PRODUCT STEWARDSHIP INSTITUTE

Sustainable Solutions to Protect Our Environment

Pesticide Stewardship Briefing Document

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Prepared by the Product Stewardship Institute, Inc.

The Product Stewardship Institute

The Product Stewardship Institute (PSI) is a national nonprofit that strives to reduce the environmental, health, economic, and social impacts of consumer products across their lifecycle. We focus mainly on what happens to products when consumers are done with them. We believe that manufacturers have a responsibility to internalize the costs of safely managing, reusing, and recycling the products that they create. When manufacturers assume this responsibility, the result is reduced waste and lower impacts, reduced costs for governments and taxpayers, and job creation. We help make this possible, in large part, by promoting policy. We also support high-performing voluntary programs. We do all this with the support of 47 state environmental agencies and hundreds of local governments (which represent our members), and nearly 120 companies, organizations, academic institutions, and non-U.S. governments (which represent our partners).

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I. INTRODUCTION

Purpose

The purpose of this *Pesticide Stewardship Briefing Document* was to prepare participants for a PSI-facilitated national webinar discussion on end-of-life pesticide management that was held on July 10, 2017 (see Appendix B for webinar discussion notes). The document is also expected to serve as a basis for future discussions on end-of-life pesticide stewardship in the United States. The briefing document includes background information on pesticide uses and impacts, quantitative information on the scope of the problem of end-of-life management of pesticides, and pesticide policy and management. It also includes key issues, project goals, barriers to achieving those goals, and presents potential solutions pertaining to each of the project goals. The information in this report was derived from stakeholder input obtained during the national webinar discussion, on several telephone discussions with key stakeholders that took place in the spring of 2017, a review of available literature, and an informal PSI survey regarding the identification of discarded pesticide management problems and solutions. **This *Briefing Document* reflects varying perspectives on the management of discarded pesticides and not a unanimous approach.**

Product Scope and Covered Entities

Based on a PSI informal on-line survey primarily of representatives of state and local governments[1] but also stewardship organizations, most respondents indicated that this national pesticide stewardship initiative should cover **households, small farms/small businesses, and commercial/industrial sectors**. Others also suggested including agricultural dealers, golf courses, cities and towns, and schools and universities.

Generally speaking, there are two types of programs across the country that manage discarded pesticides: (1) programs that take product and containers from the agricultural and commercial sectors; and (2) household hazardous waste (HHW) programs that collect small quantities of pesticides with other HHW. Agricultural and commercial programs will take pesticides from many sectors, not just farmers, but also other businesses (e.g., golf courses), government agencies, other entities (e.g., universities), and households residents (although these seem to be primarily in rural or agricultural areas). HHW programs may take, often for a fee, pesticides from small agricultural or commercial generators. Funding of both types of programs varies. Some agricultural and commercial programs are funded at least in part through pesticide registration fees. HHW programs may receive some state funding (fees or general funds), but many rely on local solid waste fees.

Special mention should also be made of programs that focus on collection of agricultural and commercial **pesticide containers**. The U.S. Environmental Protection Agency (EPA) has pesticide container regulations that apply to pesticide registrants, refillers (retailers and distributors), pesticide users, agricultural retailers, commercial applicators, and custom blenders. In California, sellers of agricultural- or structural-use pesticides must belong to a recycling program for high-density polyethylene (HDPE) pesticide containers that are 55 gallons or less. The Ag Container Recycling Council (ACRC) recycles HDPE agricultural crop protection, animal health, and specialty pest control product containers that are 55 gallons or smaller. Containers from products labeled for consumer use in households, lawn and garden, and swimming pools are excluded from ACRC's program.

Based on our research and feedback received during the national webinar discussion, those least aware of how to properly manage discarded pesticides include households, small farms, small businesses (including golf courses), cities/towns, and schools/universities. Larger industrial and commercial generators of discarded pesticides are more aware of proper management strategies and have more resources to maintain compliance with requirements to properly manage discarded pesticides as well as to avoid liability. While these larger entities individually may generate higher volumes of waste pesticides than the smaller entities mentioned above, smaller institutions and businesses cumulatively can have a significant and diffuse impact over a larger geographic area. Furthermore, smaller generators tend to stockpile unused and obsolete materials to a greater extent than large commercial/industrial sectors, posing an environmental, health, and safety risk. Additional information and data are needed to more clearly define the scale and nature of the problem.

II. KEY ISSUES AND PROJECT GOALS

Key Issues

The following issues regarding pesticide stewardship have been identified as reasons for engaging stakeholders. These issues are representative of a range of perspectives. They do not represent a consensus among all stakeholders. Instead, they are indicative of the concerns expressed to PSI staff regarding key problems related to the end-of-life management of pesticides, based on a survey that PSI conducted in late 2016/early 2017, telephone conversations with key stakeholders, and comments provided during PSI's National Pesticide Stewardship Webinar Discussion.

- **Toxicity/Hazards:** Many pesticides contain hazardous and toxic materials. These materials pose public health and environmental risks when improperly disposed, including to surface water and groundwater. In addition, considerable quantities of out-of-date and banned pesticides are stored in homes and businesses, or are being stockpiled on farms, representing a significant risk to the environment and public health. Furthermore, federal legal and regulatory requirements do not prohibit trash disposal of HHW, including pesticides. In many communities where there is a lack of collection facilities or events, or inconsistent collection services, significant quantities of these materials end up in the landfill or are improperly disposed.

- **Awareness and Education:** There is a lack of awareness about the risks of improper disposal of discarded pesticides and/or where to properly dispose of these materials. For example, household consumers may believe that, if the product is targeted for in home use, it is safe for residents, children, and pets. Household consumers also lack adequate information to select the appropriate pesticide for the job and to purchase the correct quantities. More information is needed to help these consumers identify pests and different methods of pest control, including less harmful approaches to pest management. People may be reluctant to use alternatives because they don't believe they will work, they will take too long to be effective, or they are unsure of how to use alternatives properly. While agriculture, commercial, and

municipal/institutional pesticide users are educated in the proper selection and use of pesticides, they may be unaware of the potential impacts (human health, environmental, economic) that are associated with long-term storage and disposal of unwanted pesticides.

- **Uncontrolled Stockpiles of Pesticides on Farms:** While some discarded pesticides are collected through local government HHW facilities and events, there continues to be an accumulation of stockpiles of unwanted pesticides that pose hazards to public health and the environment, as well as resulting in significant government costs for clean-up and enforcement. Factors contributing to the development of stockpiles include lack of consumer convenience and regulatory barriers that increase costs and decrease the convenience of collection.

- **Cost to Government:** Collection programs often rely on state and local governments to pay for the management of discarded pesticides, and these costs can be significant. However, in at least 12 states, pesticide disposal for residential, agricultural, and/or commercial pesticides is at least partly funded by pesticide registration fees paid to the state by manufacturers.[2] There are eight states as well as Washington, DC where paint manufacturers take responsibility for the costs of managing paint – a major portion of the products that government HHW programs take in. Efforts to develop similar programs for other household hazardous wastes, including pesticides, are being considered in several states.

- **Lack of Sustainable Financing:** While the majority of states have state-run pesticide disposal programs, many do not have dedicated funding and operate only intermittently. Funding for these programs comes from enforcement settlements, state environmental funds, state toxics control accounts, cost sharing between large farms and businesses, US Environmental Protection Agency (EPA) grants, and/or annual state pesticide registration fees. Local government HHW facilities also share the financial burden of pesticide disposal by collecting and paying for the proper end-of-life management of discarded pesticides from residents. All states charge a pesticide registration fee to pesticide manufacturers, but these funds are not always used to finance the proper management and disposal of unwanted pesticides. Often this money is used for other purposes such as training, licensing and registration, and program administration. Even if funds are provided for pesticide disposal, the costs of collection and disposal are often not adequately covered by these funds. Furthermore, financing for these programs may cover only a subset of discarded pesticides, such as agricultural and commercial grade pesticides, but does not help residents dispose of those used in and around the home. Stakeholders have also noted problems with pesticide registration fees: 1) being deposited in state general funds and requiring high level approvals to fund education, collection, and disposal; and 2) not getting through to local governments, which collect and pay for pesticide disposal. EPA also charges pesticide manufacturers a registration and annual maintenance fee, but these funds do not go to finance the management and disposal of discarded pesticides. EPA does, however, provide grants to the states that can be used for pesticide disposal, but states must apply for these each year.

- **Data Gaps:** While many local governments collect discarded pesticides as part of HHW collections, and some compile related data, there is not readily available, comprehensive information on the magnitude of the waste pesticide problem in the U.S. Many programs do not publicly report their collection results, and if they do, they often do not separately specify pesticide quantities apart from other HHW. Furthermore, pesticide products may be “hoarded”

(stored for a period of time after use and before disposal), or disposed of in the trash. There is also a need to determine how much pesticide waste is generated. As an example, several technical studies regarding household paint have corroborated that about 10 percent of purchased paint is leftover. This estimate has been helpful in planning for programs to reduce paint waste and to measure progress toward achieving program goals.

- **Accessibility (convenience):** While many local governments provide a service to their residents by collecting discarded pesticides, sometimes using state funding, the demand for service is often well beyond what local governments can provide, particularly in rural areas. State representatives have also indicated that an increase in funding would make possible an increase in collection of waste agricultural pesticides. Many governments also lack guidance as to how many sites are enough to maximize participation.

- **Level Playing Field**: Voluntary programs in the U.S. for agricultural pesticide container recycling and in Canada for agricultural pesticide containers and obsolete pesticides experience issues with "free riders" – those manufacturers that benefit from the collection and disposal programs, but do not contribute funding to finance the program. A level playing field is critical to ensuring, for companies paying for pesticide and pesticide container collection and processing, that funding is fair and sustainable. The voluntary program in Canada for pesticide containers is estimated by CleanFARMS to have a very low number of "free riders" (less than 1 percent), which has been attributed to leadership by the pesticides industry association (CropLife Canada) including requiring its members to participate in the program, annual waste characterization studies to identify free riders, and regulations in two provinces that act as a catalyst to encourage new members to join the voluntary nation-wide program.[3] In the absence of driving forces such as these, including industry commitment and support, either from the manufacturing sector or the supply chain (including agricultural retailers), legislation is one way to address this issue.

- **Volume/Wasted Resources:** More education is needed to reduce the over purchasing of pesticides, which results in unnecessary waste. Company sales practices often include offering a lower unit price for larger quantities of product than for smaller quantities. This practice often results in leftover pesticides requiring disposal. Although commercial pesticide exchange programs can reduce waste, several barriers to reuse include: 1) ensuring the product in the container is what the label states; 2) ensuring the product exchanged is currently registered; and 3) ensuring that the product has not broken down chemically due to poor storage or instability.

- **Regulatory Barriers:** Regulatory barriers to advancing pesticide stewardship include a lack of laws preventing household pesticide disposal in the solid waste stream, lack of labeling requirements that discourage open burning and encourage recycling of commercial containers, and the toxic nature of unwanted pesticides that make take back challenging.

- **Lack of Container Collection Opportunities:** Lack of collection programs for empty pesticide containers result in many of these containers unnecessarily being thrown in the trash, adding to the solid waste disposal burden as well as contributing to hazards to public health and the environment from residues contained within. While an industry group, the Ag Container Recycling Council (ACRC), will properly recycle triple or pressure rinsed agricultural pesticide high density polyethylene containers (55 gallons or less) once they are collected and

consolidated, municipalities and states often do not have the resources to collect and recycle household generated containers, and some material recovery facilities specifically exclude pesticide containers. However, even the ACRC's program has only recycled approximately 30 percent of eligible containers in recent years.[4] Furthermore, pressurized pesticide cylinders, in particular, are very expensive to manage.

- **Product Revisions and Cancellations:** EPA continually revises the list of registered pesticides and uses of these pesticides. Product registrations may be suspended, cancelled, and phased out to protect public health and the environment from undue risk. EPA's re-evaluation process has changed over time and is now called Registration Review. Depending on the conditions, cancelling pesticide registrations and uses may create stocks of unusable pesticides, which can add to disposal needs.

Project Goals

Based on the current issues and context of discarded pesticide management in the U.S., stakeholders have generally proposed the following project goals:

Goal 1: Increase percentage of properly managed discarded pesticides, including uncontrolled stockpiles, with the ultimate goal of properly managing *all* unwanted pesticides.

Goal 2: Increase public awareness of:

- Public health and environmental risks of improper pesticide disposal;
- Collection locations; and
- Impacts of pesticide use (e.g., alternative, less hazardous products and over purchase).

Goal 3: Increase convenient collection for proper disposal of discarded pesticides.

Goal 4: Provide adequate and sustainable funding to increase the percentage of safely managed discarded pesticides and containers, and reduce costs incurred by state and local governments.

Pesticide Stewardship National Webinar Discussion Outcomes

The following outcomes were achieved for the July 10, 2017 PSI National Pesticide Stewardship Webinar Discussion, and helped to establish joint expectations:

1. Developed a greater understanding of the problem of post-consumer pesticide management;
2. Developed a greater understanding of the goals of post-consumer pesticide management;
3. Developed a greater understanding of key barriers to pesticide management;
4. Began to identify potential solutions; and
5. Identified data gaps and potential further research.

III. PESTICIDE TYPES, USES, AND IMPACTS

There are a wide range of pesticides in use with a variety of risks and potential impacts to human health and the environment. The risks posed by pesticides to human health and the environment depend on the toxicity of a pesticide and the exposure to it (e.g., how much is ingested, inhaled, and/or absorbed through the skin or eyes). Pesticides may also contain more than one ingredient, each with a different degree of toxicity.

Pesticide Types and Uses

According to the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the federal law that regulates pesticide distribution, sale, and use in the U.S., **a pesticide is:**

> **"(1) any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest, (2) any substance or mixture of substances intended for use a as a plant regulator, defoliant, or desiccant, and (3) any nitrogen stabilizer."[5]**

There are three basic types of pesticide users, from which discarded pesticides are generated, which include agricultural, home and garden/residential, and industry/commercial/government. **Pesticides that are commonly used** include:

- **Insecticides** – used to kill insects
- **Herbicides** – used to kill weeds and other plants that grow where they are not wanted
- **Rodenticides** – used to kill rats, mice, and other rodents.
- **Fungicides** – used to kill fungi, including mildews, molds, and rusts.
- **Disinfectants and Sanitizers** – used to kill or inactivate disease-producing microorganisms on inanimate objects.

Pesticides can also include attractants, plant defoliants, swimming pool treatments, and plant growth regulators. For a more detailed list of types of pesticides and brief definitions, see EPA's list here.[6]

EPA classifies end-use pesticides (as opposed to product for further formulation into other pesticides) as follows:

- **Restricted Use Pesticides (RUP)** – Pesticides that require special training in handling and applying to ensure the proper use of the product. Use of RUPS is limited to certified applicators or persons under their direct supervision.
- **General Use/Unclassified** – Pesticides for which users are not limited in any manner unless the labeling limits use to a specific group (e.g., veterinarians). Pesticide products that may be purchased and used without any federal license or certification. However, many states require certification of all commercial applicators, not only those applying RUPs.

Chemical Compounds

Pesticide products are made up of both "active" and "inert" ingredients:

- **Active ingredients** are those chemicals that control the pests and fall into three categories; antimicrobial, biopesticides, and conventional.
    - *Antimicrobial pesticides* are used to destroy or suppress growth of microorganisms (e.g., bacteria, viruses, or fungi) on inanimate objects.
    - *Biopesticides* are derived from natural materials and are typically less toxic than conventional pesticides.
    - *Conventional pesticides* contain ingredients other than biological and antimicrobial pesticides and are generally synthetic chemicals that tend to pose greater risk than antimicrobial and biopesticides.
- **Inert ingredients** are combined with at least one active ingredient in a pesticide, and are used to improve pesticide effectiveness and performance. These ingredients can act as solvents to help the active ingredient penetrate a plant, prevent caking or foaming to improve ease of application, extend the product shelf-life, improve worker safety, and protect against degradation from sunlight. "Inert" does not mean non-toxic and EPA must approve all inert ingredients. Examples of inert ingredients include emulsifiers, solvents, carriers, aerosol propellants, fragrances and dyes.

The chemicals used in pesticides are large in number and varied. More information about these chemicals can be found on EPA's Ingredients Used in Pesticide Products page, which includes a range of pesticide chemical databases. The most commonly used conventional pesticide active ingredients are provided further below (see Table 3. in Section IV. Quantifying the Issue).

Health and Environmental Concerns

Pesticides are some of the more toxic products used and stored in our homes and businesses, and on farms. According to American Association of Poison Control Centers, approximately 84,000 cases of human exposure to pesticides occurred in 2015 (with serious outcomes – moderate, severe, and death).[7] In addition, pesticides are one of the top three substance categories involved in pregnant exposures, and also one of the top twenty substance categories most frequently involved in pediatric deaths.[8] For calls to poison centers, pesticides are the most common inquiry after cleanup of mercury.[9] A United States Geological Survey study published in 2014 indicates that levels of pesticides continue to be a concern for aquatic life in many rivers and streams that drain agricultural, urban, and mixed-land use watersheds.[10] The proportions of evaluated streams with one or more pesticides that exceeded an aquatic-life benchmark were over 60 percent for agricultural streams and increased from 53 percent during 1992-2011 to 90 percent during the 2002-2011 time period for urban streams. The potential for adverse effects on aquatic life is likely greater than the results indicate because potentially important pesticide compounds were not included in the assessment. Long-term storage of unusable/unwanted pesticides can also pose risks to the farmer as well as contaminate the farm as the containers degrade and pesticides are released.

Because pesticides are designed to kill or harm living organisms, many pesticides pose risks to humans and the environment. Pesticides are inherently toxic and exposure to pesticides may result in:

- **Damage to the liver, kidneys, central nervous system, and endocrine system;**
- **Increased risk of cancer; and**
- **Eye, nose, and throat irritation.**

Examples of potential effects on humans and the environment by specific active ingredients in pesticides are provided below (a more comprehensive list can be found here):

- **Glyphosate** – is low in toxicity to fish and wildlife, but may indirectly affect fish and wildlife by altering the animals' habitat by killing plants. Studies have provided conflicting results on whether the use of glyphosate containing products is associated with cancer. Some studies have associated glyphosate use with non-Hodgkin's lymphoma.
- **Sulfuryl fluoride** – may act as a greenhouse gas and is highly toxic to fish and water fleas, and is estimated by EPA to be highly toxic to honey bees.
- **Naphthalene** – may cause cancer in humans, considered moderately toxic to fish and Pacific oysters.

- **Permethrin** – likely to be carcinogenic to humans if ingested, highly toxic to fish and other animals that live in either salt water or fresh water, low toxicity to birds, highly toxic to bees and other beneficial insects.

Due to the risks and toxicity of pesticides**, EPA, Centers for Disease Control and Prevention (CDC), and many pest control professionals urge that reliance on chemical pesticides be reduced** to protect human health and the environment from the risks posed by these substances. Furthermore, it is important to consider that pests can become resistant to pesticides, increasing control costs, crop losses or other pest damage. Many natural enemies of pests are killed by pesticides, reducing the effects of these natural controls. EPA, CDC, and pest control professionals assert that "prevention is the most effective way to control disease-carrying pests and their health risks. The combination of preventive measures and reduced-risk treatment methods to reduce the reliance on, and therefore the corresponding risk from, the use of chemical pesticides is generally known as Integrated Pest Management (IPM)."[11] Adopting IPM reduces exposure to both pests and pesticides, and decreases hazards by reducing pesticide use, using pesticides which are less hazardous, and implementing protective measures to reduce exposure to humans and other living organisms, as well as the environment.

IV. QUANTIFYING THE ISSUE: PESTICIDE SALES, USE, AND END-OF-LIFE MANAGEMENT

This section provides background information on the nature of pesticide sales, use, and end-of-life management.

Pesticide Sales and Use

According to the U.S. EPA Pesticides Industry Sales and Usage report (2017), the overall total U.S use for all types of conventional pesticide active ingredients was approximately 1 billion pounds in 2012.

- **Agricultural**: Use of conventional pesticides on farms was 899 million pounds of active ingredient in 2012 and accounts for almost 90 percent of the total amount of conventional pesticides.
- **Home and Garden/Residential**: An estimated 88 million households used 59 million pounds of conventional home and garden conventional pesticide active ingredient in the United States in 2012.
- **Industry/Commercial/Government**: Conventional pesticide use in this category totaled 48 million pounds of active ingredient in 2012.

In addition, this EPA report provides information on the number of pesticide producers, as well as pest control firms and applicators, summarized below in Table 1 and Table 2 respectively.

Table 1. Number of U.S. Pesticide Producers, Formulators, and Distributors (2012)*

Type[12]	Number
Major Pesticide Producers	12
Other Pesticide Producers	100
Major Pesticide Formulators	120-150
Other Pesticide Formulators	1550
Distributors	24,686
Establishments	42,160

Source: Atwood, Donald, and Claire Paisley-Jones. 2017. *Pesticides Industry Sales and Usage: 2008-2012 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. EPA.

*Note that one entity may operate as both a producer and a formulator.

In 2011, six pesticide manufacturers represented over 76 percent of global sales. With additional mergers in July 2016, five top pesticide firms now dominate global sales - Syngenta, Bayer, Dow/Dupont, BASF, and Monsanto.[13] An extensive list of pesticide manufacturers, formulators, producers, and registrants is available on the National Pesticide Information Center's website.

Table 2. Number of Exterminating and Pest Control Firms and Number of Certified Applicators (2012)

Type[14]	Number
Exterminating and Pest Control Firms	23,413
Private Certified Applicators	424,525
Commercial Certified Applicators	425,086
Certified Applicators that Work for Federal Agencies	4,007

Source: Atwood, Donald, and Claire Paisley-Jones. 2017. *Pesticides Industry Sales and Usage: 2008-2012 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. EPA.

An estimated 18,000 pesticide products are in use.[15] The most commonly used conventional pesticide active ingredients are listed below in Table 3 (based on 2012 data, the most recent available from the EPA).

Table 3. Most Commonly Used Conventional Pesticide Active Ingredients (2012)

Rank	Active Ingredient	Type	Usage Rate Range (millions of lbs. active ingredient)
Agricultural Market Sector			
1	Glyphosate	Herbicide	270-290
2	Atrazine	Herbicide	64-74
3	Metolachlor-S	Herbicide	34-44
4	Dichloropropene	Fumigant	34-42
5	2,4-D	Herbicide	3-40
Home and Garden Market Sector			
1	2,4-D	Herbicide	7-9
2	Glyphosate	Herbicide	4-6
3	Methylchlorophenoxypropionic acid (MCPP)	Herbicide	2-4

Rank	Active Ingredient	Type	Usage Rate Range (millions of lbs. active ingredient)
4	Pendimethalin	Herbicide	2-4
5	Carbaryl	Insecticide	2-4
Industry/Commercial/Government Sector			
1	Glyphosate	Herbicide	7-9
2	Chlorothalonil	Fungicide	5-7
3	2,4-D	Herbicide	4-6
4	Pendimethalin	Herbicide	2-4
5	Prodiamine	Herbicide	0-2

Source: Atwood, Donald, and Claire Paisley-Jones. 2017. *Pesticides Industry Sales and Usage: 2008-2012 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. EPA.

Discarded Pesticide Disposal Quantities and Management Costs

From a review of existing studies and an informal PSI survey of state and local government representatives, data on discarded pesticide quantities collected and the costs of disposal were compiled for this report. These data are representative of an example of quantities and costs associated with the management of post-consumer pesticides in different U.S. jurisdictions, but should not be considered an exhaustive, comprehensive summary of this type of data.

According to a 2002 EPA Clean Sweep Report (the most recent report of this type available), more than 24 million pounds of waste pesticides were collected through Clean Sweep programs in 46 states across the country from approximately 1986 to 2001.[16] In Minnesota, the amount of waste pesticides collected from households and farms has grown over the past three years, with approximately 453,000 pounds collected in 2014 to almost 500,000 pounds in 2016.[17] In Portland, Oregon, a study conducted from 2011-2012 indicated that Metro, a regional government in the Portland-area, paid $503,000 to dispose of 248,880 pounds of pesticide products received from residents and small businesses.[18] While this waste quantity represented only an estimated 6 percent of the total pounds of HHW collected, management of this waste incurred a cost of approximately $2.02 per pound, almost twice the cost paid for the average of all HHW disposed ($1.03 per pound).[19] More recently, Metro estimated that it pays approximately $700,000 to dispose of 325,000 pounds of pesticides annually as part of its HHW program with per pound direct costs (labor, materials, and disposal) ranging from $1.53 - $3.53 per pound.[20]

PSI's informal government survey indicated that waste pesticide disposal costs could range from a low of $0.88 per pound up to $3.91 per pound, with an average cost of $1.57 per pound. A separate analysis of these costs conducted in 16 states across the country in 2007 indicated a range of $1.12 per pound to $2.50 per pound to dispose of waste pesticides.[21] This study also indicated that 12 states each spend an average of over $1 million per year to dispose of household and agricultural waste pesticides and collect over 500,000 pounds per year of waste pesticides.

It is important to note that this review of data has highlighted the need for more consistent performance metrics and recordkeeping. Some survey respondents provided information on HHW that included pesticides, but did not break out costs and quantities specific to pesticides. Others provided data separately for household events and facilities and agriculture/commercial sectors. Still others indicated their totals included all poisons, or excluded poison aerosols, but that the data did not

necessarily consist of pesticides exclusively. Lastly, information was provided in some cases by volume (gallons), and in others by weight (pounds or tons). Without density information for the liquid data, it is difficult to make comparisons or compile totals.

Beyond the burden of disposal costs, cost avoidance should also be considered in evaluating the need for more extensive pesticide stewardship. Proper disposal of chemicals avoids expensive penalties for local and state waste management agencies. Local governments can face significant federal fines if their landfills are contaminated with chemicals such as household and garden pesticides. In Florida, the EPA has designated approximately 20 Superfund sites that have pesticides listed as a contaminant of concern.[22]

Data Gaps and Information Needs

To better understand the scope of the problem related to discarded pesticides, along with potential solutions, PSI recommends gathering the following additional data and information:

- The extent to which the pesticide registration fee in each state helps fund collection and disposal of discarded pesticides, and the products that fall within the scope of these funds (e.g., agricultural, households, commercial businesses, etc.);
- The collection rate for discarded empty household pesticide containers in each state;
- The scope of the current collection infrastructure in each state for household, agricultural, and commercial/institutional generators (permanent facilities and programs, collection events, and intermittent programs) for discarded pesticides and containers to help determine gaps in collection convenience that contribute to environmental and public health risks associated with lack of options for proper disposal;
- Estimates on the number, magnitude, and types of materials being kept in stockpiles in each state;
- The reasons people are not bringing discarded pesticides and/or containers to collection locations for recycling and proper disposal, and what is being done with these materials (e.g., stockpiling, improper disposal, etc.); and
- The extent to which discarded pesticides are being generated (e.g., what percent of purchased pesticides become leftovers to be discarded as waste?).

V. PESTICIDE POLICY AND MANAGEMENT

U.S. Federal Requirements and Guidance

Requirements Addressing Pesticide Sales and Use

At the federal level, EPA is responsible for "**ensuring that pesticides do not pose unreasonable risks to the public and to the environment.**"[23] EPA uses the authority of FIFRA and the Federal Food, Drug and Cosmetic Act (FFDCA) to carry out this responsibility, which includes the requirement for manufacturers to register pesticides with EPA in order for them to be legally used in the U.S.[24,25] These laws have been subsequently amended by the Food Quality Protection Act of 1996 and the Pesticide Registration Improvement Act, PRIA, of 2003 and its

reauthorizations (PRIA 2 and PRIA 3), the latest of which is set to expire September 30, 2017. The PRIA legislation was **designed to facilitate and accelerate the pesticide review process by establishing specific timelines for regulatory decision-making and to require registration and annual maintenance fees be paid by manufacturers to EPA** for conducting registration and review activities.

Through FIFRA, EPA requires **pesticide registration and pesticide labeling, and carries out compliance and enforcement activities**. EPA assesses the potential human health and environmental effects associated with the use of the product. It also regulates the language used on each pesticide label, which provides directions to achieve effective product performance while minimizing health and environmental risks. Pesticide registration is a procedure through which EPA regulates the following:

- Pesticide ingredients;
- The site or crop where the pesticide is to be used;
- Amount, frequency, and timing of the pesticide use; and
- Practices for storage and disposal.[26]

EPA works with the Food and Drug Administration and the U.S. Department of Agriculture to address food safety issues, and the Bureau of Land Management and US Fish and Wildlife Service to assess the risks of pesticides to the environment. EPA must comply with the Endangered Species Act in determining whether to register a pesticide. The agency also works with state agencies to review pesticide safety information, educate applicators and agricultural workers, monitor compliance, and investigate pesticide problems.

EPA's Office of Pesticide Programs also manages programs that include integrated pest management in schools and worker safety protection. In addition, EPA partners with the pesticide-user community in the U.S. to promote integrated pest management practices through the Pesticide Environmental Stewardship Program, established in 1994.

Pesticide Disposal and End-of-Life Management

Federal law allows disposal of HHW, including household generated pesticides, in the trash. However, the EPA strongly encourages avoiding residential disposal of pesticides in the solid waste stream, whenever possible, through best practices listed further below.[27]

For agricultural and industrial/commercial/government generated discarded pesticides, the federal Resource Conservation and Recovery Act (RCRA) hazardous waste requirements and U.S. Department of Transportation requirements for hazardous materials may apply. RCRA requirements include manifesting, storage, and disposal requirements that do not allow certain pesticide wastes to be placed in the solid waste stream. However**, EPA's Universal Waste regulations** (Title 40 of the Code of Federal Regulations (CFR) Part 273) **simplify the hazardous waste management standards for certain categories of hazardous waste, including pesticides, although some states may have more stringent standards**. In general, materials managed as universal waste:

- can be stored for a year and are not required to have a manifest;
- do not need to be counted toward a generator's category in determining whether it is a conditionally-exempt small quantity generator, small quantity generator, or large quantity generator;
- must be managed in a manner that prevents releases to the environment; and

- have associated requirements that include labeling, response to releases, and transport to a facility that is permitted or otherwise designated for receiving hazardous waste.

While farmers and commercial pesticide users generally cannot dispose of pesticides through local HHW collection programs, many states run pesticide disposal programs specifically for farmers and commercial pesticide users, which are often referred to as "Clean Sweep" programs.

EPA also has Pesticide Management and Disposal regulations (40 CFR Part 165) that establish standards for pesticide containers, label instructions, repackaging pesticides, and pesticide containment structures. These requirements apply to registrants (those who apply to register a new pesticide active ingredient, new product for an existing pesticide, or adding a new use to an existing product) who distribute or sell a pesticide product in nonrefillable containers, and are intended to ensure proper use, reuse, disposal, and adequate cleaning of containers. Both pesticide registrants and refillers (typically distributors or retailers) must comply with the regulations. Pesticide users are expected to follow the label instructions for cleaning and handling empty containers.

State Pesticide Management

In each state, one agency works cooperatively with the EPA to enforce federal pesticide regulations and respond to potential complaints. FIFRA allows states to register pesticides for use within states, and all 50 states and Washington, DC charge a pesticide registration fee. This fee can be as high as $3,000 per product or as low as $40 per product, but mostly ranges from approximately $100 to $400 per product.[28] Information available from The Pesticide Stewardship Alliance indicates that while some or all of this fee has been used in 12 states to help pay for discarded pesticide disposal, at least 16 states do not fund pesticide disposal through this fee (for the remaining 22 states, this information was not available).[29] Minnesota and Arkansas specifically add a $50 per product fee as part of their registration fees to be designated for waste pesticide collection and disposal. While there is a lack of specific data on the scope of the problem, the funding provided from these registration fees to finance discarded pesticide collection and disposal is generally inadequate to address the current problems posed by discarded pesticides.

State pesticide disposal programs exist in over 40 states. Table 4 below shows a sample of these programs from across the country with information obtained from The Pesticide Stewardship Alliance's State Pesticide Disposal Database. This table indicates who can participate, products collected, and the funding source for a range of programs. Included in the table are some of the most active programs in the country and represent geographically diverse regions in the U.S.

Table 4. Sample of U.S. State Pesticide Disposal Programs

State	Oversight Agency	Frequency	Collection Type	Who Can Participate?	Products Collected	Funding Source
AZ	Arizona Department of Agriculture, Environmental Services Division	2 events per year – can vary	Pre-registered collection events at central locations on specific days	All private and commercial applicators, sellers, registrants, Universities, other governmental units	Pesticides only	Pesticide Registration Funds
IN	Office of Indiana State Chemist	Annually	Central Drop Off	Farmers, Ag Dealers, Pest Control Operators, Golf Courses, Schools, Corporations or anyone who uses pesticides during the course of business	Pesticides Only	US EPA Grant plus participant funding dependent on pounds submitted
NC	North Carolina Department of Agriculture and Consumer Services	N/A	N/A	No businesses/limited commercial applicators	No fertilizer, Yes Weed & Feed / Yes Gas Cylinders thru cooperator	N/A
OR	Oregon Department of Agriculture, OR Department of Environmental Quality	Statewide program is currently active. Collection events held at various times during the year.	N/A	Farmers, growers, and other commercial and institutional operations. Potential customers are instructed to contact the program's hazardous waste disposal company at least two weeks before an announced event to sign up and provide information about what they have to dispose. The contractor organizes and operates the collection events.	The state-sponsored program collects Ag & Commercial grade pesticides. Local government programs collect HHW pesticides, which are active in many counties within the state. Larger counties/cities have fixed HHW/Conditionally Exempt Small Quantity Generators (CESQG) collection facilities.	N/A

State	Oversight Agency	Frequency	Collection Type	Who Can Participate?	Products Collected	Funding Source
PA	Pennsylvania Department of Agriculture	Permanent	Scheduled site-to-site	Ag & professional applicators	All pesticides incl. cylinders & pool chemicals.	Pesticide registration fees
VT	Vermont Agency of Agriculture, Food & Markets	Permanent	Central events	All persons	General ag & homeowner pesticides including cylinders.	Pesticide registration fees (Plus cost-sharing with large farms & businesses.)
WA	Washington State Department of Agriculture	Statewide program is currently active. State holds collections events at various times during the year based on customer demand.	N/A	Nearly anyone with unwanted/unusable Agricultural or Commercial grade pesticides is eligible. Participation and/or eligibility depends on what pesticide products a person/organization has, not who they are.	The state-sponsored program collects Agricultural & Commercial grade pesticides. Local government programs collect HHW pesticides, which are active in every county within the state. Larger counties/cities have fixed HHW/CESQG collection facilities.	Program is funded entirely by biennial appropriations from the Washington State Toxics Control Account.

Source: The Pesticide Stewardship Alliance. 2017. State Pesticide Disposal Database – Map & Contact Info, accessed at http://tpsalliance.org/resources/state-disposal-map/ on March 16, 2017.

Information in the table above raises the following important questions regarding improving pesticide stewardship in the U.S.:

- Is collection frequency and infrastructure adequate?
- What is a preferred product scope?
- Who should be allowed to participate?
- Is funding adequate to properly dispose of all available waste pesticides?
- Is the oversight agency provided with adequate funding for administration, enforcement, education/outreach, and discarded pesticide collection and disposal?

While there are currently no extended producer responsibility (EPR) laws in the U.S. that require manufacturers to fund and manage post-consumer pesticides, Metro, a regional government in the Portland, Oregon metropolitan area, worked with legislators to introduce, in February 2015, a bill (HB 3251-1) to establish, in Oregon, an EPR program for HHW that includes pesticides. The bill was reintroduced in January 2017 as SB 199, and a public hearing was held on February 16, 2017. Over the past year, Metro has undertaken a series of stakeholder meetings to obtain feedback on the approach used in the bill, which is intended to provide sustainable funding to increase the collection and proper disposal of pesticides and other HHW. Other state and local governments across the country have expressed interest in the EPR approach as they face increasing challenges posed by the cost burdens of collecting and disposing of HHW, including pesticides.

Pesticide Container Stewardship in California

An EPR law in California requires any seller of an agricultural or structural use pesticide to belong to a pesticide container recycling program. It is the only law of its kind in the U.S. In January 2009, California established this law (Food and Agricultural Code (FAC) section 12841.4) for recycling rigid, non-refillable high-density polyethylene (HDPE) pesticide containers of 55 gallons or less. This law requires every registrant of any production agricultural- or structural-use pesticide product sold for use in California to establish or participate in a recycling program. The recycling requirements were designed to reinforce voluntary efforts that recycle HDPE (#2 plastic) containers and divert used containers away from landfills. The recycling program must comply with the American National Standard Institute (ANSI) American Society of Agricultural and Biological Engineers (ASABE) Standard S596, *Recycling Plastic Containers from Pesticides and Pesticide-Related Products*. The recycling rate for this program (estimated based on a three-year rolling average) is 48 percent (for 2013, 2014, and 2015).[30] Since the California law was implemented in 2011, the state has seen an increase in the annual pounds of plastic collected from 1.7 million pounds to almost 2.2 million pounds in 2016.[31]

Pesticide and Pesticide Container Stewardship in Canada

In Canada, unwanted pesticides and empty pesticide containers are managed in a variety of ways. For residential pesticides, end-of-life management is mandated in British Columbia, Manitoba, and Ontario as part of EPR programs for HHW that include other materials such as solvents and flammable materials. These programs require product manufacturers to establish a collection program for these materials and pay for collection and proper disposal of HHW, including residential pesticides. In all three provinces, manufacturers currently manage this program through a stewardship organization, Product Care. In addition to residential materials, Ontario's program includes small quantity institutional, commercial, and industrial (IC&I) fertilizers, such as packaged products regulated under Canada's Fertilizers Act that contain pesticides, herbicides, insecticides, and/or fungicides. In 2015, Ontario's program collected almost 86,000 pounds of pesticides, 59 percent of pesticides available for collection.[32] In British Columbia, approximately 6,580 gallons of pesticides were collected in 2015, a 21.7 percent recovery rate (based on 30,344 gallons sold).[33] In recent years, local government pesticide bans on the use of residential pesticides for cosmetic reasons have reduced sales and disposal volumes of these products in Canada.

Discarded agricultural pesticides have been managed on a Canada-wide basis since 1998 as part of a voluntary program. CleanFARMS, a nonprofit industry stewardship organization, provides this industry-led program for farmers and other users of commercial class pesticides to return obsolete and unwanted pesticides to agricultural retail and municipal waste collection sites for safe disposal free of charge. CleanFARMS funds the program through a fee collected on each container sold from its pesticide manufacturer members. The program aims to deliver collection programs in all provinces every three years. While there are no collection targets or monitoring requirements, CleanFARMS does produce an annual report on its activities. CleanFARMS also operates a voluntary pesticide container collection and recycling program for containers less than 23 Liters (approximately 6 gallons), which contributes to reducing contamination and saving space in landfills. In Manitoba, the CleanFARMS program is regulated under the Packaging and Printed Paper Stewardship Regulation. Users of targeted products must remove caps and labels, and triple rinse their empty containers prior to taking them to collection locations, which operate from May to October. Containers are shredded, cleaned, and recycled into various value-added plastic products, largely field drainage tiles. CleanFARMS members have committed

to an 80 percent recovery rate of containers sold into the market, and have seen the return of 4.66 million empty pesticide and fertilizer containers representing over 60 percent of the total sold.[34] Pesticide containers greater than 23 Liters are the responsibility of the manufacturer to manage. Since 1998, CleanFARMS has collected nearly 5.5 million pounds of discarded agricultural pesticides.[35]

Other Initiatives

As mentioned previously in this report, an industry-led voluntary initiative of the Ag Container Recycling Council (ACRC) facilitates and funds the operation of agricultural pesticide container recycling programs in 44 states. Empty triple or pressure-rinsed HDPE agricultural crop protection, animal health, and specialty pest control product containers that are 55 gallons or smaller are collected at no cost to farmers and applicators across the U.S. The containers are recycled into valuable end uses, such as specialized pallets for agrochemicals and seeds, agricultural drain pipe, and highway and agricultural fence posts. The program is funded by ACRC member companies and affiliates that formulate, produce, package and distribute crop protection and other pesticide products (38 members and 9 affiliates as of 2017), but accepts containers from non-members as well. Containers from products labeled for consumer use in households, lawn and garden, and swimming pool uses are excluded from ACRC's program. ACRC contractors collect containers from retailers, applicators, farmers and other users at more than 5,000 collection sites.[36] Since the program was established in 1992, more than 175 million pounds of pesticide containers have been recycled.[37] In 2016, approximately 11 million pounds were collected and recycled.[38]

Some manufacturers have limited buy-back programs for commercial pesticides. Under such programs, farmers and other users may return unused product to dealers for a refund.

Best Practices

Along with regulatory and voluntary management initiatives, there is also extensive guidance on how to safely use, store, and dispose of pesticide products to reduce risks to public health and the environment. These best practices can be found through accessing a range of resources including those from the National Pesticide Information Center, the US EPA (Citizen's Guide to Pest Control and Pesticide Safety and Safe Disposal of Pesticides), and a variety of state and local government agencies. There is also a standard that represents best practice for recycling pesticide containers (American National Standard Institute (ANSI) American Society of Agricultural and Biological Engineers requirements (ASABE) Standard S596, *Recycling Plastic Containers from Pesticides and Pesticide-Related apply to all Products*). This standard is required for pesticide container recycling programs under California law.

Some of the following best practices for safe use, storage, and disposal apply to all pesticide categories and users, while others apply only to household/residential use pesticides.

Safe use includes:

- Selecting the appropriate product;
- Reading and following label directions;

- Ensuring children, pets, and others non-essential to the application are out of the area before mixing and applying pesticides;
- Wearing clothing that will protect you, such as long sleeve shirts, long pants, and closed-toe shoes;
- Mixing only what is needed for immediate use;
- Being prepared for a spill;
- Removing personal items from the spray area to avoid contamination;
- Avoiding windy conditions; and
- Washing hands after use.

Safe storage is encouraged through the following suggested best practices:

- Store pesticides in original containers with original labels that list ingredients, directions for use, and first aid steps in case of accidental poisoning.
- Ensure that the container has an appropriate lid.
- Read the label for storage instructions as extreme temperatures can change the pesticide chemistry and/or damage containers.
- Designate a storage location that is only used for pesticides, is well ventilated, and cannot be accessed by children or pets, preferably with a lock.
- Choose a storage location away from food, medical supplies, animal feed, flames, waterways, and drinking water. Do not store pesticides in places where flooding is possible or in places where they might spill or leak into wells, drains, groundwater, or surface water.
- Keep pesticide inventory as low as possible. Buy only what you need. Don't stockpile.
- Consider storing bottles inside a larger container that could contains potential leaks or spills.
- Never transfer pesticides to soft drink bottles or other containers. Children or others may mistake them for something to eat or drink.
- If you can't identify the contents of the container, or if you can't tell how old the contents are, follow best practices for safe disposal.

Best practices for **safe disposal** are indicated below.

- Avoid the need for disposal in the first place by
    - Mixing only enough pesticides for the job at hand;
    - Using up small amounts of excess pesticides -- apply them according to the directions on the label; and
    - If a household pesticide user, asking your neighbors if they have a similar pest control problem and can use the product if you cannot use it up.
- Follow all disposal instructions on the pesticide label.
- If you are a household pesticide user, check with your local solid waste management authority, environmental agency or health department to find out whether your community has a HHW collection program or a similar program for getting rid of unwanted, leftover pesticides. These authorities can also inform you of any local requirements as state and local pesticide disposal laws may be stricter than the federal requirements on the label. You can also contact Earth 911 at 1-800-CLEANUP or www.earth911.com for assistance.
- Do not pour leftover pesticides down the sink, into the toilet, or down a sewer or street drain. Pesticides can interfere with operation of wastewater treatment systems or pollute waterways. If pesticides reach waterways, they may harm fish, plants, and other living things.
- Many communities have programs to recycle empty bottles and cans. Do not recycle any pesticide containers, however, unless the recycling program specifically accepts pesticide

containers and you follow the program's instructions for preparing the empty containers for collection. Never reuse empty pesticide containers as residues can contaminate the new contents.

VI. POTENTIAL STRATEGIES RELATED TO PROJECT GOALS

This section presents potential strategies related to the project goals listed in Section I to improve the management of discarded pesticides. The potential strategies described below were raised in response to PSI's December 2016 survey on post-consumer pesticide management problems and solutions, during PSI's 2017 stakeholder interviews, and as part of PSI's National Pesticide Stewardship Webinar Discussion in July 2017. These potential strategies are presented for the purpose of engaging stakeholders in a productive discussion about how to enhance the management of discarded pesticides.

Goal 1: Increase Amount of Safely Managed Discarded Pesticides, including Uncontrolled Stockpiles

Strategies to increase the amount of safely managed discarded pesticides include the following: 1) improve collection infrastructure and performance; 2) increase awareness and education; 3) establish performance measures and compile improved data on existing stocks of discarded pesticides; and 4) address regulatory barriers and enforcement.

Improve Collection Infrastructure and Performance

The following strategies can potentially improve the collection infrastructure for both discarded pesticides and containers.

Strategy #1. Conduct research to determine gaps in collection infrastructure for households, agricultural, and industrial/commercial/government. National data regarding the current collection infrastructure (permanent facilities and programs, collection events, and intermittent programs) for discarded pesticides and containers will help determine the existing level of convenience and the gaps in that convenience that contribute to environmental and public health risks associated with lack of options for proper disposal

Strategy #2: Increase collection convenience. Collection convenience includes the number of collection sites per population size or geographic area, as well as the effectiveness of existing sites. Approaches to increasing this convenience might include developing voluntary industry standards or establishing legislative requirements. The following options could help to achieve this strategy:

- **Increase the number of municipal/county sites collecting discarded pesticides and empty containers.** This strategy could also help increase collections in rural areas.
- **Increase the number of collection events.**
- **Provide local "harmonized" collection.** Encourage state and local governments and existing stewardship organizations (e.g., PaintCare, Call2Recycle, Thermostat Recycling Corporation, etc.) to collaborate to provide annual "bundled" events in very remote (especially "underserved") areas.
- **Encourage or require agricultural retailers/pesticide dealers to collect discarded pesticides and empty containers.**
- **An example of a possible standard**, which is included in product stewardship programs in North America is the following[39]:

- In *urban areas*, facilities should be within approximately 15 minutes traveling distance from any point.
- In *rural areas*, a radius of approximately 30 miles is appropriate spacing for facilities or annual events.
- In *remote areas*, other standards may be proposed. Initiatives such as special collection events may be appropriate.

Increase Awareness

Strategies to increase awareness related to discarded pesticide management are considered here in three main areas: (1) increase education and outreach on health and environmental risks; (2) increase education on collection locations; and (3) increase education related to pesticide purchase and use (e.g., preventing purchase of excessive quantities, use of alternatives, implementing integrated pest management, etc.).

Strategy #1: Increase education and outreach on the health and environmental risks of pesticides. Require pesticide manufacturers and retailers to include information about the health, safety, and environmental risks of inappropriate disposal as well as stockpiling in packaging and in store aisles where pesticides are sold. An effective outreach and education program will identify the target audience, develop a clear and simple message, use various methods to disseminate information, and solicit feedback on education efforts. Education on the health and environmental dangers of discarded pesticides may help increase collection and safe disposal of these materials.

Strategy #2: Increase education on the location of collection sites. Require pesticide manufacturers and retailers to include information about existing pesticide collection programs in stores where pesticides are sold. In general, high rates of safe waste disposal require that targeted participants know where and how to properly manage discarded hazardous material, that they are motivated to safely manage/dispose of waste, and that a convenient collection infrastructure be in place (whether collection sites, collection events, or other). The more aware participants are of where to safely dispose of waste and the easier (more convenient) it is to do so, the more such disposal will take place.

Strategy #3: Increase education on the benefits of limiting pesticide purchases, using pesticide alternatives, and applying different approaches to pest management. Using outreach to raise awareness of the importance of decreasing the use of pesticides is essential to addressing the pesticide management problem. Consumers as well as those in the agricultural and commercial/industrial sectors should be educated to avoid over purchase of pesticides, which generates unnecessary waste, is costly to dispose, and presents an avoidable risk to human health and the environment. The purchase of lower quantities of pesticides as well as use of alternatives can reduce the pesticide waste generation rate. Information about how to estimate appropriate quantities and purchase only what is needed and benefits of using alternative approaches to pest management (e.g., safer choices, natural gardening techniques, organic lawn management, and planting native vegetation) could help encourage more consumers to save money (through purchasing less) and protect human health and the environment.

For example, integrated pest management (IPM), in contrast to traditional pest control, which involves the routine application of pesticides, focuses on pest prevention and use of pesticides only as needed. IPM reduces the number of pests and pesticide applications while saving money and protecting human health.

Strategy #4. Develop a coordinated management and education strategy. Use of a consistent message and coordinated strategy can help increase program participation and collection of discarded pesticides and empty containers. Develop an education program regarding better purchasing practices, safe on-site management and transportation to collection events/facilities, and consider funding support for R&D and implementation of alternative and less toxic farming methods. This education strategy could be developed and implemented through a voluntary industry effort or through public policy.

Establish Performance Metrics for Program Success and Compile Relevant Data

Developing and establishing program success performance metrics for pesticide stewardship are an important component of any strategy to encourage progress towards a goal of increasing the collection of discarded pesticides. Table 5 below provides some general options for measuring program performance. Despite inherent challenges, it is important for policy makers and program operators to know how collection programs are performing, including the overall environmental benefits gained, program cost, and how program changes (such as increasing the number of collection sites, or a new promotional campaign) impact program performance.

Strategy #1: Conduct research to determine and establish viable performance metrics for pesticide stewardship. These metrics might include discarded pesticide generation rate (by sector – household, agriculture, etc.), number and magnitude of existing stockpiles, sales and use data (including for pesticide alternatives), data on the extent of the use of IPM, collection quantities of discarded pesticides and containers, reuse/re-distribution of pesticides, disposal of pesticides, recycle of pesticide containers, collection locations and events, and/or education and outreach effectiveness indicators. These measures can be used to establish a baseline for the current state of pesticide stewardship, help gauge changes over time, and assess strengths and weaknesses in the management of pesticides at end of life, which can be used to help identify recommendations for future action and improvement going forward. Research on Canadian programs may help in this regard.

Strategy #2: Compile data on discarded pesticide generation and existing stockpiles. Using the metrics identified above, begin to scope out the magnitude of the problem with respect to discarded pesticide management to help identify and quantify the need for increased collection of waste pesticides and empty containers, improved collection convenience, and enhanced and expanded education and outreach with respect to discarded pesticide management. Implementing a system to periodically compile this data from across the country would help advance understanding of program performance over time, and where challenges and opportunities for improvement may exist. Recordkeeping is essential to generate data and identify trends.

Strategy #3: Set measurable goals for discarded pesticide collection. Setting goals for the amount of discarded pesticides and empty containers that should be collected and appropriately disposed, reused, or recycled can help focus priorities for action (e.g., increase discarded pesticide collection X percent per year, recycling of X percent of containers purchased). Setting short- and long-term goals for safe disposal, reuse, and recycling can draw attention to the need for additional collection infrastructure

and/or outreach to promote discarded pesticide collection, as well as allowing for a dynamic vision for pesticide management that does not lock into a single approach. This work should be accomplished with agreed upon timelines and a method for monitoring the progress towards meeting the goals.

Table 5. General Options for Measuring Program Performance

	Description
Absolute collection	Measures total amount collected annually against a baseline year (either by number, by volume, or by weight).
Convenience	Measures convenience of recycling by number of collection sites, distance from point of sale, or density of collection sites per capita. Consider also number and frequency of events.
Recovery rate	Measures the total amount collected against the amount available for collection or amount placed on the market (for a specific year or average over several years). Using the amount available for collection requires estimates of product lifespan and hoarding.
Recycling rate	Measures the amount of material collected that is recycled out of the total amount available for collection.
Recycling efficiency	Measures the amount of material that is recycled after collection and during processing.
Collection compared to amount disposed	Compares the amount of material collected and recycled to the amount of material ending up in the waste stream.
Per capita collection	Divide total amount available for collection by the population.

Address Regulatory Barriers and Enforcement Needs

Strategy #1: Support the development of regulatory requirements that ban household disposal of pesticides within the solid waste stream and down the drain. Prohibiting improper disposal of HHW, including pesticides, would help provide supporting policy leverage for increased collection and safe disposal of these materials.

Strategy #2: Support greater harmonization of hazardous waste management regulations across U.S. states. This strategy could help decrease regulatory costs (for collectors, haulers, and disposal facilities as well as government oversight) without compromising environmental protection, improve efficiencies, streamline and make more consistent messaging for education and outreach, which could serve to increase collections.

Goal 2: Provide Adequate and Sustainable Funding to Increase Percentage of Safely Managed Discarded Pesticides and Reduce Costs Incurred by State and Local Governments.

As mentioned previously, the majority of states have state-run pesticide disposal programs, many of which do not have dedicated funding and operate only intermittently. Funding for these programs comes from enforcement settlements, state environmental funds, state toxics control accounts, annual state pesticide registration fees, cost sharing between large farms and businesses, and/or EPA grants. Local government HHW facilities also share the financial burden of pesticide disposal by collecting and paying for the proper end-of-life management of discarded pesticides from residents. Even for those states with pesticide registration fees, challenges exist related to use of these for discarded pesticide management. Additional and sustainable funding dedicated to pesticide end-of-life management can allow for a larger and more convenient collection infrastructure and greater outreach and education,

which, in turn, can increase collection and reduce the generation and improper disposal of unwanted pesticides.

Strategy #1: More effective use and expansion of pesticide registration fee. Given the variety of products, entities, and activities currently covered by different state pesticide registration fees, a focused consideration of directing adequate and consistent funding towards discarded pesticide and empty container management and education for, at a minimum, residents and farmers, should be pursued. A harmonized approach across the states would also provide consistent and efficient messaging for consumers. Funds could be distributed based on a negotiated agreement among stakeholders representative of the key interest groups in a state. Funding would follow priority strategies agreed to as part of this dialogue process. Such a mechanism could lead to greater commitment from stakeholders to a full package of options rather than staying focused on their own particular interests. The goal of the funding strategies would be to work towards a sustainable pesticide disposal infrastructure, and fund program priorities set by the state and other participants. Stakeholders would need to develop a process for updating priorities and evaluating projects and funding allocations.

Strategy #2: Explore the potential for extended producer responsibility (EPR) to provide sustainable funding, including developing a third-party stewardship organization (SO) that can provide cost-effective system management. As part of this effort, consider how EPR could complement or take the place of state pesticide disposal programs in which pesticide registration fees are used to fund discarded pesticide end-of-life management. EPR is a mandatory type of product stewardship that includes, at a minimum, the requirement that the producer's responsibility for their product extends to post-consumer management of that product and its packaging. There are two related features of EPR policy: (1) shifting financial and management responsibility, with government oversight, upstream to the producer and away from the public sector; and (2) providing incentives to producers to incorporate environmental considerations into the design of their products and packaging (for more information, see *Product Stewardship and Extended Producer Responsibility: Definitions and Principles* and *Elements of an Extended Producer Responsibility (EPR) Bill* in Appendix A).

EPR laws for a variety of consumer products have provided sustainable funding, increased the collection of discarded material, and created green jobs in many states across the U.S. In Canada, three EPR for HHW programs currently accept pesticides from residents. Research on these programs could help inform the development of such a program in the U.S. (note that in Oregon, a bill has been introduced to develop and implement this type of program). An SO, composed primarily of pesticide industry officials, with a multi-stakeholder advisory panel could manage the pesticide infrastructure system and other critical initiatives. The SO could also function as the fund manager, keeping government out of fund collection and distribution. Government could maintain its planning and enforcement role and set overall system goals. Having a third-party organization manage the fund could ensure that pesticide registration fees are not raided to meet state general fund needs. For states with existing government-managed fee-based systems, research would be needed to determine how an SO could be integrated into the existing system. It is possible that an SO could serve a function other than collecting and distributing fees, such as on education, contracting for collection and disposal services, and other tasks. In other product stewardship initiatives, a third-party organization oversees all funding and programs and helps set, meet, and evaluate goals. Whether led by the state or an independent organization, evaluating the fee on a regular basis and setting and working towards reaching goals will ensure that adequate funding is available and spent to meet predetermined goals for safe pesticide disposal and diversion from landfills.

Further Research to Support Strategies that Can Advance Goals 1 and 2

Further research is critical to further understanding issues and identifying potential solutions related to pesticide end-of-life management. The following possibilities to help advance pesticide stewardship should be considered, expanded upon (with additional suggestions), and prioritized for funding and action:

- Research to fill important data gaps on pesticide management and flow, including:
    - The extent to which the pesticide registration fee in each state is helping to fund collection and disposal of discarded pesticides, and the products that fall within the scope of these funds (e.g., ag, households, commercial businesses, etc.) to determine the degree of need for additional and sustainable financing for pesticide collection and disposal. In addition, it will be important to understand where the authority lies for determining whether a portion of the fees can fund disposal and what flexibility there is in that decision-making.
    - Collection of data regarding discarded household pesticide containers (e.g., what is available to be collected and what is being collected) to determine the extent to which further action (and type of action) needs to be taken on this issue.
    - National data regarding the current collection infrastructure (permanent facilities and programs, collection events, and intermittent programs) for discarded pesticides and containers to identify the existing level of convenience and the gaps in that convenience.
    - Data estimates on the number, magnitude, and types of materials being kept in stockpiles in each state to understand the scope of this problem.
- Examine how stewardship organizations could be integrated into existing government-run fee programs in the U.S.
- Review EPR and other Canadian programs that address pesticides and empty pesticide containers to learn from their experiences, including challenges and opportunities, in implementing pesticide stewardship programs.
- Review state programs that are identified as potential models in the use of pesticide registration fees to support pesticide disposal. As part of this effort, also research the emergence and implementation of each state's current funding source for pesticide disposal to understand and learn about successes and challenges associated with the alternative ways that states have approached this problem.
- Identify gaps and challenges in existing outreach and programs on safer pesticide alternatives and alternative approaches to pesticide management, as well as identification of opportunities to extend the reach and effectiveness of these programs. More information is needed on: 1) the reasons people are not bringing discarded pesticides and/or containers to collection locations for recycling and proper disposal; and 2) what is being done with these materials (e.g., stockpiling, improper disposal, etc.).
- Consider the implications of national pesticide policy and management strategy if the Pesticide Registration Improvement Act (PRIA), set to expire on September 30, 2017, is weakened or fails to be re-authorized by the current administration. As mentioned above, the PRIA was designed to facilitate and accelerate the pesticide review process by establishing specific timelines for regulatory decision-making and to require registration and annual maintenance fees be paid by manufacturers to EPA for conducting registration and review activities.

Endnotes

[1] including local solid waste management officials, public health representatives, and state environmental agency and department of agriculture officials

[2] The Pesticide Stewardship Alliance. 2017. State Pesticide Disposal Database – Map & Contact Info, accessed at http://tpsalliance.org/resources/state-disposal-map/ on March 16, 2017.

[3] Friesen, Barry. CleanFARMS. August 15, 2017, Email Communication.

[4] Ag Container Recycling Council. 2016. ACRC Calculation of Overall Recycling Rate of Plastic Used for Packaging Liquid Formulated Pesticide, March 21, 2016, accessed at http://www.acrecycle.org/News.

[5] Pesticides, under FIFRA, do not include "new animal drugs" or "liquid chemical sterilant products for use on a critical or semi-critical device which is introduced directly into the human body.

[6] U.S. Environmental Protection Agency. 2017. *Types of Pesticide Ingredients*. January 23, 2017. Accessed at https://www.epa.gov/ingredients-used-pesticide-products/types-pesticide-ingredients.

[7] Mowry, J.B., et al. 2016. 2015 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 33rd Annual Report, *Clinical Toxicology*, 54:10, 924-110, DOI: 10.1080/15563650.2016.1245421, accessed at https://aapcc.s3.amazonaws.com/pdfs/annual_reports/2015_AAPCC_NPDS_Annual_Report_33rd_PDF.pdf

[8] Ibid.

[9] Ibid.

[10] Stone, Wesley W., Robert J. Gilliom, and Karen R. Ryberg, 2014, Pesticides in U.S. Streams and Rivers: Occurrence and Trends during 1992–2011, *Environmental Science & Technology*, 48 (19), pp. 11025–11030.

[11] U.S. EPA, Pesticides and Public Health, March 30, 2017.

[12] Producers are companies that manufacture and formulate pesticides. Major producers are those that hold the technical pesticide registrations. Other producers do not hold the technical pesticide registrations and tend to sell generic or store brand pesticides. Formulators develop the pesticide product from the active ingredient. Distributors sell the pesticide products. Establishments are defined as any place where a pesticide or device or active ingredient used in producing a pesticide is produced, or held, for distribution or sale. (Sims, Diann. U.S. Environmental Protection Agency, 2017. Personal communication on June 27, 2017; Atwood, Donald, and Claire Paisley-Jones. 2017. *Pesticides Industry Sales and Usage: 2008-2012 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. EPA.)

[13] Krohnfeldt, Jeff. 2016. Top 5 Pesticide Companies in the World (SYT, DOW). Investopedia. August 25, 2016.

[14] Exterminating and Pest Control Firms are those commercial pest control firms that serve residential and business customers. Private Certified Applicators primarily refers to farmers or other persons producing an agricultural commodity and using restricted-use pesticides (RUPs). Commercial certified applicators refer to professional pesticide applicators. (Sims, Diann. U.S. Environmental Protection Agency, 2017. Personal communication on June 27, 2017; Atwood, Donald, and Claire Paisley-Jones. 2017. *Pesticides Industry Sales and Usage: 2008-2012 Market Estimates*, Biological and Economic Analysis Division, Office of Pesticide Programs, Office of Chemical Safety and Pollution Prevention, U.S. EPA.)

[15] Schierow, Linda-Jo, and Robert Esworthy. 2012. Pesticide Law: A Summary of the Statutes. Congressional Research Service, 7-5700, RL31921, CRS Report for Congress, November 14, 2012.

[16] United States Environmental Protection Agency, 2002. Clean Sweep Report 2001 Without Appendices: State and Local Government Achievements in Disposal of Agricultural Waste Pesticides. Office of Pesticide Programs, United States Environmental Protection Agency, Washington, DC. EPA 735-R-02-001, May 2002.

[17] Minnesota Department of Agriculture, 2016, Waste Pesticide Collection Program: Legislative Report, March 6, 2017.

[18] Cascadia Consulting Group, *Producer Responsibility Scenario Analysis: Product Stewardship in Oregon and Expected Implications for Metro's Hazardous Waste Program*, December 2012.

[19] Ibid.

[20] Quinn, Jim. 2017. *HHW Program Perspective – Metro, OR.* Presented on PSI National Pesticide Stewardship Webinar Discussion, July 10, 2017.

[21] Volkman, Jennifer. 2007. *Partners: Household Hazardous Waste and Agriculture Pesticide Programs.* Presented at the 2007 North American Hazardous Materials Management Association (NAHMMA) Conference, October 8-12, 2007, San Diego, CA.

[22] Florida Department of Environmental Protection. 2016. Cleansweep-Pesticides Background and History webpage, November 4, 2016, accessed at http://www.dep.state.fl.us/waste/categories/cleansweep-pesticides/pages/backgroundhistory.htm.

[23] U.S. EPA, Prevention, Pesticides, and Toxic Substances, Citizen's Guide to Pest Control and Pesticide Safety, EPA 735-K-04-002, March 2005.

[24] In general, FIFRA regulates antimicrobial substances used on inanimate surfaces and FFDCA regulates antimicrobial substances used in or on living animals or humans (e.g., human or animal drugs, antiseptics, liquid chemical sterilants used on medical devices, etc.). Some antimicrobials are regulated by both FIFRA and FFDCA because they involve direct or indirect food uses, or use on food contact surfaces (see U.S. EPA, Pesticide Registration Manual: Chapter 4 - Additional Considerations for Antimicrobial Products, June 23, 2016.)

[25] Before EPA registers a pesticide, the applicant must show that using the pesticide "will not generally cause unreasonable adverse effects on the environment.'' FIFRA defines the term ''unreasonable adverse effects on the environment'' to mean: ''(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act.'" (From EPA's website, Summary of the Federal Insecticide, Fungicide, and Rodenticide Act, last updated on January 10, 2017.)

[26] U.S. EPA, About Pesticide Registration. September 1, 2016.

[27] U.S. Environmental Protection Agency. 2017. *Safe Disposal of Pesticides*. May 23, 2017. Accessed at https://www.epa.gov/safepestcontrol/safe-disposal-pesticides.

[28] ISSA—The Worldwide Cleaning Industry Association. 2014. ISSA State Pesticide Registration Survey, February 2014, Lincolnwood, IL.

[29] The Pesticide Stewardship Alliance. 2017. State Pesticide Disposal Database – Map & Contact Info, accessed at http://tpsalliance.org/resources/state-disposal-map/ on March 16, 2017.

[30] California Department of Pesticide Regulation. Undated. Pesticide Container Recycling Program for Registrants of Agricultural/Structural Use Products Web Page.

[31] California Department of Pesticide Regulation. Undated. Annual Pounds of Plastic Collected in California; Email communication with Ron Perkins, Ag Container Recycling Council, June 7, 2017.

[32] Stewardship Ontario, 2015, 2015 Annual Report.

[33] Product Care Association. 2016. Product Care Association Paint and Household Hazardous Waste Annual Report to the Director 2015. June 30, 2016.

[34] CleanFARMS, 2015, AG Stewardship in Action: Annual Report 2015.

[35] Ibid.

[36] Perkins, Ron. 2017. *Pesticide Container Stewardship - Ag Container Recycling Council (ACRC).* Presented on PSI National Pesticide Stewardship Webinar Discussion, July 10, 2017.

[37] Ag Container Recycling Council. 2015. Ag Container Recycling Council 2015 Fact Sheet.

[38] Perkins, Ron. Ag Container Recycling Council. June 22, 2017, Email Communication.

[39] Government of Manitoba. 2011. *Household Hazardous Material and Prescribed Material Stewardship Guideline*, Guideline 2010-01E, May 2011.

APPENDIX A

PRODUCT STEWARDSHIP AND EXTENDED PRODUCER RESPONSIBILITY: DEFINITIONS AND PRINCIPLES

Reducing Economic, Environmental, Health, and Safety Impacts from Consumer Products
March 21, 2012

The growing product stewardship movement in the United States seeks to ensure that those who design, manufacture, sell, and use consumer products take responsibility for reducing negative impacts to the economy, environment, public health, and worker safety. These impacts can occur throughout the lifecycle of a product and its packaging, and are associated with energy and materials consumption; waste generation; toxic substances; greenhouse gases; and other air and water emissions. In a product stewardship approach, manufacturers that design products and specify packaging have the greatest ability, and therefore greatest responsibility, to reduce these impacts by attempting to incorporate the full lifecycle costs into the cost of doing business.

The terms product stewardship and extended producer responsibility (EPR) are often used differently by stakeholders involved in the product stewardship movement. The purpose of this document is to harmonize terminology in the U.S. and to guide development of policies, legislation, and other initiatives by governments, companies, and other organizations. By speaking the same language, we can have a constructive public discussion.

We use the following definitions for product stewardship and EPR. Since we define EPR as a legislative approach, we believe it requires further clarification and therefore developed the subsequent *Principles of Extended Producer Responsibility*.

Product Stewardship is the act of minimizing health, safety, environmental and social impacts, and maximizing economic benefits of a product and its packaging throughout all lifecycle stages. The producer of the product has the greatest ability to minimize adverse impacts, but other stakeholders, such as suppliers, retailers, and consumers, also play a role. Stewardship can be either voluntary or required by law.

Extended Producer Responsibility (EPR) is a mandatory type of product stewardship that includes, at a minimum, the requirement that the producer's responsibility for their product extends to post-consumer management of that product and its packaging. There are two related features of EPR policy: (1) shifting financial and management responsibility, with government oversight, upstream to the

producer and away from the public sector; and (2) providing incentives to producers to incorporate environmental considerations into the design of their products and packaging.

PRINCIPLES OF EXTENDED PRODUCER RESPONSIBILITY

The following EPR Principles include key elements that should be included in all EPR legislation. Although these Principles will be applied differently by different jurisdictions, they are aspirational and considered best practice to achieve maximum results.

- **Producer Responsibility**
    - Producers are required to design, manage, and finance programs for end-of-life management of their products and packaging as a condition of sale. These programs may or may not use existing collection and processing infrastructure. Programs should cover all products in a given category, including those from companies no longer in business and from companies that cannot be identified.
- **Level Playing Field**
    - All producers within a particular product category have the same requirements, whether they choose to meet them individually or jointly with other producers.
- **Results-based**
    - Producers have flexibility to design the product management system to meet the performance goals established by government, with minimum government involvement.
    - Producer-managed systems must follow the resource conservation hierarchy of reduce, reuse, recycle, and beneficially use, as appropriate.
    - Products must be managed in a manner that is protective of human health and the environment.
    - Producers design and implement public education programs to ensure achievement of performance goals and standards established by government.
    - All consumers have convenient access to collection opportunities without charge.
- **Transparency and Accountability**
    - Government is responsible for ensuring that producer programs are transparent and accountable to the public.
    - Producer programs, including their development and the fate of products managed, provide opportunity for input by all stakeholders.
- **Roles for Government, Retailers and Consumers**
    - Government is responsible for ensuring a level playing field for all parties in the product value chain to maintain a competitive marketplace with open access to all, for setting and enforcing performance goals and standards, for supporting industry programs through procurement, and for helping educate the public.

- Retailers only sell brands within a covered product category that are made by producers participating in an industry program, and are responsible for providing information to consumers on how to access the programs.
- Consumers have a responsibility to reduce waste, reuse products, use take-back and other collection programs, and make appropriate purchasing decisions based on available information about product impacts and benefits.

APPENDIX B

NATIONAL PESTICIDE STEWARDSHIP WEBINAR DISCUSSION NOTES

Meeting Overview

On July 10th, 2017, PSI convened the National Pesticide Stewardship Webinar Discussion. In this two-hour webinar discussion, government and industry speakers from the U.S. and Canada assessed the problem of leftover pesticides, identified goals for improving their management, and discussed potential solutions. The webinar included 86 participants from 23 U.S. states and three Canadian provinces, including representatives from industry as well as federal, state/provincial, and local government (environmental protection, health, public works, agriculture, and pesticide regulation departments). The Draft Pesticide Stewardship Briefing Document served as the basis for discussion. PSI has finalized this document based on the webinar discussion and participant feedback.

Speaker Presentations

Speakers included Jim Quinn, Metro, Oregon; Kevin Neal, Office of Indiana State Chemist and The Pesticide Stewardship Alliance; Ron Perkins, Ag Container Recycling Council; Barry Friesen, CleanFARMS; and Mark Kurschner, Product Care. These experts provided an overview of existing waste pesticide and container collection and management programs, the problems with pesticides, quantities currently collected, the costs of collection, industry's role in pesticide management, pesticide stewardship goals, barriers to achieving goals, solutions to overcoming those barriers, and potential sources of sustainable funding for collection and safe disposal, including extended producer responsibility (EPR). The speakers also covered the Canadian EPR model for pesticide stewardship and proposed legislation for EPR for household hazardous waste (HHW) that includes pesticides, in Oregon.

Q&A Session

Following speaker presentations, attendees participated in a Q&A session. Call participants asked questions and provided comments concerning specific program details, pesticides management, manufacturers' roles and participation, and potential support for EPR legislation.

Overview of Draft Pesticide Stewardship Briefing Document

After the Q&A session, Suna Bayrakal of the Product Stewardship Institute introduced the Draft Pesticide Stewardship Briefing Document. She described the methodology and data, then explained the goals of the briefing document and the webinar discussion. The Pesticides Stewardship Briefing Document is expected to serve as a basis for future discussions on end-of-life pesticide stewardship in the United States.

Discussion

After questions about the Draft Pesticide Stewardship Briefing Document were addressed, webinar speakers and participants entered an hour-long discussion, which focused on the key issues and barriers to sustainable pesticide management in the U.S and solutions to those barriers. There was general consensus that more information to fill data gaps would help better characterize the problem of pesticide management, pesticide product stockpiles, lack of convenient take-back options, lack of education about proper purchasing and disposal, and lack of adequate funding.

There was debate as to whether goals for pesticide stewardship should include the full lifecycle or focus on end of life management. Attendees discussed the merits of focusing on residential pesticides, agricultural pesticides, and/or industry sources of unwanted pesticides. Call participants also pointed

out that goals should include curtailing excess pesticide purchases, sustainable funding, and involving manufacturers in the improvement of pesticide management, including the need for industry leadership in this area.

To achieve goals for pesticide stewardship, call participants discussed the need for updated labeling about proper disposal on pesticide containers (e.g., discouraging open burning and promote recycling), convenient safe disposal options, and motivators for businesses and farmers to turn in pesticides (including products that have been banned after the time of purchase). One participant also advised against relying on state budgets for sustainable funding, given experience with recent state budget crises.

Participants were given until Monday, July 24th (two weeks following the webinar) to provide additional comments, questions, revisions, or other feedback regarding the Draft Pesticide Stewardship Briefing Document.