improper cleaning of application equipment, the wrong active ingredient is applied to the crop, incorrect rate or timing of the application. The crops involved were mostly corn, including sweet corn. Five of the incidents involve a popcorn crop, all in 2011, and four of them occurred in two adjacent counties in Indiana.

Although we are unable to estimate the damage caused by these preventable incidents, it is possible to put an upper bound on some of them, as an example. If we were to assume the crops were a total loss, then in some cases we could multiply the expected yield by the price growers received that year to find an estimate of the total revenue lost to the grower. For example, a total for 367 acres of popcorn were reported damaged in Indiana. If the 367 acres of popcorn were to achieve the 2011 average yield for Indiana of 4,000 pounds per acre (NASS, 2012) at the 2011 average price (NASS, 2012) of $0.258 per pound (2011 was a relatively high value year) would have netted a grower $1,032 per acre (over $378,000 for the total area), which would be the lost revenue in Indiana. Of course, if the crop were lost, there would be some savings in unneeded harvest activities, etc., but this is a substantial loss to growers. If yield were reduced somewhat, rather than fully, the losses would be somewhat lower.

Similarly, for field corn, the average incident involved 238 acres. At 2013 yields and prices (158.8 bushels per acre (NASS, 2014a) and $4.50 per bushel (NASS, 2014b)), preventing the average incident could save revenue to the grower of up to $170,000. These example numbers show that misuse incidents involving RUPs can be very costly, and avoiding the incidents potentially has substantial value.

As shown in Table 4.6-1, the EIIS data show 7 reported preventable incidents involving RUPs that killed colonies of bees. In two of the incidents, there was insufficient information to determine how many colonies were harmed, although the beekeeper reported mortality (reported as 50% mortality in one case). These two incidents are included in the count of 7, but not the

count of colonies harmed. In all cases, the bees were killed by misapplication of RUPs, when the applicator applied the pesticide to the area where bees were actively foraging or allowed the pesticide to drift into areas where significant numbers of bees were present. It is difficult to know the value of the colonies destroyed in the preventable incidents that show up in the EIIS data. The value of a bee colony can be thought of in several ways, all of which are incomplete. One is the replacement cost for the colony, which includes purchasing of new bees, and possibly new hives and frames, if the beekeeper is concerned about past contamination. According to Rucker and Thurman (2012), the cost of a new packet of bees which includes a queen is about $50. This could be considered the rough cost of replacing a colony, but it ignores the lost value of ecosystem services. The first of these is the loss of honey production for the beekeeper. Depending on how late in the year the new colony is established, there may be a substantial reduction in the honey produced by the bees. Average yield per colony in the US for 2012 was 56 pounds, with a value of about $1.99 per pound, or about $112 per colony, which could be lost if the colony could not produce enough honey to maintain itself and allow harvesting (Rucker and Thurman, 2012). Another important service that bees provide is pollination services, critical to U.S. agriculture. Beekeepers are contracted to provide bees for pollination for some crops, and the price they are paid for this service varies by the crop. Among the more valuable crops that depend on pollination services are almonds, which in recent years paid beekeepers about $140 per colony (Rucker *et al.*, 2012). This represents a revenue source for beekeepers, but it may not reflect the losses to growers if pollination is not available during the essential time when plants are flowering. At a very conservative estimate of $100 per hive, the reported loss of hives would have a value of over $39,000.

The remainder of the preventable incidents from the EIIS data are animals, generally counted after they have died. The mammal incidents include the killing of 14 dogs, at least six coyotes and two fox. Five of the coyotes were killed in one incident, due to improper disposal of RUP containers, but it is possible that they were killed intentionally, which would be a misuse of an RUP. The other coyote incident involved a farmer baiting for raccoons to protect a corn crop in Connecticut. The farmer used an RUP insecticide, which resulted in the deaths of the coyote and a dog, and severe injury to another dog. This was a case where the RUP was mishandled several ways, including off-label use and distributed to noncertified applicators. There were substantial fines in this case, of $55,000 to the distributor and $15,000 to the farmer, although the fines to the distributor also included distribution to other noncertified applicators. In a similar incident in Missouri, a man baiting for coyote used an RUP insecticide, which resulted in the death of three crows, a red-tailed hawk, three dogs, a gray fox, a skunk and “several” coyotes.

The remainder of the mammal incidents were the killing of dogs and one fox. In all cases, they were killed by predacides. In most cases, these incidents were caused by applicators not following the label instructions, which have clear use restrictions to protect dogs. One of the cases involves a landowner lacing deer meat with predacides to protect deer from coyote, but where a dog actually consumed the poison. In this case, the RUP compound was distributed illegally, and applied by someone without following label instructions.

Most of the deaths of aquatic animals came from the application of RUPs to control lamprey. These events typically resulted in the deaths of hundreds of non-target fish, because the conditions of the application were insufficiently monitored or the application rate was too high.

One case from California was a result of confusion in the appropriate rate of application, which allowed the chemical to move downstream at high concentration beyond the irrigation canal targeted for treatment, resulting in the deaths of several hundred fish, along with crayfish and tadpoles. Because of the vague description of the numbers killed, these were not counted in Table 4.6-1, although the incident was. The final case with aquatic impacts involves non-aquatic applications of RUPs that ended up killing aquatic animals. The disposal ran into an adjacent creek, resulting in the deaths of approximately 6,000 fish, 600 crayfish, and four aquatic snakes. There are some estimates in the literature that provide a starting place for valuation for fish, but these typically provide estimated values for maintaining populations of well-known fish, like salmon, rather than individual aquatic animals from these RUP incidents. A 2006 meta-analysis of willingness to pay per fish based on recreational fishing reported a mean value of about $17 per fish protected, but the range of estimates in the underlying studies, even after outliers were removed was from under five cents to over $300 per fish (Johnston *et al.*, 2006), which highlights the amount of uncertainty in estimates of aquatic valuation.

For birds, there are five incidents involving bird fatalities, one of which was already described above that resulted in the death of three crows and one hawk in addition to several mammals. Two of the remaining incidents, both in 2009, stem from a rodenticide being applied in a faulty and careless manner which resulted in the deaths of a total of 30 dead geese in Oregon. Fifty Brewer's blackbirds and grackles were killed in an urban area of Sacramento, California in 2010. Although the pesticide was targeting these types of birds, it is designed to frighten rather than kill most of the birds, and the application was in an inappropriate area. The final bird kill was substantial, and very well documented. An RUP was used for a rat eradication project on an island in Alaska, and misuse resulted in the deaths of 420 birds, of which 219 were identified. The birds were killed because, although the label requires picking up spilled bait and any animal carcasses to prevent killing of non-target animals, this was not done until months after the application. There were many birds killed in this incident: 157 gulls, 41 bald eagles, one peregrine falcon, along with many others. As with the other species involved in RUP incidents, it is difficult to find estimates of the value of individual birds, but it is clear that they have substantial societal value, both among recreational bird observers and the general public. There are available estimates for protecting populations of birds, and they confirm the substantial value for protecting these animals. Kotchen and Reiling (2000) report a mean annual willingness to pay per household (in Maine) of about $26 (1997 dollars) to protect the population of peregrine falcon. Richardson and Loomis (2009) report annual mean willingness to pay per household in their meta-analysis of contingent valuation studies. These include bald eagles, which were one of the species in the above incidents, for which they reported the mean values for maintaining the population of bald eagles: studies that report an average value of $39 (2006 dollars) per household per year, and studies that report a lump sum, or an average value of $297 (2006 dollars) per household per year. These estimates are based on protecting populations of birds at a regional level, so it is difficult to translate losses of individual birds into extinction probabilities that these estimates reflect.

In all the cases involving wildlife, EPA is unable to estimate the value of these preventable losses described above, although they could be substantial. The provisions to the rule could help to prevent incidents like these.

These incidents likely represent a small percentage of the actual ecological incidents caused by certified applicator errors. In addition to the reasons for under-reporting mentioned earlier, the approach used to search the EIIS database only captured the incidents that occurred from 2009 through 2013. An example of under-reporting involves deaths of geese in Oregon from zinc phosphide poisoning. EPA's search of 2009 – 2013 incidents identified two of these cases during 2009. By limiting ourselves to that time period, this analysis did not capture a number of similar incidents. A paper published in the Journal of Veterinary Diagnostic Investigation discussed investigations of ten goose mortality events in Oregon from 2004 to 2008. The number of birds impacted in these incidents ranged from 5 to over 300 birds (Bildfell, *et al*., 2013).

# Chapter 5. Paperwork Burden Requirements

Associated with changes in the certification and training requirements, the affected entities are subject to paperwork burden. The Paperwork Reduction Act requires federal agencies to estimate the burden of complying with regulations that require firms or individuals to file reports, maintain records, or otherwise incur a paperwork burden. Agencies are likewise required to estimate their resources expended. Because of the substantial changes in certification and training requirements, EPA developed a new Information Collection Request (ICR) entitled, "Pesticides; Certification of Pesticide Applicators; Final Rule [RIN 2070-AJ20]" in conjunction with this action, using the same parameters and data as utilized in this Economic Analysis.

The rule-related ICR addresses various the paperwork requirements contained in the final rule, including:

- Annual reports required from certifying authorities with EPA approved certification programs
- Pesticide dealer record keeping
- Commercial applicator records for certifying authorities
- Certified applicator training and exams for both private and commercial applicators including keeping records
- Noncertified applicator training record keeping
- State plan revisions.

The total estimated annual respondent burden for this ICR renewal for respondents is 3,601,796 hours. This is an increase of 2,281,542 from the 1,320,254 total burden hours in the ICR approved by OMB under OMB Control No. 2070-0029. The increase in burden is due to both program changes and adjustments made in assumptions and data used to calculate the time and frequency of required information exchange. The program changes and modifications include rule familiarization; revision and submission of RUP certification plans; training records for noncertified applicators under the direct supervision of commercial applicators; and record keeping of RUP sales by pesticide dealers. Adjustment to the baseline costs and hours from the proposed rule ICR are also made where appropriate, due to improved information available on the number of respondents, updated wage rates and to more fully account for activities. Respondent records are not required to be submitted to the Agency. They are to be retained on the establishment and made accessible for inspection.

The estimated paperwork and information exchange burden represents the total to comply with the full suite of requirements for certification and training, including all final revisions and those that are unchanged by this rule. This differs from the estimated incremental cost of the final rule, estimated in the Economic Analysis, which only considers the net cost of the revisions.

The total estimated annual Agency burden for this ICR renewal for respondents is 7,572 hours. This is an increase of 5,237 from the 2,335 total burden hours in the ICR approved by OMB under OMB Control No. 2070-0029. The increase in burden is due to program changes, adjustments made in assumptions and updates to the data used to calculate the time and frequency of required information exchange. The main program change includes review of the

various State, Territory, Federal Agency and Tribal certification plans that are required to be submitted to the Agency. Adjustment to the baseline costs and hours from the previous proposed rule ICR are also made where appropriate, due to improved information available on wage rates and to more fully account for activities.

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