Final Report

Reducing Persistent Pollutants in Oregon's Waters: SB 737 Legislative Report

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State of Oregon
Department of Environmental Quality

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Executive Summary

Summary

Many Oregonians are concerned about the health of Oregon's waters and the people who use them. There's also growing concern about persistent pollutants – those that come from a wide variety of sources but linger in the environment and have a documented effect on human health, wildlife and aquatic habitat. These pollutants are the chemical remnants of manufactured goods we use and dispose of every day. Many of these chemicals end up in our waters, where they persist and travel up through the food chain, in some cases having long-term effects on people and the environment. This report summarizes Oregon's first effort to comprehensively evaluate which of these pollutants should be a priority to address, and lists a variety of measures that state and local governments, businesses and citizens can take to reduce their presence in Oregon's waters.

Background

The 2007 Oregon Legislature directed the Oregon Department of Environmental Quality to compile a prioritized list of persistent pollutants (the P3 List) to guide Oregon's pollution prevention efforts. Senate Bill 737 contains specific requirements for DEQ that included submitting a priority list of persistent pollutants to the Legislature by June 1, 2009, and reporting on the sources and pathways of these pollutants in June 2010. The legislation also requires Oregon's 52 large municipal wastewater treatment plants to develop plans to reduce the presence of those persistent pollutants detected in their effluent above levels set by the Oregon Environmental Quality Commission. Municipalities must submit Persistent Pollutant Reduction Plans to DEQ by July 1, 2011.

Scope

This report identifies potential local, regional and global sources of persistent pollutants that may contribute to water pollution in Oregon. In addition, this report outlines measures that could be implemented by state and local governments, non-governmental organizations, businesses, industries, manufacturers and individual citizens to reduce the presence of persistent pollutants in Oregon's waters.

Addressing Pollutants with Greatest Potential to Cause Harm

All persistent pollutants on the P3 List can potentially harm human health or aquatic life if they enter the water. While information exists on many of the P3 pollutants, definitive information on some is limited, especially information about how these pollutants move through the environment and affect human health and the environment.

In determining which persistent pollutants have the greatest potential to cause harm, DEQ assessed scientific evidence on each pollutant's potential to harm human health or aquatic life in Oregon relative to other pollutants on the P3 List. In addition DEQ considered the following questions: Is the pollutant widely used? Has the pollutant been detected in Oregon's waters? Has it also been detected in fish tissues, human blood or stream sediments?

Through research on each persistent pollutant, DEQ discovered that groups of pollutants with similar chemical properties and uses often have comparable potential to cause harm and similar opportunities for pollutant reduction measures.

- Many substances used today, including flame retardants and surface protectants such as non-stick coatings on cookware, show characteristics similar to "legacy" pollutants (i.e. DDT) that are no longer produced but persist in the environment and may accumulate in animal tissues. While information on the environmental effects of flame retardants and similar modern-day substances is far from complete, DEQ has enough information to conclude that these substances, as pollutants, may have serious, long-lasting environmental health impacts and thus warrant consideration for immediate reduction.
- Some very toxic persistent pollutants are widely produced and used and have been found in the environment in low concentrations. Information about many of these pollutants, including several types of metals and combustion byproducts is available because they are already monitored under state water quality standards and water quality permits. Efforts to reduce several of these pollutants (such as polycyclic aromatic hydrocarbons, mercury, lead and cadmium) are already underway in Oregon through water quality pollution reduction plans for certain rivers and streams (i.e. Total Maximum Daily Load limits), various permit restrictions and other means.
- Many pesticides currently used for commercial agriculture and forestry, landscaping and urban residential weed/pest control can potentially cause harm if they get into water after use.
- While no longer in active use, legacy pollutants still have the potential to cause harm. Pollutants in this category include the long-banned pesticide DDT and other pollutants no longer produced or used. These pollutants linger in the environment for years, often becoming embedded in soils and sediments in or near streams and rivers. They can be "re-released" into water bodies by physical disturbances such as dredging or streamside construction work and logging.

Pollution Prevention Makes Sense

The most effective way to reduce pollution is through prevention that targets chemical pollutants at the source. In general, prevention measures are less expensive and more effective, efficient and reliable than treating, recycling or cleaning up pollutants after use. Everyone - homeowners, industries and local governments alike - can help reduce persistent pollutants in Oregon's waters. DEQ will focus on strategic planning, strengthened by collaboration and partnerships with industry and local governments, to reduce the amount of persistent pollutants in our bodies and in our environment.

The following are examples of reduction measures considered in this report:

- Chemical replacement and phase-outs of certain pollutants when viable, safer alternatives are identified
- Public education about the risks of exposure to persistent pollutants
- Product labeling and environmental certification programs for products that do not contain persistent pollutants
- Required disclosure of product ingredients
- Bans and restrictions on certain pollutants

- Pollution prevention partnerships with chemical and product producers to reduce the use of certain persistent pollutants in products
- Regulatory, voluntary or incentive-based approaches to improve stormwater controls in urban areas, and targeted erosion control measures in rural and urban areas, to reduce persistent pollutants entering surface waters from runoff
- Collection events and education on proper disposal
- Required producer responsibility for the full life-cycle of a pollutant
- Restrictions on residential, agricultural and forestry burning
- Activities such as assessments to identify specific contaminated sites and monitoring to measure effectiveness of reduction activities
- Comprehensive pollution prevention, addressing pollutants holistically rather than on a pollutant-by-pollutant basis.

Conclusion

This DEQ report focuses on the persistent pollutants that pose potential and known threats to human and aquatic life if they enter Oregon's waters. It concludes that pollution prevention activities to address priority persistent pollutants should be an essential component of environmental programs at DEQ and elsewhere. All Oregonians can take steps to limit the generation of, exposure to, and movement of these pollutants. Information in this report can provide a basis for continuing discussions about identifying and reducing priority persistent pollutants in Oregon's waters. Additionally, this report contributes significantly to DEQ's work with Oregonians to develop a comprehensive toxics reduction strategy for the State of Oregon and our environment.

1 Introduction

1.1 Background

The 2007 Oregon Legislature passed Senate Bill 737 (See ORS 468B.138 and Attachment 1), which requires DEQ to: (1) by June 2009, consult with all interested parties to develop a list of priority persistent bioaccumulative toxics ("persistent pollutants") that have a documented effect on human health, wildlife and aquatic life, and (2) by June 2010, report to the Legislature on the list of priority persistent pollutants; including point, nonpoint and legacy sources of priority persistent pollutants, as identified from existing data; and source reduction and control methods that can reduce discharges to Oregon's waters. SB 737 also requires: (3) Oregon's 52 largest municipal wastewater treatment plants ("permittees") to develop plans by July 2011 aimed at reducing priority persistent pollutants through pollution prevention and toxics reduction.

This report fulfills the second requirement of the statute.

1.2 Legislative Report Requirements

Senate Bill 737 outlines specific information for inclusion in this report. The statute states that "…the Department of Environmental Quality (DEQ) shall conduct a study of persistent pollutants discharged in the State of Oregon and report the results of that study to an appropriate interim committee of the Legislative Assembly related to the environment by June 1, 2010."[1] The statute specifies that the department's report include the following components:

(a) A priority listing of persistent pollutants (P3 List) that pose a threat to the waters of this state.[2] DEQ finalized this list in October 2009 (see Attachment 2).

(b) Identification of individual point, nonpoint and legacy sources of priority-listed persistent pollutants from existing data, including an analysis identifying the quantity, concentration and volume of such pollutants discharged by individual sources on an annual basis.[3]

(c) An evaluation and assessment of source reduction and technological control measures that can reduce the discharge of persistent pollutants into the waters of the state, including an assessment of the costs and effectiveness of such measures and which measures should be prioritized for reducing such pollutants.[4]

The statute further directs that "the department shall consult with interested local and tribal governments, state and federal agencies and other private organizations in preparing the report."[5]

This report is organized in a sequence that mirrors these statutory requirements. Chapter 2 describes the P3 List; Chapter 3 describes potential sources of persistent pollutants to water; Chapter 4 provides more detail about specific sources of each persistent pollutant;

[1] ORS 468B.139(1)
[2] ORS 468B.139(2)(a)
[3] ORS 468B.139(2)(b)
[4] ORS 468B.139(2)(c)
[5] ORS 468B.139(4)

and Chapter 5 details the process DEQ used to identify, evaluate, and assess reduction measures. Each chapter describes the specific processes DEQ used to gather and assess information, including public and stakeholder/advisory committee input, and provides a summary of conclusions.

1.3 Next Steps to implement SB 737

Rulemaking to Establish 'Trigger Levels"

SB 737 requires Oregon's 52 largest municipal wastewater treatment plants to develop Persistent Pollutant Reduction Plans by July 2011 aimed at reducing priority persistent pollutants detected in effluent above the drinking water the Maximum Contaminant Level (MCL) or that the Environmental Quality Commission determines should be included.[6] In order for DEQ and municipalities subject to SB 737 to identify the scope of their Persistent Pollutant Reduction Plans, DEQ proposed "trigger levels" as a quantitative method to determine which priority pollutants will be addressed by the Persistent Pollutant Reduction Plans. DEQ developed a proposed rule that identifies the numeric concentration of a pollutant in effluent that could serve as the "trigger level" for inclusion in Persistent Pollutant Reduction Plans for each pollutant on the P3 List. The rulemaking process began in October 2009, and DEQ held four public hearings across Oregon in January 2010 to solicit public input on this proposed rule. DEQ evaluated comments received and incorporated modifications to the proposed rule language where appropriate. DEQ will bring the proposed rule to the Environmental Quality Commission for adoption on June 17, 2010.

Effluent Screening by Municipalities

As soon as trigger levels are established in rule, the 52 largest municipal wastewater treatment plants will begin testing their effluent for priority persistent pollutants. These sampling efforts will enable municipalities to determine whether any of the trigger levels have been exceeded, and if so, prepare and submit Persistent Pollutant Reduction Plans by the July 2011 deadline. DEQ is working with municipalities to plan coordinated sampling and analysis for two sampling events. This municipal effluent screening is not described as a recurring event in the statute. Rather, effluent screening will provide individual wastewater treatment facilities a specific listing of persistent pollutants that must be addressed by their Persistent Pollutant Reduction Plan.

Persistent Pollutant Reduction Plans

SB 737 requires municipal wastewater treatment plants (WWTPs) to submit Persistent Pollutant Reduction Plans which include, but are not limited to: (a) A specific description of the concentrations and estimated annual quantity of persistent pollutants that are discharged, based on water quality sampling data; (b) The identification of measures to reduce the discharge of persistent pollutants; and (c) The identification of focused goals for reduction of persistent pollutants.[7] DEQ will be developing guidelines addressing the types of specific reduction measures that will be included in Persistent Pollutant Reduction Plans due July 2011. DEQ is working with municipalities on this effort.

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[6] ORS 468B.140(1)(a)

[7] ORS 468B.140(2)(a) - ORS 468B.140(2)(c)

Public Involvement

DEQ is continually committed to using a collaborative approach during every phase of the project, including consultation with interested parties through the project's completion. To communicate specific opportunities broadly, DEQ uses an electronic mailing list to notify interested parties.[8]

1.4 DEQ's Toxics Reduction Strategy

Shortly after the Oregon Legislature passed SB 737, DEQ initiated work on a comprehensive, integrated approach to address toxic pollutants in the environment, called the Toxics Reduction Strategy (or Toxics Strategy). This integrated strategy will help ensure that DEQ is addressing the problem of toxic chemicals in the environment in the most effective and efficient way. It will contain recommendations for activities to reduce the burden of toxic chemicals on humans and ecological life in Oregon. These recommendations will encompass all relevant DEQ programs (in the Air Quality, Land Quality, Water Quality and Laboratory and Environmental Assessment Divisions) and make linkages to related programs implemented by other agencies. DEQ's Toxics Strategy reflects the Department's commitment to:

- Optimize agency resources by focusing on the highest priority pollutants in a coordinated way and developing strategies that reduce multiple pollutants;
- Implement actions that reduce toxic pollutants at the source whenever feasible;
- Establish partnerships with other agencies and organizations to increase the effective use of public and private resources;
- Use environmental outcome metrics to measure the effectiveness of strategy implementation where feasible; and
- Build on existing effective toxic pollutant reduction programs when possible.

DEQ formed an external stakeholder group to help develop the Toxics Strategy, and plans to complete a draft of the strategy by fall 2010. The draft Strategy will then be shared broadly to gather input from the public on the recommended actions.

There are many parallels between the requirements for this report and DEQ's Toxics Reduction Strategy. Both projects identify priority pollutants, identify sources of those pollutants, and use a collaborative approach to identify effective reduction measures. Many of SB 737's priority persistent pollutants are included in DEQ's agency-wide toxics focus list used in the Strategy. However, because the scope of these two Department efforts are different, some Priority Persistent Pollutants are not on the agency's Focus List and some Focus List pollutants are not on the Priority Persistent Pollutant List. For example, the Toxics Reduction Strategy addresses pollutants that are not known to persist or bioaccumulate but may nevertheless have significant potential impacts on human health and the environment. The Focus List also reflects the priorities of DEQ's Air and Land Quality Divisions, as well as surface and groundwater concerns. Where possible, DEQ has aimed to coordinate the efforts of these two programs to enhance the efficiency and effectiveness of each.

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[8] http://www.deq.state.or.us/wq/SB737

2 Priority Persistent Pollutant List (P3 List)

2.1 DEQ's Process to Develop a Priority Persistent Pollutant List

Timeline

Senate Bill 737 set specific requirements for DEQ to follow in compiling the Priority Persistent Pollutant List (P3 List). The statute required DEQ to present a list of priority persistent pollutants to the Legislature by June 1, 2009. An Interim Final P3 List was submitted to the Legislature at that time. From June through July 2009, DEQ provided the public an opportunity to submit additional information on certain pollutants; information relevant to the pollutants' behavior in sediment, overall persistence, degradation rates, toxicity to humans, bioaccumulation in fish or measurements in water, sediment, or fish tissue. DEQ evaluated all information received and released a final P3 List in October 2009.

Persistent Pollutant Science Workgroup

To develop the P3 List, DEQ convened a Science Workgroup of seven experts in the fields of fate and transport, hydrology, as well as in the field of human health, aquatic life, and wildlife toxicology. This group provided advice as DEQ assessed the toxicity, persistence and bioaccumulation characteristics of more than 2000 chemicals utilizing several U.S. Environmental Protection Agency (EPA) chemical property estimation models.

Public Involvement

Because persistent pollutants are known to migrate through air, water and land environments, and there are many different individuals and organizations that are working to address pollutants in these various media environments, DEQ sought input and coordinated extensively with other state and federal agencies, tribal nations, outside experts, stakeholders, interested parties and the general public. DEQ used this approach in developing the P3 List and throughout the SB 737 implementation process. A comprehensive public outreach initiative in March 2009 reached more than 200 individuals, with 55 individuals and/or organizations submitting over 150 written comments.

During winter 2009, DEQ presented information about this project to a variety of audiences at the Northwest Environmental Conference, the American Water Resources Association Conference, the Oregon Board of Agriculture, the City of Portland's Bureau of Environmental Services and others. At each of these presentations DEQ answered questions and outlined the project timeline, highlighting opportunities for public input.

2.2 Final Priority Persistent Pollutant List

DEQ's final P3 List identified 118 persistent pollutants, divided into two categories (or tiers), that persist in the environment or accumulate in animals (Attachment 2). All of the pollutants on the list may cause harm to human health or aquatic life when present in sufficient quantities in the water and thereby have the potential to pose a threat to Oregon's waters. Some are known carcinogens, and others are thought to disrupt endocrine functions.

The list includes both well-studied pollutants that people have worked to reduce for many years, and those for which less information exists.

A detailed technical report on DEQ's process to develop the P3 List, *Senate Bill 737 Development of a Priority Persistent Pollutant List for Oregon*, is available on the project website: http://www.deq.state.or.us/wq/SB737/index.htm. Below is a summary of the types of pollutants on the P3 List (see Attachment 2).

Tier 1: 69 Persistent Pollutants

"Persistent pollutant" means a substance that is toxic and either persists in the environment or accumulates in the tissues of humans, fish, wildlife or plants.[9]

Pollutant	Uses / examples
PAHs	Combustion byproducts. Many of these have been identified as carcinogenic. Several PAHs have been detected in Oregon's waters at concentrations above state water quality criteria, which are levels established to protect human health and the environment.
Halogenated flame retardants	Flame retardants such as Polybrominated Diphenyl Ethers (PBDEs) used in furniture and electronics.
Pesticides	Used for agricultural, grounds-keeping and urban pest and weed control. Some of these were selected by U.S. EPA for screening as endocrine disruptors. Two[10] have been detected in Oregon's waters at concentrations above state water quality criteria or guidance levels established to protect human health and the environment.
Pharmaceuticals and personal care product ingredients	Includes synthetic hormones, pharmaceuticals, fragrances, food additives and disinfectants. Some of these were selected by U.S. EPA for screening as endocrine disruptors.
Perfluorinated surfactants	Surface protectants and non-stick coatings.
Metals	Arsenic, cadmium, lead, methylmercury and selenium. Some of these have been identified as carcinogenic. Several of these have been detected in Oregon's waters at concentrations above state water quality criteria.
Industrial chemicals	Includes stabilizers for polymers and plasticizers.

[9] ORS 468B.138(4)
[10] Diazinon and Chlorpyrifos

Tier 2: 49 Legacy Persistent Pollutants

"Legacy" means a pollutant, the use of which has been banned or restricted for several years, that remains at detectable levels in sediment and tissue samples.[11]

Pollutant	Uses / examples
Pesticides	Includes Chlordane, DDT, Dieldrin, Endrin, Heptachlor, and Mirex. Some of these have been identified as carcinogenic, and some of these were selected by U.S. EPA for screening as endocrine disruptors. Several have been detected in Oregon's waters at concentrations above state water quality criteria. [12]
Polychlorinated Biphenyls (PCBs)	Used for cooling and insulating fluid for closed electrical systems. Some of these have been identified as carcinogenic. Several have been detected in Oregon's waters at concentrations above state water quality criteria
Polychlorinated Naphthalenes (PCNs)	Used for insulating coatings for electrical wires, wood preservatives, as rubber and plastic additives; in very limited production since 1976.
Dioxins and furans	Occur as by-products in the manufacture of organochlorides, in the incineration of chlorine-containing substances such as PVC (Polyvinyl Chloride), and from natural sources such as volcanoes and forest fires. Some of these have been identified as carcinogenic.

[11] ORS 468B.138(1)

[12] DDT, DDE, Dieldrin and Chlordane

3 Sources of Persistent Pollutants into Water

3.1 DEQ's Source Identification Process

SB 737 required DEQ to identify individual point, nonpoint and legacy sources of listed priority persistent pollutants from existing data, including an analysis identifying the quantity, concentration and volume of such pollutants discharged by individual sources on an annual basis.[13] To accomplish this, DEQ consulted with several experts from academia, various government agencies, non-governmental organizations and industries to provide advice and comment on existing data identifying point, nonpoint and legacy sources of persistent pollutants in Oregon. This outreach included a survey, targeted interviews and informational sessions to solicit public input. DEQ used information it received from the public to supplement information found in the scientific literature. Much of the work to identify sources was a joint effort with DEQ's Toxics Reduction Strategy team to maximize efficiencies where possible.

Source Identification Survey

DEQ developed an online survey to seek information from interested parties about the presence, origin, and contaminant levels of persistent pollutants on the initial draft P3 List. DEQ posted the survey on the SB 737 project website[14] in March 2009. Although the survey was distributed broadly as one method for collecting information about the pollutants on the P3 List, it yielded little response.

Targeted Interviews

During November and December 2008, DEQ's Toxics Reduction Strategy team and the SB 737 implementation team consulted with interested parties and experts in the fields of public health, toxicology, fate and transport and related sciences, as well as representatives from municipalities and industry (e.g. forestry, agriculture and manufacturing), and organizations that have collected or evaluated data related to toxic pollutants in the environment. DEQ sought input on existing information regarding sources of P3 pollutants and measures to reduce the discharge of these pollutants into Oregon's waters.

In late 2009, DEQ organized small workgroups of professionals with specific relevant expertise to identify the potential sources of particular groups of pollutants, such as consumer product ingredients, industrial pollutants, metals, etc. Members of the workgroups responded to information summaries drafted by graduate student interns for a select number of pollutants.

As a result of these targeted interviews DEQ received detailed information about selected pollutants. DEQ assessed all information received from targeted interviews and incorporated comments and suggestions into Chapter 4 of this report.

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[13] ORS 468B.139(2)(b)

[14] www.deq.state.or.us/wq/sb737

Public Involvement

During April 2010, DEQ made a draft of this report available for public input. Several commenters suggested that DEQ include more detailed information about sources of specific pollutants in the final report. DEQ evaluated the input it received and significant changes are reflected in this report. Most notably, input received by DEQ resulted in the expansion of this chapter describing potential sources of persistent pollutants. Staff in DEQ's air, land, surface water and groundwater programs also contributed and reviewed additions to the report.

Literature Review

DEQ used high quality, peer-reviewed or similar quality scientific and technical information and data to complete a profile for each pollutant on the P3 List. DEQ compiled information from a number of sources, including third party peer-reviewed literature, government documents (i.e., documents published by the U.S. Environmental Protection Agency, U.S. Geological Survey, and other state or federal governments), measurements from both field studies and laboratory studies with an approved Quality Assurance Plan. A Quality Assurance Plan documents how quality assurance (QA) and quality control (QC) are applied to an environmental data operation to assure that the results obtained are of the type and quality needed and expected. DEQ did not consider anecdotal information or data obtained without an approved Quality Assurance Plan. Chapter 4 summarizes and provides examples of the type of information DEQ used to complete pollutant profiles.

Detailed information regarding the quantity, concentration and volume of persistent pollutants discharged by individual sources as required in the statute is not available. Absent those data, DEQ expended substantial effort to compile relevant and credible data relating to the sources and pathways of a given pollutant.

3.2 Sources and Pathways of Persistent Pollutants into Water (Attachment 3)

Toxic chemicals, including persistent pollutants, may be found in a variety of environmental media (i.e., air, water, sediment and soil) and may reach humans, wildlife and plants via different exposure pathways (see Attachment 3). While all of these pathways are important, SB 737 directed DEQ to focus on persistent pollutants discharged in Oregon[15] that pose a threat to the waters of the state (which includes groundwater).[16] To comply with SB 737, DEQ focused on chemicals that have a potential to reach humans, wildlife and other life only through the aquatic system (surface water, groundwater, sediment, or biota - e.g., fish and shellfish ingestion). All of the persistent pollutants on the list have potential to cause harm to aquatic of human life if they are present in sufficient amounts in Oregon's waters. All of the pollutants on the P3 List have either been detected in, or have the potential to be present in, Oregon's waters.

Potential Sources

In general, persistent pollutants enter the environment from seven primary points of origin, depicted as A through G in Attachment 3 and described below.

A. Global uses, both historic and current, emitted or currently emit persistent pollutants into the air. Persistent pollutants (such as mercury and PCBs) emitted into the

[15] ORS 468B.139(1)

[16] ORS 468B.139(2)(a)

atmosphere by industrial and other human activities around the planet, can travel via high altitude winds (the jetstream) to the United States, particularly the western U.S.

B. Regional uses, both historic and current, emitted and in some cases continue to emit persistent pollutants into the air and adjacent waterbodies. For example, persistent pollutants (such as PAHs and some metals) emitted into the air in Idaho, California or Washington by agricultural biomass burning or by forest fires may drift into Oregon. Similarly, persistent pollutants released into a waterbody in Idaho or Washington may ultimately reach an adjacent, connected waterbody in Oregon (e.g., the Columbia or Snake Rivers).

C. Local combustion-related activities, such as running gasoline and diesel engines, forest fires, residential trash burning, and woodstoves, emit pollutants (such as PAHs and some metals) primarily into the air. Some of these air emissions (primarily the particulates) will subsequently deposit onto soil and surface water.

D. Local agricultural and forestry uses, both current and historic, may result in the release of persistent pollutants (such as pesticides) to soil, surface water or groundwater through land application, permitted discharges and other discharges (such as spray drift or erosion).

E. Individual consumer uses of indoor or outdoor household products may result in persistent pollutants being present in wastewater effluent as well as in biosolids and recycled water, (i.e. treated materials remaining from wastewater processing which are often applied to surface soil for agricultural purposes). Municipal wastewater treatment processes are not designed to remove all persistent pollutants. As a result, the discharge of treated effluent to surface water or groundwater can result in the release of persistent pollutant to waters of the state. Persistent pollutants used by individual consumers may also be discharged to surface water via wastewater effluent, and may accumulate in sediment. Land application of biosolids and recycled water may result in persistent pollutant releases to the soil, where they are often immobilized or degraded. They may also enter the food chain if accumulated by soil dwelling organisms. Federal and state requirements as well as site specific management practices require biosolids and recycled water land application programs to protect surface and groundwater. However, if biosolids or recycled are improperly or illegally managed, they water may enter surface or groundwater.

F. Local industrial and commercial activities, both historic and current, released or may release persistent pollutants (some metals and organic chemicals) to the soil or surface water through land application, permitted discharges and other discharges. Persistent pollutants applied to surface soil may run off into surface water, while those discharged to surface water may stay in the water column or move into sediment.

G. Local cleanup sites contaminated with legacy persistent pollutants (such as PCBs, PAHs, some pesticides, and some metals) may release (through leakage or leaching) these persistent pollutants into adjacent surface water or groundwater, or be carried on eroding soil particles.

Release Mechanisms

The previous section broadly describes where persistent pollutants may originate and a conceptual model for how pollutants move through the environment to water and then on to aquatic life or humans. This section provides more information on the mechanisms that release pollutants into the environment and describes information summarized in Attachment 3.1. The table *Relationships of Pollutants and their Potential Sources* notes which types of pollutants could move to water from each of the seven primary origins described in the previous section and depicted in Attachment 3 (Potential Sources A through G).

Point, Nonpoint and Legacy Sources

There are four primary release mechanisms: emissions to air, releases to land via land application, permitted discharges, and other discharges. These release mechanisms may be grouped into broad categories, commonly referred to as 'point sources', 'nonpoint sources' and 'legacy sources' of pollutants. These terms generally categorize pollutants' release mechanisms and in turn which regulatory programs are used to address them. For the purposes of this report, the following descriptions refer only to physical conveyance of pollutants, not the regulatory context for addressing these sources.

- **Point Sources (Permitted Discharges).** The term "point source" means a stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit or factory smokestack.[17] The following descriptions relate to all pollutants' potential conveyance from a stationary source, regardless of regulatory status. Generally, main categories of point sources in Oregon include:
  - **Industrial / Commercial Effluent.** This type of effluent is the treated waste water discharged to streams, lagoons, and groundwater from industrial or commercial facilities. In some cases industrial or commercial effluent is routed through wastewater treatment plants prior to discharge.
  - **Municipal Wastewater Effluent.** This type of effluent is the treated wastewater discharged to streams, lagoons, rivers and estuaries from wastewater treatment plants.
  - **Urban Stormwater.** Urban stormwater runoff of particulate and dissolved pollutants from land and impervious areas such as paved streets, parking lots, industrial sites and building rooftops during rainfall and snow events. Stormwater that does not soak into the ground becomes surface runoff which is channeled into storm sewers and eventually discharged to surface waters or to groundwater via stormwater injection wells.

- **Nonpoint Sources (Air Emissions, Land Application and Other Discharges).** When it rains or snows, water washes over driveways, roofs, agricultural lands, streets, lawns, construction sites, and forestry operations. As the runoff moves across the ground surface or through groundwater, it picks up and carries with it natural and human-made pollutants, depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. The largest source of water pollution in Oregon's rivers, lakes and streams does not come from a pipe, such as from factories and sewage treatment plants, but from urban and rural

[17] Note that most of the pollutants on the P3 List are not regulated in effluent because there are not water quality standards for them.

runoff. This is likely true across all pollutant categories, although information regarding relative loading is not available. This type of pollution is called "nonpoint source" pollution because it comes from various sources often distributed over large areas, and not from a single discharge pipe. Some general nonpoint sources in Oregon include:

- **Overland Flow.** When it rains, surface "sheet" runoff from a variety of sources (e.g. gardens, parking lots and forestry and agricultural lands) that is not channeled to stormwater treatment may flow over lands and into waterways.
- **Land Application.** Various types and quantities of materials are applied to soils to support and promote the growth of crops, or livestock or both. These include pesticides, fertilizers, compost, manure, biosolids, irrigation water and recycled water. These materials may be applied in solid, liquid, or gaseous forms, and may contain persistent pollutants. Inappropriate application or site management practices can lead to unintended impacts to surface and ground waters due to soil erosion, surface runoff, spray drift, collection in drainage systems, or subsurface movement through the soils.
- **Soil Disturbance.** When contaminated soil is disturbed by human or natural processes that move soil or sediment, persistent pollutants may be released into the water via runoff or erosion. Runoff carries dissolved matter and erosion carries particulate matter.

- **Legacy Sources (Other Discharges).** Many persistent pollutants have been banned or restricted for several years, yet remain at detectable levels in sediment and tissue samples. These pollutants are called legacy pollutants because they are no longer in production or use, but rather are present as a legacy of historic practices. Mechanisms that release these pollutants, or legacy sources, include:
  - **Leaching to Groundwater.** Groundwater is water located beneath the ground surface in the spaces between soil particles and in the fractures of rock formations. Oregon's groundwater has many uses including drinking water and other household uses, irrigation for crops, numerous industrial and commercial uses, and also provides the base flow of streams.
  - **Soil Disturbance.** When soil contaminated with legacy pollutants is disturbed by human or natural processes, persistent pollutants may be released into the water via runoff or erosion.

- **Other Sources: Air Deposition.** Persistent pollutants are emitted to the air from a variety of sources, such as smokestacks and automobile exhaust. A permitted air emission "point source" is a direct source to air and an indirect source to water. Emissions to air from "area sources" (forest fires, open burning, residential trash burning, etc.) also go directly to air and may go indirectly to water. Some of these pollutants are "deposited" from air onto the soil and into surface water, which is called air deposition. After pollutants are deposited, they may move through the environment in a variety of ways (see Attachment 3 for more detail about these processes).

Primary Media (Attachment 3)

There are four primary environmental media relevant to understanding how persistent pollutants enter water:

- **Air.** Pollutants emitted to air may eventually fallout on to soil and into surface water via aeolian transport, that is, the wind's ability to erode, transport and deposit materials such as soil and dust.

- **Soil.** Persistent pollutants in products applied to soil or the ground may run off into surface water or leach into groundwater.

- **Surface Water and Groundwater.** Persistent pollutants that enter surface water may stay within the water column or may move to groundwater or sediment. Persistent pollutants in groundwater also seep into surface water and wells. Fish, plants, animals and humans may be exposed to persistent pollutants in groundwater or surface water directly, through drinking the water, or through the food chain.

- **Sediment.** Persistent pollutants in sediment may "partition" or move into surface water when the sediment is disturbed. Fish, plants, animals and humans may be exposed to persistent pollutants in sediment through direct contact or when the sediment is ingested in search of food (incidental ingestion), or when organisms that have accumulated persistent pollutants are consumed.

Exposure Media (Attachment 3)

Because of their physicochemical characteristics, human or aquatic life are most likely to be exposed to the pollutants on the P3 List that have found their way into surface soil, sediment, or have worked their way up food chains leading to humans, higher aquatic life (e.g., fish), and wildlife. Persistent pollutants tend to attach to soil or sediment particles, and when sediment or soil are disturbed these pollutants may become detached and enter into the surrounding water. Soil or sediment-dwelling animals (e.g. earthworms or benthic invertebrates), by ingesting soil or sediment particles containing persistent pollutants, may release these pollutants either into the water or, through bioaccumulation, enter the food chain. Pollutants that bioaccumulate in animals can also move up the food chain through biomagnification, potentially impacting a variety of higher organisms, including humans.

3.3 Relationships of Pollutants and their Potential Sources

SB 737 requires DEQ to identify individual point, nonpoint and legacy sources of listed priority persistent pollutants.[18] DEQ elected to provide a further level of detail by identifying which of the sources described in the previous section may emit certain types of pollutants to the environment. Available information regarding release mechanisms for priority persistent pollutant groups is summarized in the table *Relationships of Pollutants and their Potential Sources* (Attachment 3.1). This section describes notations in each column of the table.

Column 1. Pesticides

A pesticide is any substance or mixture of substances intended to be used to prevent, destroy, repel or mitigate any pest. Pesticides on the P3 List include insecticides, herbicides, fungicides, and various other substances used to control pests. (See Attachment 2 for a complete listing.) Pesticides used in agricultural and forestry settings may unintentionally enter waterways either during the course of land application, via overland flow or via soil disturbance (erosion). Pesticides used in commercial and residential settings for landscaping and pest control may enter waterways from wastewater effluent

[18] ORS 468B.139(2)(b)

after indoor dust goes down the drain, and from urban stormwater after runoff from lawns and other urban areas enters storm drains. Legacy pesticides may enter waterways from local contaminated sites via soil disturbance (erosion) or leaching to groundwater.

Column 2. Consumer-Related

Consumer-related persistent pollutants include antimicrobials used in soaps and other products, synthetic hormones, antibiotics, pharmaceuticals, fragrances used in laundry detergents and soaps, food additives, and ingredients in personal care products such as cosmetics and sunscreen. Consumer-related persistent pollutants reach Oregon's waters primarily from individual consumer uses via wastewater effluent. Some consumer-related persistent pollutants may be released to the environment via land application of biosolids and recycled water for agricultural purposes.

Point Sources
Industrial / Commercial Effluent
Municipal Wastewater Effluent
Urban Stormwater

Nonpoint Sources
Land Application
Overland Flow
Soil Disturbance

Legacy Sources
Leaching to Groundwater
Soil Disturbance

Other Sources
Air Deposition

Column 3. Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons are by-products from auto exhaust and other combustion sources that enter Oregon's waters from global, regional and local combustion-related activities, primarily through air deposition. PAHs deposited onto land may run off roads and other land surfaces and reach water via urban stormwater.

Column 4. Flame Retardants

Flame retardants such as PBDEs and HBCD are used in products including electronics and furniture. Flame retardants may enter waterways from individual consumer uses via wastewater effluent and from industrial and commercial facilities via effluent.

Column 5. Surfactants

Surfactants are used as surface protectants in commercial products such as carpet and clothing, and as coatings for paper and cardboard packaging. Surfactants may enter waterways from local individual consumer uses via wastewater effluent and from industrial and commercial facilities via effluent.

Column 6. Industrial Chemicals

Industrial chemicals on the P3 List include stabilizers for polymers and plasticizers, additives that increase the plasticity or fluidity of materials, and a fuel additive. Chemical ingredients that can become persistent pollutants once used may reach Oregon's waters from industrial and commercial facilities via their effluent, or from accidental releases to surface and groundwater.

Column 7. Metals

Metals are naturally-occurring elements present in the earth's crust. They have been mined or extracted for use in industry and agriculture. The metals listed as priority persistent pollutants are arsenic, cadmium, lead, methylmercury and selenium. Arsenic and cadmium released through local combustion activities may be deposited into water from the air. Inorganic mercury from global and legacy sources and abandoned mines can reach

Oregon's waters through air deposition and erosion. Inorganic mercury can become methylated in the aquatic environment to form methylmercury that bioaccumulates in fish and fish consumers including wildlife and people. Metals once used in legacy pesticides (arsenic and lead) may be released from soil disturbance in urban and rural areas. All of these metals may reach water from industrial and commercial effluent, or when soil is disturbed or pollutants leach to groundwater at local contaminated sites.

Column 8. Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls were manufactured for use as cooling and insulating fluid for closed electrical systems before being banned decades ago. Although PCBs are no longer manufactured in the U.S., some uses in closed systems remain. PCBs may enter Oregon's waters from global and regional activities via air deposition to surface water, and from local contaminated sites via soil disturbance and leaching to groundwater.

Column 9. Polychlorinated Naphthalenes (PCNs)

Polychlorinated naphthalenes were used for insulating coatings for electrical wires, as wood preservatives and as rubber and plastic additives, and have been in very limited production since 1976. They are considered legacy pollutants. PCNs may enter Oregon's waters from global and regional activities via air deposition to surface water, and from local contaminated sites via soil disturbance and leaching to groundwater.

Column 10. Dioxins and Furans

Dioxins and furans occur as by-products in the manufacture of organochlorides and are emitted from the incineration of chlorine-containing substances such as PVC (Polyvinyl Chloride), as well as from natural sources, such as volcanoes and forest fires. Dioxins and furans enter Oregon's waters through air deposition from global and regional activities and from local combustion activities. Dioxins and furans may also reach water when soil is disturbed or pollutants leach to groundwater at local contaminated sites.

More details about sources and pathways for specific persistent pollutants follow in Section 4.1

4 Pollutant Profiles

DEQ developed a detailed "pollutant profile" for each pollutant on the P3 List, summarizing each pollutant's unique life cycle "story," from production through use to eventual disposal. The pollutant profile identifies the chemical properties, current and past uses, sources to the environment, annual discharge and environmental detections for each P3-listed pollutant, and is summarized in the table *Pollutant Profiles*, provided in Attachment 4. The data were compiled through targeted interviews and review of scientific literature (further described in Section 3.1 of this report). This section provides a description of the data provided in each column of the *Pollutant Profiles* table (Attachment 4). It should be noted that information is published daily on many of these pollutants, and this data compilation reflects the general current state of knowledge at the time of this report; it is not intended to be exhaustive.

4.1 Summary Descriptions of Priority Persistent Pollutants (Attachment 4)

The first four columns of the table *Pollutant Profiles* (Attachment 4) contain general information to describe each persistent pollutant. The first two columns list the pollutant name, the numeric identifier (see Column 1 explanation, below) and a general characterization of the pollutant's relative persistence and bioaccumulation properties and toxicity. The third and fourth columns describe each persistent pollutant's general current and past uses, where the persistent pollutants might come from and how each persistent pollutant may move through the environment. More details on each column are provided below.

Column 1. Chemical Abstract Service Registry Number (CASRN)

Column one in the table *Pollutant Profiles* (Attachment 4) lists the unique numeric identifier for each persistent pollutant as assigned by the Chemical Abstracts Service (CAS) registry. CAS, a division of the American Chemical Society, assigns registry numbers, (referred to as CAS numbers, CAS RNs or CAS numbers), for every chemical element, compound, polymer, biological sequences, mixture and alloy that has been described in the scientific literature. The purpose of using these numeric identifiers is to make database searches more convenient and accurate, as chemicals often have many names.

Maximum Contaminant Level (MCL)

Column one also contains information about whether the pollutant has a Maximum Contaminant Level (MCL) set by the United States Environmental Protection Agency (EPA) for drinking water quality. An MCL is the legal threshold limit on the amount of a contaminant that is allowed in drinking water under the Safe Drinking Water Act (SDWA). EPA sets standards for approximately 90 contaminants in drinking water, including 32 that are P3-listed pollutants.

Column 2. Pollutant

Column two in the table *Pollutant Profiles* organizes persistent pollutants into chemical classes, with pollutant names alphabetized by the most frequently-used common name.

Column two also contains information about a pollutant's persistent, bioaccumulative and toxic (PBT) score. In developing the P3 List, DEQ assessed the potential threat to human health and the environment posed by each chemical based upon its overall persistence, its potential to bioaccumulate, and its toxicity to fish and, in some instances, toxicity to humans. DEQ described the process for determining a pollutant's PBT score in a technical report, *Senate Bill 737 Development of a Priority Persistent Pollutant List for Oregon* (DEQ, 2009). A higher PBT score indicates a higher potential threat to human health or the environment.

Column 3. Uses

Column three in the table *Pollutant Profiles* (Attachment 4) summarizes available information regarding current or historical uses of each pollutant. Information regarding uses provides insight into potential sources. These datasets include:

- **U.S. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles.** The ATSDR is a United States federal agency that prepares information about the toxicological properties of chemicals for the Department of Defense (DOD) and the Department of Energy (DOE) on substances related to federal sites.

- **EPA's Integrated Risk Information System (IRIS).** IRIS is a human health assessment program that evaluates quantitative and qualitative risk information on health effects that may result from exposure to environmental contaminants. The IRIS database contains information for more than 540 chemical substances and the human health effects, both carcinogenic and noncarcinogenic, that may result from exposure to these substances in the environment. IRIS is prepared and maintained by the EPA's National Center for Environmental Assessment (NCEA) within the Office of Research and Development (ORD).

- **Report on Carcinogens (RoC).** The U.S. Department of Health and Social Services' RoC is an informational scientific and public health document that is published biennially and serves as a useful compilation of data on the listed substance's carcinogenicity (ability to cause cancer), genotoxicity (ability to damage genes), potential for human exposure to these substances and Federal regulations to limit exposures.

- Fact sheets from state and federal agencies and third-party peer-reviewed literature.

Column 4. Sources and Pathways to the Environment

Column four in the table Pollutant Profiles summarizes available information about where pollutants originate and generally the pathway a pollutant might take to move into and through the environment. DEQ compiled and interpreted information from a variety of sources, including many of the documents used for determining uses of certain pollutants. For example, DEQ referenced the ATSDR, RoC, fact sheets from state and federal agencies and peer-reviewed literature.

4.2 Relative magnitude in the environment

The fifth column of the table Pollutant Profiles (Attachment 4) summarizes information on each persistent pollutant's relative magnitude – or amount present – in the environment, to the degree that such information was available.

Column 5. Annual discharge

SB 737 required DEQ to identify the quantity, concentration and volume of persistent pollutants discharged on an annual basis in Oregon.[19] These data are not readily available in one dataset, if at all. Because of the lack of data on discharges of persistent pollutants, DEQ documented available information from a variety of sources to describe the amount of a pollutant potentially present in Oregon per year to assess relative magnitude. DEQ compiled information regarding the relative magnitude of the chemical in the environment, based on a qualitative assessment of the amount of each pollutant released to the environment, produced, used, or stored. If this information was not available for a pollutant, DEQ reported surrogate information such as state or national production or import volumes, inventories, and chemical use statistics to represent discharge amounts. In the absence of quantitative data specific to Oregon or the United States, DEQ used the most recent available national or global estimates. Magnitude of use is necessarily different for different types of pollutants. DEQ aimed to determine a statewide average magnitude without adjusting for specific geographic anomalies, such as a single high emission of a pollutant that is otherwise rarely used.

DEQ also aimed to standardize available information and estimate a magnitude relative to other pollutants on the P3 List. After compiling information from a variety of sources reported in different measurement units, DEQ compared results for all pollutants relative to other pollutants on the list, and assessed patterns and logical groupings of data points. Examples of datasets referenced and general categorization approaches follow.

Environmental releases

Toxics Release Inventory (TRI). The TRI database is available from EPA and contains information reported annually by certain industry types as well as federal facilities. Each year, facilities report to TRI the amounts of toxic chemicals disposed of or otherwise released onsite to air, water, and land and injected underground, and the amounts of chemicals transferred off-site for recycling, energy recovery, treatment, and disposal or release. Companies from numerous types of industries (including chemical, mining, paper, oil and gas industries) that produce more than 25,000 pounds (12.5 tons US) or handle more than 10,000 pounds of a listed toxic chemical must report it to the TRI. If the company treats, recycles, disposes, or releases more than 500 pounds of that chemical into the environment (as opposed to just handling it), then they must provide a detailed inventory for that chemical.

The TRI database has some limitations. Facilities that manage listed TRI chemicals but do not meet the TRI threshold levels (those with fewer than 10 full-time employees or those not meeting TRI quantity thresholds) are not required to report even though they may release toxic chemicals into the environment. Fewer than 300 Oregon facilities report to TRI, and it doesn't specifically identify amounts discharged to water. Despite the TRI's limitations, it is the most comprehensive source of information available for comparing releases of some toxic pollutants relative to one another. DEQ queried TRI data at the national and state level, and generally categorized relative magnitude as follows:

U.S. Toxics Release Inventory (TRI), total

- High: ≥100,000 kg/yr
- Medium: >1,000 <1,00,000 kg/yr
- Low: ≤1,000 kg/yr

[19] ORS 468B.139(2)(b)

Oregon Toxics Release Inventory (TRI), total

- High: ≥1,000 kg/yr
- Medium: >100 <1,000 kg/yr
- Low: ≤100 kg/yr

100,000 kg = approx. 110 tons (US)
1,000 kg = approx. 1 ton (US)

Production

For many persistent pollutants, information regarding environmental releases, whether from the TRI or other similar types of databases, is not available. DEQ documented information about national production rates to estimate a pollutant's relative magnitude using a variety of datasets, including:

- **Hazardous Waste Generation Reports.** EPA manages a national information system to support the Resource Conservation and Recovery Act (RCRA) of 1976 and the Hazardous and Solid Waste Amendments (HSWA) of 1984. The system allows tracking of many types of information about the regulated universe of RCRA hazardous waste handlers. The information characterizes facility status, regulated activities, and compliance histories and captures detailed data on the generation of hazardous waste from large quantity generators and on waste management practices from treatment, storage, and disposal facilities.

- **High Production Volume Data.** EPA maintains a national list of 1,689 high-production volume chemicals. Under the High Production Volume (HPV) Challenge Program, companies are "challenged" to make health and environmental effects data publicly available on chemicals produced or imported in the United States in the greatest quantities. HPV chemicals are classified as those chemicals produced or imported in the United States in quantities of 1 million pounds or more per year. DEQ classified any pollutant on this list as "high" production.

- **U.S. Agency for Toxic Substances and Disease Registry (ATSDR).** DEQ used summary information prepared by U.S. Agency for Toxic Substances and Disease Registry (ATSDR) to estimate national production rates. DEQ classified chemicals produced at greater than 100,000 kg/yr as "high" production, and chemicals produced at less than 1,000 kg/yr classified as "low" production.

Use

Information regarding amount of use in Oregon is available for a select few pollutants. While this information does not directly address amount released to the environment, it gives some indication of a pollutant's potential magnitude. DEQ relied on one dataset for this information:

- **Oregon Pesticide Use Reporting System (PURS).** The 1999 Oregon Legislature passed legislation directing the Oregon Department of Agriculture (ODA) to develop and implement a system to collect, organize, and report information on all categories of pesticide use in Oregon. DEQ generally classified pesticide magnitude as "high" if more than 20,000 kg/yr (~22 tons US) were reportedly used, "medium" if between 4,500 kg/yr and 20,000 kg/yr, and "low" if the pollutant was not among the top 100 active ingredients used in Oregon.

Storage

For pollutants without release, production or use information, DEQ recorded data regarding amount of persistent pollutants stored in Oregon. Again, this information does not directly address the amount released to the environment, but it gives some indication of a pollutant's magnitude. DEQ relied on one dataset for this information:

- **Oregon State Fire Marshal database.** This database contains the locations of hazardous material stored in an Oregon above certain threshold quantities. In 1985, the Oregon Legislature passed the Community Right to Know and Protection Act which requires the Office of State Fire Marshal to conduct an annual Hazardous Substance Information Survey (HSIS) of Oregon facilities. The data identifies hazardous substances that are used, stored, manufactured and/or disposed of at business and government sites in Oregon. Facilities are required to provide demographic information and report hazardous substances at or above TRI reportable quantities. Facilities possessing reportable quantities of hazardous substances are required to report specific information including the chemical name, maximum amount and storage location. DEQ used this information to characterize magnitude based on average storage, rather than maximum storage. For example, average storage of 1000-4999 pounds (~0. 5 – 2.5 tons US) classified as "high" storage, and average storage of 50-199 pounds (~0.25 – 0.1 tons US) classified as "low" storage.

Importation

For pollutants without release, production, use or storage information for Oregon or the U.S., DEQ gathered data regarding the amount of persistent pollutants imported into Canada or Europe. Again, this information does not directly address the amount released to the environment, but it gives some indication of a pollutant's magnitude or likely importation into the United States. DEQ classified more than 100,000 kg/yr of likely importation as a being at a "high" level. DEQ classified pollutants imported at less than 1,000 kg/yr at a "low" level.

4.3 Presence (Attachment 4)

The previous section describes how DEQ estimated a pollutant's relative magnitude in the environment on a statewide scale. In compiling that information, DEQ noted that for many pollutants, complete data regarding relative magnitude in Oregon is not available, or conflicting information exists. For example, if TRI data indicate that a pollutant is not released in large quantities, but it was frequently detected in surface water and/or sediment, DEQ concluded that the information as a whole built a case for concern. DEQ opted to systematically document the presence of persistent pollutants in wastewater treatment plants, Oregon's waters and other places to provide a more complete picture for each pollutant. To achieve this, DEQ searched peer-reviewed literature and government documents for site-specific field measurements. Note that DEQ did not base its conclusion about whether there was a cause for concern on detection alone. Rather, detection in unexpected places such as human or animal tissue, streams or sediment may indicate that a pollutant behaves differently than other information suggests it might. Persistent pollutants present in unexpected places may indicate unintended exposures.

Column 6. Presence in Municipal Wastewater Treatment Plants

Column six in the table Pollutant Profiles (Attachment 4) summarizes recent studies measuring pollutants in outputs from municipal wastewater treatment plants both in the United States and internationally. DEQ compiled information about the presence of P3-listed pollutants in effluent, the treated water coming from the end of the pipe that is released directly into streams, as well as information about P3-listed pollutants in sludge and biosolids, the residual, semi-solid material left from sewage treatment processes that is not generally discharged to water. Relatively few studies have reported on presence of certain persistent pollutants (such as flame retardants and ingredients in consumer products) in municipal wastewater treatment plant effluent or biosolids for any given location. DEQ relied on studies from wastewater treatment plants (WWTPs) across the globe to better understand whether certain persistent pollutants might be present in effluent or biosolids. For example, DEQ cited:

- Measurements at municipal influent, effluent and septic effluent in Oregon (DEQ LASAR)
- A study of persistent pollutants in influent and effluent samples at 9 U.S. publicly owned treatment works (USEPA, 2009a)
- A national study of sewage sludge (USEPA 2009b)
- A study of persistent pollutants in WWTP effluent discharged into the Columbia River (USGS, 2009)
- Surveys of persistent pollutants in sewage sludge (biosolids) (USEPA, 2009b and Harrison, et al. 2006)
- International studies of persistent pollutants in wastewater (Environment Canada, Osemwengie and Gersetnberger, 2004; Choi et al., 2008 and Miao et al., 2004)

Column 7. Presence in Oregon Waters

Column seven in the table *Pollutant Profiles* summarizes results from several recent studies measuring pollutants in Oregon's surface water (e.g. streams, ponds) and sediment (e.g., sands and river channel deposits). DEQ also cited information about detections in fish tissue and osprey eggs in Oregon in this column because of the logical connection to presence in Oregon's waters. DEQ primarily cited results from U.S. Geological Survey and Oregon DEQ studies, including the following:

- Results from DEQ studies in Oregon's surface waters, groundwater, sediments and fish tissue (DEQ LASAR)
- A study of persistent pollutants detected in surface water and/or sediment (USGS 2007)
- A study of persistent pollutants present in sediment (Billig and Gould, 2007)
- Studies of persistent pollutants detected in fish tissue from the Willamette River (Henny et al., 2003)
- Studies of persistent pollutants detected in osprey eggs from the Willamette River (Henny et al., 2008ab)

Column 8. Other

Column eight in the table *Pollutant Profiles* notes other information relevant to understanding how a particular pollutant behaves in the environment. This column includes information on detections in animal tissue, including human tissue, but does not necessarily indicate the presence of persistent pollutants in water. In many of the following examples, exposures to persistent pollutants may be occurring through routes other than water. DEQ included this information because, in some cases, it provided context for other information compiled about the pollutant. Examples of information DEQ documented include:

- Measurements from industrial effluent and landfill leachate in Oregon (DEQ LASAR)

- Third-party peer-reviewed literature.
  - Study of persistent pollutants detected in fish sampled in U.S. lakes and reservoirs (Stahl et al., 2009)
  - Study of persistent pollutants detected in fish sampled by a national pilot study (Ramirez et al., 2009)

- Center for Disease Control, National Report on Human Exposure to Environmental Chemicals (CDC, 2009). This report provides an ongoing assessment of the exposure of the U.S. population to environmental chemicals by measuring chemicals or their metabolites in human blood or urine. The measurement of an environmental chemical in a person's blood or urine is an indication of exposure; it does not by itself mean that the chemical causes disease or an adverse effect. DEQ cited information from the most recent studies with numeric results.

- Pollutants selected by U.S. EPA for Tier 1 screening as an endocrine disruptor (Federal Register, October 21, 2009: 54422-54428). This is a list of chemicals that the Environmental Protection Agency decided to test, based primarily upon exposure potential. In announcing its selection of certain pollutants for screening, EPA noted that the pollutants should not be construed as known or likely endocrine disruptors. Nothing in the approach for selecting the initial list would provide a basis to infer that any of the chemicals selected for the list interferes with or is suspected to interfere with the endocrine systems of humans or other species. DEQ included this information in the table because EPA's selection process indicates that the information is relevant to assessing potential exposure.

4.4 Broad Pollutant Categories

After summarizing relevant information on sources, magnitude, presence and detections, DEQ categorized each pollutant according to similarities in these areas relative to other pollutants on the P3 List. DEQ assessed P3-listed pollutants according to: (1) their potential to cause harm (e.g. very high, high, medium and low) and (2) potential opportunities to address pollutants at the source (e.g. many, some and few). Categories were designed to both understand the pollutant better and to provide information for guiding selection of logical measures and actions for reducing persistent pollutants.

Potential to cause harm

All of the pollutants on the P3 List have the potential to cause harm to human health or aquatic life if they get into the water, and thereby pose a potential threat to Oregon's waters if present in sufficient amounts. All persistent pollutants are of concern when present in the environment in sufficient amounts. However, DEQ assessed the total value of scientific evidence regarding each pollutant's potential to be harmful to human health or aquatic life in Oregon relative to other pollutants on the P3 List using each pollutant's PBT score, magnitude and presence.

PBT Score + Magnitude + Presence = Potential to Cause Harm

DEQ aimed to understand which of the persistent pollutants on the P3 List pose the greatest potential to cause harm relative to other persistent pollutants. To achieve this, DEQ generalized a pollutant's relative potential to cause harm by assigning high, medium and low ranking in each of the following areas:

- **PBT Score.** During development of the P3 List, DEQ assigned a general score ranking each pollutant's persistence, bioaccumulation and toxicity. DEQ consulted with a science workgroup for this process as described in DEQ's detailed technical report *Senate Bill 737 Development of a Priority Persistent Pollutant List for Oregon* (DEQ, 2009).[20] A higher PBT score indicates a higher potential threat to human health and the environment. For the purposes of assessing a persistent pollutant's potential to cause harm, DEQ categorized PBT scores as follows:
    - PBT score of 6 = high
    - PBT score of 4 or 5= medium
    - PBT score of 3= low

- **Magnitude.** DEQ estimated each pollutant's relative magnitude in Oregon, either from Oregon-specific data or extrapolated from national data as described in Section 4.2 of this report and summarized in column 5 of the *Pollutant Profiles* table (Attachment 4). A higher magnitude indicates a higher potential threat to human health and the environment.

- **Presence.** DEQ summarized information regarding the pollutant's presence in water and other places as described in Section 4.3 and summarized in columns 6-8 of the *Pollutant Profiles* table (Attachment 4). DEQ placed a higher priority on pollutants with more frequent presence in unexpected places. For the purposes of assessing a persistent pollutant's potential to cause harm, DEQ categorized pollutants as follows:

    - Pollutants detected in municipal WWTP effluent, Oregon waters and other places = high presence

    - Pollutants monitored for and not detected in any of the studies DEQ referenced = low presence

Opportunities to reduce at the source

Persistent pollutants, like other toxic chemicals, have a "life cycle" beginning with manufacture, spanning purchase through use, and ending with some type of disposal, treatment, or recycling (Fig. 1).

[20] http://www.deq.state.or.us/wq/SB737

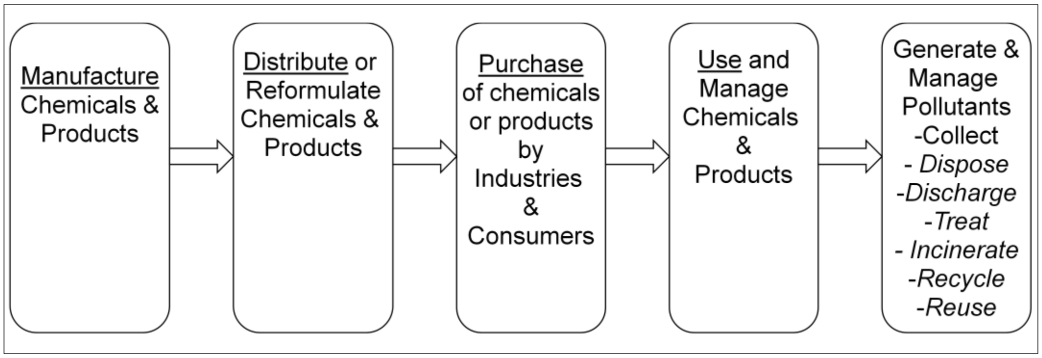

Figure 1. Life cycle of a pollutant.

Most environmental regulations address toxic chemicals at the end of their life cycles, when they are pollutants in need of management, *after* their manufacture, distribution, purchase and use. Pollution prevention is a primary objective of SB 737 and of DEQ's toxic chemical reduction efforts, which aim to address potential pollutants earlier in their life cycles, before the chemicals become pollutants in the environment. A variety of pollution prevention activities can take place before toxic chemicals are distributed or used.

To define the potential for persistent pollutants to be addressed at the source, DEQ assigned pollutants into one of three categories:

- **Many opportunities to reduce at the source**. Pollutants in this category are currently produced and/or used in the United States, including secondary "production" in the form of emissions & releases (e.g., PAHs released by fossil fuel burning for energy production). Pollutants in this category present many opportunities to reduce at the source.

- **Some opportunities to reduce at the source**. Pollutants in this category are in use but no longer in production in the United States (PCBs, e.g.), and occur in Oregon through unintended releases in Oregon or from other states or foreign countries. Pollutants in this category present some opportunities to reduce at the source.

- **Few opportunities to reduce at the source.** Pollutants in this category are no longer in use or production and are not legally available (e.g. DDT), but exist in the environment as a legacy of past practices that are now illegal or that no longer occur. Some chemicals that become persistent pollutants in the environment may currently be in storage, awaiting collection or disposal. Pollutants in this category present few opportunities to reduce at the source.

5 Reduction Measures

This chapter describes the process DEQ used to identify, evaluate and assess potential measures for reducing persistent pollutants. It explains how DEQ inventoried potential reduction measures and lists mechanisms for achieving pollution prevention and control. This chapter details how DEQ determined the level of effort to reduce certain persistent pollutants at the source, and how DEQ associated reduction efforts with the sources of pollutants. It describes how DEQ assessed cost and effectiveness for reduction measures and proposes evaluation criteria for use prior to implementation. Finally, this chapter provides a list of potential reduction measures for each group of persistent pollutants.

5.1 DEQ's Process to Identify Reduction Measures

SB 737 requires DEQ to perform an evaluation and assessment of source reduction and technological control measures that can reduce the discharge of persistent pollutants into the waters of this state, including an assessment of the costs and effectiveness of such measures and which measures should be prioritized for reducing such pollutants.[21] Further, SB 737 requires DEQ to consult with interested local and tribal governments, state and federal agencies and other private organizations in this effort.[22] To accomplish this, DEQ worked with interested parties to identify the range of actions that could be taken to reduce priority persistent pollutants in Oregon's waters. DEQ discussed and inventoried reduction measures by coordinating with program leaders within the agency, hosting a public workshop on the topic, performing targeted outreach with stakeholders and experts and by seeking public input whenever possible.

Assess existing DEQ and Interagency Programs

Existing programs, including programs implemented by DEQ, interagency programs and programs led by other agencies, address many persistent pollutants. Through these efforts, reduction measures are taken in many places and on many different scales. DEQ began its process to inventory reduction measures by assessing existing programs within the Department's purview. DEQ did not perform an exhaustive review of all existing programs, but coordinated with experts to identify key reduction measures for pollutants on the P3 List. In many cases the reduction measures identified for certain pollutants are already underway, reinforcing actions being taken. An inventory of DEQ's programs to reduce and assess toxic chemicals is included in this report (see Attachment 5).

Intra-Agency Coordination

To understand the current state of knowledge on toxics reduction, DEQ collected information about potential reduction measures for P3-listed pollutants by coordinating closely with an agency-wide team of experts from DEQ's Air, Land, and Water programs. This team began meeting bi-weekly in June 2009 to share information and ideas regarding DEQ's development of a comprehensive Toxics Reduction Strategy, described below. Members of the team assisted greatly in compiling sections of and editing this report, and will continue to meet to select reduction measures for implementation of the Toxics Reduction Strategy by DEQ.

[21] ORS 468B.139(2)(c)
[22] ORS 468B.139(4)

Agency-wide Toxics Reduction Strategy

DEQ is in the process of developing a comprehensive Toxics Reduction Strategy that will act as a mechanism to implement reduction measures for many of the pollutants identified in this report. DEQ leveraged similarities between the two efforts to collaboratively identify potential reduction strategies. While the two efforts target slightly different lists of pollutants, the types of potential reduction activities are similar. The strategy's Focus List of pollutants targets toxic chemicals currently prioritized by multiple existing DEQ programs (Attachment 5). Several persistent pollutants identified in this report with a high potential to cause harm did not meet criteria for inclusion in the agency's Focus List at this time because they have not been identified as priorities by multiple DEQ programs. However, other persistent pollutants may be added to the Focus List in the future based on a review of monitoring and other relevant data. During development of the Toxics Reduction Strategy DEQ will evaluate the effectiveness of its existing programs and outline recommendations to further reduce toxic chemicals in Oregon.

The Toxics Reduction Strategy may recommend measures identified in this report, and may also identify and recommend other measures that will provide effective reduction of toxics, including P3-listed pollutants. The final strategy is scheduled for completion in 2011.

Toxics Reduction Opportunities Workshop

One event where DEQ's SB 737 program and Toxics Reduction Strategy efforts coincided was the workshop DEQ hosted on November 17, 2009, to openly explore and document opportunities for toxics reduction in Oregon. Over 150 people participated in the workshop, including representatives from the U.S. Environmental Protection Agency, the Oregon Departments of Human Services, Agriculture and Forestry, tribal governments, Oregon State University, the U.S. Geological Survey, manufacturing and natural resource industries, municipalities and special districts, environmental and public health advocacy organizations, and community groups.

Throughout the day-long workshop attendees listened to panel presentations by representatives of industry, agriculture, municipalities, non-profit organizations and state policy-makers on innovative approaches and ideas for reducing toxic pollutants in Oregon. Attendees participated in lively facilitated breakout sessions, organized into three sectors: Community/Municipal, Agriculture/Forestry, and Industry/Commercial. DEQ staff compiled and evaluated results from this meeting for two purposes. First, DEQ identified and refined general themes and broad reduction strategies for inclusion in this report. Second, DEQ will further refine short- and long-term action items for potential inclusion in the agency's Toxics Reduction Strategy.

Figure 2. Participants at the DEQ-sponsored workshop on November 17, 2009.

Information about the workshop is available on DEQ's website at: www.deq.state.or.us/toxics/toxicsworkshop.htm.

Targeted communication with stakeholders and experts

During spring 2010, DEQ contacted individuals with specialized knowledge related to pollutant- and sector-based reduction measures the Department was considering for inclusion in the agency's Toxics Reduction Strategy and this report. These individuals were asked to provide technical insight regarding the feasibility or effectiveness of specific reduction measures. DEQ evaluated the information gained from these experts and adjusted this report accordingly.

Public input on Draft Legislative Report

DEQ released a draft of this Legislative Report for public input in March through April 2010, and hosted four public information sessions across the state to reach a broad audience interested in the topic. Nearly 50 people attended the informational sessions in Eugene, Medford, Bend and Portland, providing informal verbal input. DEQ evaluated information received during the public sessions and written input received from 15 commenters, and modified this report where appropriate.

5.2 Types of Reduction Measures

This section summarizes the types of reduction measures that DEQ inventoried for consideration. A variety of entities can take many different actions to reduce persistent pollutants in waterways. Not every measure is right in every place at every time, but combined with other measures these efforts can lead to reduction. Potential reduction measures fall into two general categories: *pollution prevention* or *pollutant control and management*. Descriptions of these reduction measures follow. The next section (5.3) details more specific actions for achieving either pollution prevention or pollutant control and management.

Pollution Prevention Measures

Pollution prevention measures directly target reducing pollution at the source, rather than controlling toxic pollution at the end of their life cycle (See Fig. 3). These measures will be advanced through technological innovations, education and technical assistance, incentives, technology transfer and regulatory requirements. They include:

- Increased research into new pollution prevention measures, such as industrial process and equipment improvements that either increase the efficiency of chemical use or achieve business objectives without the use of chemicals that can become persistent pollutants;
- Implementation and promotion of effective pollution prevention measures for businesses, institutions, agriculture and forestry through technical assistance and education (can be applicable to all sectors or sector-specific);
- Household chemical use reduction actions that everyone can participate in;
- Collaboration and partnerships on source reduction measures, whereby multiple agencies, business groups, and non-governmental organizations identify common toxics reduction objectives and implement measures to achieve those objectives;
- Increased research into Green Chemistry and incentives for use of safer alternatives to toxic chemicals that can become persistent pollutants;

- Government purchasing policies that set criteria for the purchase of safer alternatives to persistent pollutants and, thus, help to create a market for such alternatives;

- Restrictions or phase-outs of chemical ingredients in products that can become persistent pollutants when used and disposed of. Such requirements could be appropriate for those chemicals with viable safer alternatives and which are difficult (and expensive) to control once they enter the marketplace or environment;

- Implementation and promotion of labeling and certification programs for consumer products that do not contain chemicals that can become persistent pollutants; and

- Transportation alternatives – to lower emissions of persistent pollutants from engines, particularly automobiles.

Pollutant Control and Management Measures

Measures in the *Pollutant Control and Management Measures* category provide pollutant reductions through research, technology, engineering, construction, technical assistance, education and regulatory measures, and include:

- Research and promotion of air contaminant control technologies for industrial and mobile sources of persistent pollutants released to air;

- Encouragement of facility design and location decisions that minimize the discharge of persistent pollutants (e.g., installing bioswales and pervious pavement to limit contaminated stormwater runoff);

- Promotion and implementation of innovative wastewater treatment technologies for municipalities and industries to increase the removal of persistent pollutants;

- Promotion and implementation of innovative stormwater treatment and control technologies for municipalities, industries and construction sites to minimize runoff of persistent pollutants to surface water;

- Increased incentives and requirements for stream bank stabilization and erosion control methods to reduce the runoff of pollutant-laden sediments to surface waters;

- Promotion and implementation of soil and groundwater cleanup technologies that reduce the loading of persistent pollutants from cleanup sites into waters of the state;

- Implementation of management standards for wastes containing persistent pollutants; and

- Collection and "take-back" events for certain classes of persistent pollutants including agricultural pesticides, pharmaceuticals and heavy metals.

The diagram below (Fig. 3) describes a pollutant's life cycle and identifies how pollution prevention or pollutant control and management address a pollutant at different stages in that life cycle.

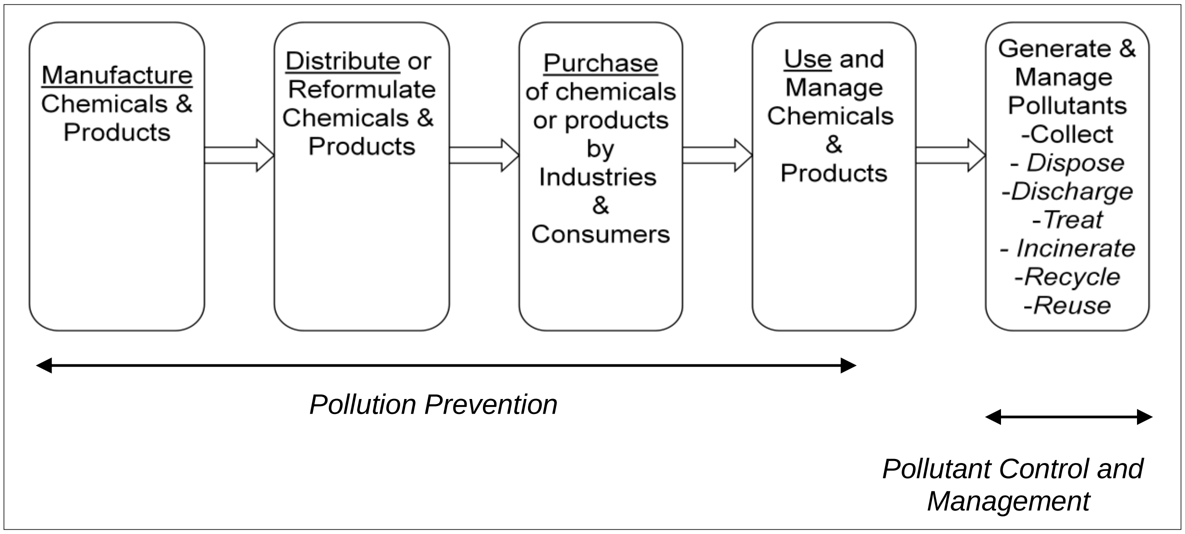

Figure 3. Reduction measures and the life cycle of a pollutant.

5.3 Mechanisms for Achieving Pollution Prevention, Control or Management

There are many actions that can help achieve either pollution prevention or pollutant control or management, depending on how they are implemented. These mechanisms can be voluntary or regulatory, and the use of one mechanism does not need to occur at the exclusion of the others. Some are outlined below.

Chemical Replacement Mechanisms
Actions in the *Chemical Replacement Mechanisms* category include approaches that would develop or identify benign chemicals that could replace persistent pollutants in products and processes. These include measures such as:

- Review and promotion of safer alternatives; and
- Support for research on green chemistry for safer chemical forms to replace persistent pollutants.

Market-based Mechanisms
Actions in the *Market-based Mechanisms* category rely on the power of the market to provide pollutant reductions and include:

- Product labeling to advertise "green" content and community "right-to-know;"
- Eco-certification by third parties for products and services that meet pollutant reduction criteria;
- Producer responsibility for a pollutant from manufacture through end of life; and
- Byproduct trading programs – e.g. repurposing waste products.

Educational Mechanisms
Actions in the *Educational Mechanisms* category rely on providing information to consumers, businesses, and industrial users of toxic chemicals that can become persistent pollutants in the environment, and can include:

- Technical assistance regarding best management practices; and
- Education and outreach.

Incentive Mechanisms

Actions in the *Incentive Mechanisms* category are or could in the future be included in direct regulatory programs to provide incentives for entities to voluntarily take specific pollution control of reduction measures. They include:

- Incentives for businesses, institutional entities and agricultural producers to take pollution prevention actions beyond regulatory compliance measures; and
- Incentives for consumer purchases of products containing safer alternatives to products containing chemicals that can become persistent pollutants.

Direct Regulatory Mechanisms

Actions in the *Direct Regulatory Mechanisms* category include traditional approaches to pollution control, such as actions required under relevant state laws or regulations (e.g. Resource Conservation and Recovery Act (RCRA) of 1976), as well as new requirements that:

- Limit or prohibit use of persistent pollutants;
- Limit or prohibit release of persistent pollutants;
- Require disclosure (i.e., require disclosure of chemical data);
- Require producer responsibility for the full life cycle of the pollutant – including take-back and recycling at the end of their life cycle; or
- Require removal of pollutants discharged into the environment.

Tax and Credit Mechanisms

Actions in the *Tax and Credit Mechanisms* category rely on financial tools to achieve reductions and include:

- Taxes at point of purchase – for products containing certain pollutants;
- Taxes on discharges – below regulatory levels; and
- Tax credits for certain, achieved reductions beyond compliance with regulations.

5.4 Supporting Activities: Monitoring and Measurement

Measures in the *Supporting Activities* category provide information about the presence of pollutants in the environment at various locations and over time, and also measure the release or presence of persistent pollutants into the environment. These activities to some level have been occurring and should continue to occur. They include:

- Source identification – to locate sources of persistent pollutants;

- Biosolids monitoring – to better understand the fate of persistent pollutants;
- Sediment monitoring – to better understand the fate of persistent pollutants;
- Effectiveness monitoring – to determine whether reduction measures are working;
- Ambient environmental monitoring – to measure levels of persistent pollutants in Oregon's waterways;
- Biological indicator monitoring and human biomonitoring to understand exposure to persistent pollutants;
- Drinking water intake systems – to assess risk of persistent pollutants in drinking water;
- Modeling & assessment – to identify contaminated sites and predict sources and pathways of persistent pollutants; and
- Source testing for air pollutants – to monitor specific amounts of persistent pollutants coming from certain types of industrial or institutional facilities.

5.5 Evaluation and Assessment Process for Reduction Measures

DEQ's list of potential reduction measures, and mechanisms to achieve those measures, included a long list of potential actions by a variety of entities. SB 737 required DEQ to assess which measures should be prioritized for reducing priority persistent pollutants.[23] To achieve this, DEQ evaluated potential reduction measures by identifying pollutants with a high potential for pollution prevention and then assessing linkages between different types of pollutants and their sources and potentially effective reduction measures.

Determine Level of Effort for Pollutant Reduction

As described in section 4.4 of this report, DEQ evaluated persistent pollutants according to two significant qualities: *potential to cause harm* and *opportunities to reduce at the source*. DEQ compared this information to better understand which reduction measures could provide the greatest pollutant reduction relative to level of effort. DEQ categorized individual persistent pollutants into broad pollutant groups, noting the median "score" for each group. For example, all individual halogenated flame retardants on the P3 List scored with a very high potential to cause harm with many opportunities to reduce at the source. In some cases there was a wide range of values within a pollutant group, and DEQ separated the pollutants into two groups. Also, many consumer-related chemicals scored with a high potential to cause harm with many opportunities to reduce at the source, but some scored with a moderate potential to cause harm with many opportunities to reduce at the source. The results of this qualitative assessment are summarized in the following diagram (Fig. 4) and described below. Placement of pollutant groups and reduction measure categories on this chart is based upon a qualitative analysis, and is intended to illustrate, in a general sense, where pollutant groups fall in this continuum. Refer to the summary table on page 7 and the *Pollutant Profiles* table (Attachment 4) for more information about specific pollutants.

[23] ORS 468B.139(2)(c)

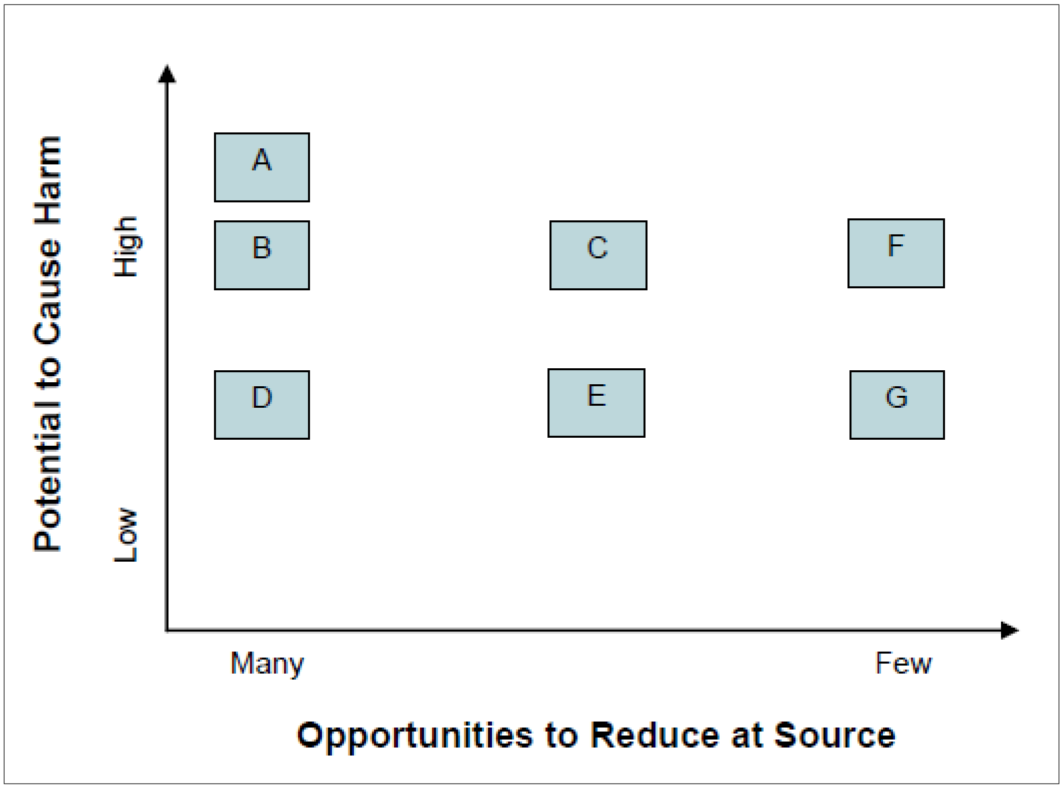

Figure 4. Level of effort for pollutant reduction.

A. **Very high potential to cause harm and many opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present the highest potential threat to human health or the environment, and the greatest opportunities for reduction at the source.
   - Halogenated Flame Retardants;[24] and
   - Organic and inorganic metals[25]

B. **High potential to cause harm and many opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a high potential threat to human health or the environment, and the greatest opportunities for reduction at the source.
   - Some Perfluorinated Surfactants;[26]
   - Polycyclic Aromatic Hydrocarbons (PAHs);
   - Many Consumer Related Chemicals;[27] and
   - Some Current Use Pesticides[28]

C. **High potential to cause harm and some opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a high potential threat to human health or the environment, and some opportunities

[24] PBDE-099, PBDE-100, PBDE-153, PBDE-047, Hexabromocyclodecane (HBCD), PBDE-209, Tetrabromobisphenol A (TBBPA)
[25] Cadmium Compounds (dissolved), Lead Compounds (dissolved), Arsenic Compounds (As(III), dissolved), Selenium Compounds (total), Methylmercury (1+ ion)
[26] Perfluorooctane sulfonic acid (PFOS), Perfluorooctanoic acid (PFOA)
[27] Triclosan, Galaxolide (HHCB}, Cholesterol, Coprostanol, Cyclopentasiloxane decamethyl- (D5), Sitostanol, beta-(Stigmastanol), beta-Sitosterol,
[28] Chlorpyrifos (Lorsban, Dursban), Endosulfan sulfate, Bifenthrin, Dicofol, Oxyfluorfen, Pendimethalin

for reduction at the source. These pollutants are already banned or are being phased out of use, but are detected in high quantities and may still be actively loaded into the environment.

- Some PCBs[29]

D. **Moderate potential to cause harm and many opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a moderate potential threat to human health or the environment and many opportunities exist for reduction at the source.

- Many Current Use Pesticides;[30]
- Industrial Chemicals;[31] and
- Some Consumer-related Chemicals[32]

E. **Moderate potential to cause harm and some opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a moderate potential threat to human health or the environment and some opportunities exist for reduction at the source. Many of these pollutants are already banned or are being phased out of use.

- Some Perfluorinated Surfactants;[33] and
- Many PCBs[34]
- Some Consumer-related Chemicals[35]

F. **High potential to cause harm but few opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a high potential threat to human health or the environment, and they are already banned or are being phased out of use.

- Many Legacy Pesticides;[36] and
- Dioxins and Furans

G. **Moderate potential to cause harm but few opportunities to reduce at the source.** Relative to other persistent pollutants, these pollutants in the environment present a moderate potential threat to human health or the environment, and they are already banned or are being phased out of use.

- Some Legacy Pesticides;[37] and
- Polychlorinated Naphthalenes

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[29] PCB-081, PCB-105, PCB-118, PCB-126, PCB-138

[30] lambda-Cyhalothrin, Fipronil, Pentachlorobenzene, Pentachloronitrobenzene, Trifluralin, Deltamethrin (decamethrin), Esfenvalerate, Fenbutatin-oxide, Myclobutanil, Prochloraz, Diazinon , Linuron, Pentachloroanisole (2,3,4,5,6-Pentachloroanisole)

[31] Octachlorostyrene, 2,4,6- Tris-(1,1-dimethylethyl)phenol (Alkofen B), Decafluorobiphenyl, Benzotrichloride (trichloromethylbenzene)

[32] octamethyl-Cyclotetrasiloxane (D4), p-Terphenyl, Musk indane

[33] PFNA, PFOSA and PFHpA

[34] PCB-052, PCB-101, PCB-153, PCB-156, PCB-157, PCB-169, PCB-180, PCB-185, PCB-028, PCB-077, PCB-114, PCB-167, PCB-189, PCB-123.

[35] Hexachlorophene, Diethylstilbestrol, Musk ketone, Musk xylene, Pimozide, Roxithromycin, Musk tibetene

[36] Dieldrin, Endrin, Mirex, cis-Chlordane, trans-Chlordane,4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Heptachlor, Heptachlor epoxide, Hexachlorobenzene (HCB), alpha-Hexachlorocyclohexane, beta-Hexachlorocyclohexane, gamma-Hexachlorocyclohexane (Lindane), cis-Nonachlor, trans-Nonachlor

[37] Bis (tributyltin) oxide (TBTO, hexabutyldistannoxane), Isodrin, single isomer Oxychlordane, Chlordecone (Kepone), Dinoseb, 2,4,6-Trichlorophenol, 2,4,5-Trichlorophenol

Associate Reduction Efforts with Pollutant Source

One of the main goals of SB 737 is to prevent pollution by persistent bioaccumulative and toxic chemicals. In general, measures that address persistent pollutants at the source are preferable over control measures, because they are generally less expensive and more efficient, effective and reliable. However, there are some pollutants already in the environment for which reduction and control measures are more appropriate. Some pollutants have unique uses or distinct pathways to the environment, and therefore will respond to specialized reduction measures.

DEQ considered how pollutants are used, and outlined general reduction measures for each pollutant or pollutant group following the general process shown in Figure 5, below.[38] DEQ then summarized potential measures for reducing the discharge of persistent pollutants into Oregon's waters.

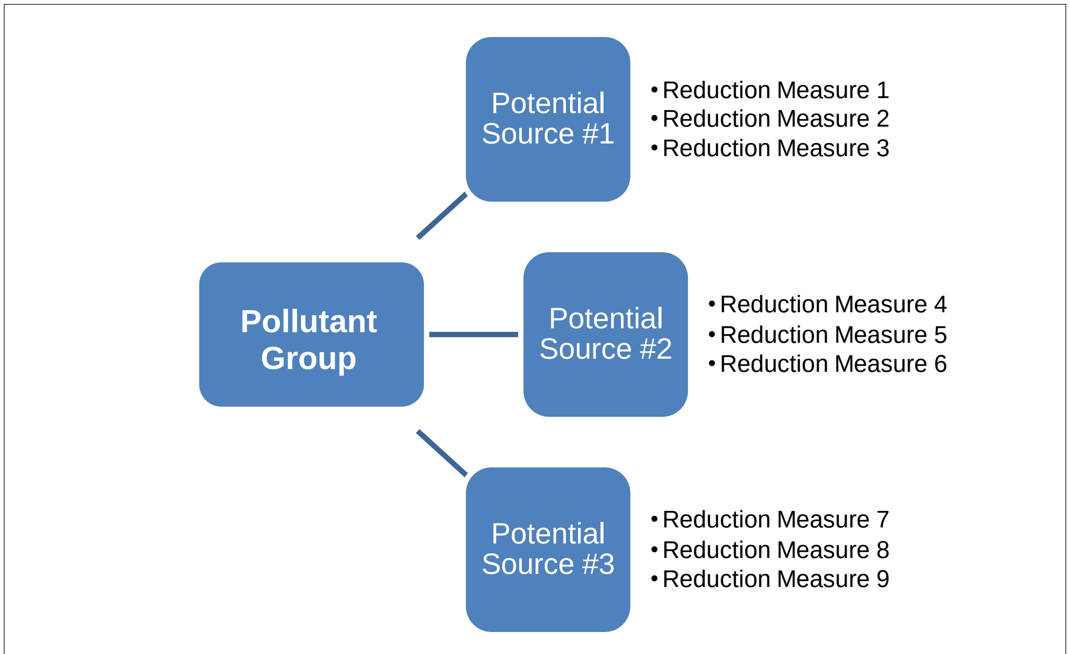

Figure 5. Process to associate reduction efforts with pollutant source

Assess Costs and Effectiveness

SB 737 required DEQ to assess the costs and effectiveness of reduction measures.[39] Generally, pollution prevention measures are lower cost than pollutant control and management. Pollution prevention is also more effective than managing pollutants at the end of their life cycle (See Fig.6). For example, reformulating products to limit ingredients that can become persistent pollutants after use is more cost effective than redesigning wastewater treatment facilities to treat the pollutant after consumers have disposed of products containing persistent pollutants down the drain.

Certain types of reduction measures are most amenable for certain entities, and the ultimate cost effectiveness will depend on how entities implement activities.

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[38] Where possible, DEQ organized individual pollutants into groups with similar chemical properties, uses and sources to the environment. For example, individual Polycyclic Aromatic Hydrocarbons were categorized into one group, PAHs.

[39] ORS 468B.139(2)(c)

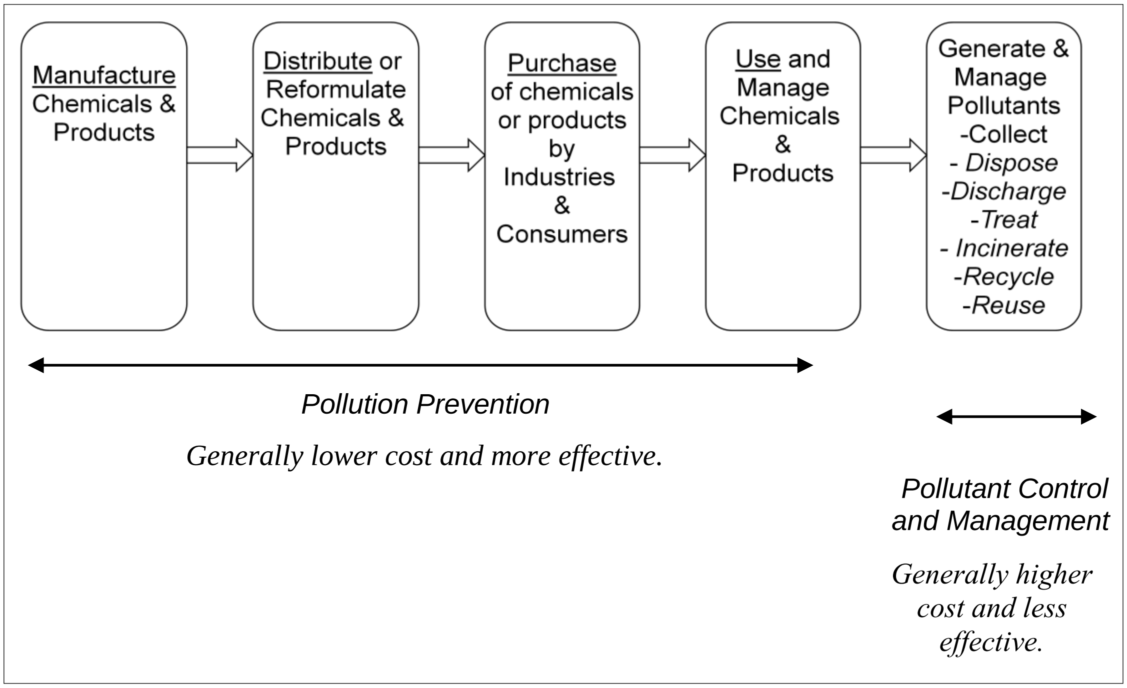

Figure 6. Reduction measures and the life cycle of a pollutant.

Next Steps Prior to Implementation: Consider Other Criteria
DEQ generally assessed whether reduction measures outlined in this report generally had the potential to successfully achieve pollution reduction when fully developed by an implementing agency. DEQ developed evaluation criteria in conjunction with the agency's Toxics Reduction Strategy team. DEQ will apply the following criteria to specific reduction programs prior to implementation These criteria should also be applied to specific reduction programs prior to implementation by other entities:

- **Effective in achieving reduction.** Measures will reduce discharge of the pollutant(s) into Oregon's waters, either directly or indirectly.
- **Implementable.** Reduction measures are capable of being implemented, as determined by program-level experts in relevant sectors.

Measures that are deemed effective and implementable should be evaluated according to the additional criteria below:

1. **Reduce pollutants at the source.** Reduction measures address persistent pollutants at their source, rather than after they have been released into the environment.
2. **Address multiple priority pollutants.** Reduction measures target many pollutants instead of addressing individual pollutants.
3. **Build on existing efforts.** Reduction measures build on successful programs and efforts currently implemented by government or non-governmental entities.

5.6 Reduction Measures to be Prioritized

Senate Bill 737 required DEQ to evaluate and assess source reduction and technological control measures that can reduce the discharge of persistent pollutants into Oregon's waters, including an assessment of which measures should be prioritized for reducing such pollutants.[40] To accomplish this, DEQ followed the process described in this report, noting that there are other measures that can and do reduce persistent pollutants. Prior to implementing any reduction measures outlined here, existing programs should be evaluated and proposed actions should be evaluated with criteria laid out in section 5.5.

Because persistent pollutants pose potential threats to human and aquatic life, any measures taken to reduce their presence in Oregon's waters will benefit Oregonians. The reduction measures listed below represent some actions DEQ considered to be most cost-effective that could be taken to reduce certain types of persistent pollutants in Oregon's waters. Pollutant categories are listed in order of the level of effort necessary to achieve pollution reduction. Pollutants with relatively high potential to cause harm and many opportunities to reduce at the source are listed first, and pollutants with less potential to cause harm and fewer opportunities to reduce at the source are listed last. Reduction measures that target reductions for each group of pollutants are generally listed with pollution prevention activities first and management or control activities last. Pollution prevention measures are generally more preferable because they are often the most cost-effective means to reduce pollutants and result in reductions at the source.

Pollutants with very high potential to cause harm and many opportunities to reduce at the source

Halogenated Flame Retardants.[41] Flame retardants such as PBDEs added to electronics, furniture, insulating foam and many other consumer products may travel into people's bodies and the environment while the products are in use or after products are discarded. Because halogenated flame retardants have the capacity to migrate out of products into the environment or to humans through direct exposure, measures that are likely to be most effective are those that reduce these persistent pollutants either before they are impregnated into consumer products, or before impregnated consumer products are purchased or disposed of as waste. Measures most likely to achieve reduction include:

- Market-based pollution prevention such as environmental certification programs and labeling relative to halogenated flame retardant content for furniture, electronics and other products;
- Chemical replacement through green chemistry research to develop safer alternatives;
- Collaborative pollution prevention such as partnerships with chemical and product producers to reduce the use of halogenated flame retardants in products;
- Regulatory measures such as required disclosure on product ingredients and phase-outs of halogenated flame retardants, once viable, safer alternatives are identified;
- Surcharges on products containing halogenated flame retardants to educate the public about the environmental costs of persistent pollutants and to pay for needed reduction measures;

[40] ORS 468B.139(2)(c)
[41] e.g. PBDEs

- Collection events for wastes containing halogenated flame retardants and required producer responsibility for the full life-cycle of a pollutant;
- Education on proper disposal of furniture containing high levels of halogenated flame retardants; and
- Supporting activities such as monitoring to identify sources and levels in organisms and the environment.

Organic and inorganic metals. Cadmium, lead, selenium, arsenic and methylmercury are naturally-occurring elements with a variety of historic and current industrial and commercial uses. Because these metals are released to the environment from both natural sources and human activities, measures that are likely to be most effective are those that reduce the discharge of metals through soil disturbance, erosion, and runoff in both rural and urban areas, and at specific discharge locations from cities and industries. For certain metals, effective reduction measures may also include reducing waste from relevant manufacturing processes and improper disposal of products containing persistent pollutants. Measures most likely to achieve reduction include:

- Chemical replacement and phase-outs of certain metals in products (such as batteries) that become persistent pollutants when used, once viable, safer alternatives are identified;
- Public education concerning the risk of exposure to certain metals such as arsenic, lead and mercury;
- Market-based pollution prevention actions such as product labeling and environmental certification programs for products that don't contain persistent pollutants;
- Regulatory, voluntary or incentive-based approaches to improve stormwater controls in urban areas, and targeted erosion control measures in rural and urban areas, to reduce persistent pollutants entering surface waters from runoff;
- Collection events for wastes containing persistent pollutants; and
- Supporting activities such as continued monitoring to identify specific sources and levels of persistent pollutants in the environment.

Pollutants with high potential to cause harm and many opportunities to reduce at the source

Some Perfluorinated Surfactants.[42] PFOS and PFOA have a higher potential to cause harm than other perfluorinated surfactants. Because chemicals used in surface protection products such as carpet and clothing treatments and coatings for packaging enter the environment through wastewater, measures that are likely to be most effective are those that will reduce these persistent pollutants before they reach wastewater. This can be achieved either by reducing the amount of persistent pollutants used in products or by reducing consumer demand for products containing perfluorinated surfactants. Measures most likely to achieve reduction include:

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[42] PFOS and PFOA

- Market-based measures such as environmental certification programs and product labeling for products without perfluorinated surfactants;
- Chemical replacement through green chemistry research on safer alternatives;
- Public and business education and outreach on available safer alternatives;
- Collaborative pollution prevention efforts, such as partnerships with chemical and product producers to reduce the use of certain perfluorinated surfactants in products;
- Regulatory measures, such as requiring disclosure on product ingredients and phase-outs of certain perfluorinated surfactants, when viable, safer alternative are identified;
- Pollutant control such as collection events, education on proper disposal and required producer responsibility for the full life-cycle of a persistent pollutant; and
- Supporting activities such as monitoring to identify sources and levels in organisms and the environment.

PAHs. These ubiquitous pollutants formed by incomplete combustion of carbon-containing fuels may be most effectively reduced by measures that limit combustion-related activities. Because PAHs also reach the environment through run-off from asphalt roofing and streets, measures that reduce the presence of PAHs in sealants may also be effective. Measures most likely to achieve reduction include:

- Incentives for more efficient cars and incentives for cleaner wood stoves;
- Transportation alternatives that foster pollution prevention, such as land use planning for less automobile-dependent communities;
- Regulatory actions, such as restrictions on residential, agricultural and forestry burning;
- Chemical replacement, such as evaluating and implementing alternatives to the use of PAHs in road surfaces and sealants;
- Regulatory, voluntary or incentive-based approaches that improve urban stormwater controls, to keep PAH-laden sediments out of streams; and
- Supporting activities such as monitoring to identify sources and levels in organisms and the environment.

Many Consumer Related Chemicals.[43] Many consumer related chemicals have a high potential to cause harm. Ingredients in consumer products such as antibacterial soap, dry cleaning fluid and scented laundry detergent generally enter the environment through wastewater after consumers wash products down the drain. Measures that are likely to be most effective are those that will reduce these persistent pollutants before they reach wastewater, either by reducing the amount of persistent pollutants used in products or by

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[43] e.g. Triclosan, D5, Galaxolide (fragrance), and Cholesterol

reducing consumer demand for products containing certain consumer-related chemicals that can become persistent pollutants when used. Measures most likely to achieve reduction include:

- Market-based measures such as environmental certification programs and product labeling for products that don't contain certain consumer-related chemicals that can become persistent pollutants when used;
- Chemical replacement through green chemistry research to develop safer alternatives;
- Public education and outreach on safer alternatives to consumer products containing persistent chemicals;
- Collaborative pollution prevention, such as partnerships with chemical and product producers to reduce the use of certain persistent pollutants in products;
- Required disclosure on product ingredients and bans and restrictions on certain pollutants;
- Pollutant control, such as collection events, education on proper disposal and required producer responsibility for the full life-cycle of a pollutant; and
- Supporting activities such as monitoring to identify sources and levels in organisms and the environment.

Some Current Use Pesticides.[44] Some current use pesticides have a higher potential to cause harm than others because they have a higher PBT score, are used more or are detected more frequently. Pesticides used for commercial agriculture, commercial landscaping and residential purposes may enter surface waters due to improper application, storage or disposal, via spray drift, or from soil erosion and runoff. Measures that are likely to be most effective are those that may reduce these persistent pollutants before they enter water, either by reducing the amount of persistent pollutants used in pesticide products where appropriate, by reducing unnecessary use of products containing persistent bioaccumulative and toxic chemicals that can become persistent pollutants after use, or by facilitating proper application and disposal of potentially persistent pesticides. Measures most likely to achieve reduction include:

- Market-based measures such as eco-certification programs and product labeling for those products that don't contain persistent bioaccumulative and toxic chemicals that can become persistent pollutants after use;
- Chemical replacement pollution prevention such as green chemistry to develop safer alternatives;
- Partnerships and technical assistance initiatives for commercial agriculture, to educate and promote Integrated Pest Management, pesticide drift reduction, safer alternatives, and other activities to minimize the amount of pesticides entering surface waters;

[44] e.g. Chlorpyrifos (Lorsban, Dursban), Endosulfan sulfate, Bifenthrin, Dicofol, Oxyflourfen, Pendimethalin

- Education and outreach to urban and residential users on Integrated Pest Management, safer alternatives, understanding pesticide labels and improved application methods;

- Changes to pesticide labels regarding proper application, vegetated buffers and drift reduction measures;

- Regulatory measures such as required disclosure on "inert" ingredients in pesticide products and use restrictions on certain product ingredients that become persistent pollutants;

- Increased registration fees for pesticides and surcharges at the point of purchase to fund pesticide pollution prevention activities and educate the public about the environmental costs of certain persistent pesticides found in water;

- Agricultural pesticide waste collection events or required producer responsibility for the full life-cycle of a persistent pollutant;

- Use of regulatory, voluntary, or incentive-based approaches to improve and expand implementation of stream bank stabilization and erosion control activities; and

- Supporting activities such as monitoring to identify sources and levels in the environment, to focus reduction activities, and to measure effectiveness of those activities (e.g. Pesticide Stewardship Partnerships).

Pollutants with high potential to cause harm and some opportunities to reduce at the source

Some PCBs. Some types of PCBs have a higher potential to cause harm than others because they have higher PBT scores or are detected more frequently. Although generally banned for production and use between 1979 and 1998, these global pollutants may be released into the environment from old equipment or products containing PCBs, such as electrical systems and industrial caulking. Stored containers of unused mixtures containing PCBs present another potential source of these persistent pollutants to the environment. Because PCBs are no longer manufactured, measures that are likely to be most effective are those that will address discharge from contaminated sites through control and management. Measures most likely to be effective will also reduce new discharge of PCBs to the environment from burning and improper disposal of old electrical systems, certain building and industrial caulking, and unused stores of PCB-containing mixtures. Measures most likely to achieve reduction include:

- Expedited removal process for contaminated areas, including identifying options for cleaning up "orphan" sites with PCB contamination;

- Maintenance of closed electrical systems and proper disposal for industrial caulking and old ballasts containing PCBs;

- Enhanced compliance and enforcement of Toxic Substances Control Act regulations related to PCBs;

- Supporting activities such as assessment to identify specific contaminated sites and monitoring to measure effectiveness of reduction activities; and
- Replacement of transformers containing PCBs.

Pollutants with moderate potential to cause harm and many opportunities to reduce at the source

Many Current Use Pesticides. Many pesticides listed as priority persistent pollutants present a moderate potential to cause harm. Like other pesticides used for commercial agriculture, commercial urban (e.g., landscaping) and residential purposes, they may run off into surface water due to improper application or disposal, or due to soil erosion. Measures that are likely to be most effective are those that will reduce these persistent pollutants before they enter water, by reducing the amount of persistent pollutants used in products, by reducing consumer demand for products containing persistent bioaccumulative and toxic chemicals that can become persistent pollutants after use, by reducing excess use of products containing persistent bioaccumulative and toxic chemicals that can become persistent pollutants after use, or by facilitating proper disposal of potential persistent pollutants. Measures most likely to achieve reduction include:

- Measures similar to those for other current use pesticides. (See page 43.)

Industrial Chemicals. Chemicals used in industrial processing, such as optical and semiconductor research and certain types of pulp processing, may become persistent pollutants after use. In some cases, gasoline transport for residential or recreational use may result in spills of industrial chemicals. Because industrial chemicals have very specific uses and pathways to the environment, measures that are likely to be most effective are those that will address particular industries and reduce the discharge of industrial persistent pollutants by chemical replacement or controlling spills from gasoline transport. Measures most likely to achieve reduction include:

- Chemical replacement, such as green chemistry to develop safer alternatives;
- Expanded industrial pre-treatment programs to encompass smaller municipalities and additional industrial sectors that discharge persistent pollutants; and
- Pollutant control such as stormwater control to keep "road dirt" containing persistent pollutants out of streams.

Some Consumer-related Chemicals.[45] Some ingredients in consumer products, such as synthetic estrogen, pharmaceuticals, sunscreen, some fragrances in soaps and scented laundry detergent, present a moderate potential to cause harm because of a relatively low PBT score or because they are little used. Like other consumer-related chemicals, these pollutants enter the environment through wastewater after consumers wash products down the drain. Measures that are likely to be most effective are those that could reduce these persistent pollutants before they reach wastewater, either by reducing the amount of persistent pollutants used in products or by reducing consumer demand for products

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[45] e.g. D4, p-Terphenyl, Musk indane (fragrance)

containing certain consumer-related chemicals that can become persistent pollutants when used. Measures most likely to achieve reduction include:

- Measures similar to those for other consumer-related chemicals. (See page 46.)

Pollutants with moderate potential to cause harm and some opportunities to reduce at the source

Some Perfluorinated Surfactants.[46] Some perfluorinated surfactants have lower potential to cause harm and present fewer opportunities to address at the source than others. Some chemicals used in surface protection products, such as carpet and clothing treatments and coatings for packaging, may still be in use but are no longer in production in the United States. Because these pollutants enter the environment through wastewater, measures that are likely to be most effective are those that will reduce these persistent pollutants before they reach wastewater. Measures most likely to achieve reduction include:

- Measures similar to for those for other perfluorinated surfactants. (See page 41.)

Many PCBs. Many PCBs pose a moderate potential to cause harm if released into the environment because they have a lower PBT score than other PCBs. These global pollutants may be released from old equipment or products containing PCBs, such as electrical systems and industrial caulking. Stores of unused mixtures containing PCBs are another potential source of these persistent pollutants to the environment. Because PCBs are no longer manufactured, measures that are likely to be most effective are those that will address discharge from contaminated sites through control and management. Measures that also reduce new releases of PCBs to the environment from burning and improper disposal of old electrical systems, certain building and industrial caulking, and leaking from unused stores of PCB-containing mixtures may also be effective. Measures most likely to achieve reduction include:

- Measures similar to for those for other PCBs. (See page 44.)

Pollutants with high potential to cause harm but few opportunities to reduce at the source

Many Legacy Pesticides.[47] Many legacy pesticides have a higher potential to cause harm than others because they have high PBT scores and are frequently detected in the environment. Although banned for production and use, these persistent pollutants may be released into the environment when contaminated soil or sediment are disturbed through erosion, new construction or sediment dredging in rivers. Storage containers of unused legacy pesticides are a potential source of these persistent pollutants to the environment because of the potential for spills, leaking and unsafe storage locations. Because legacy pesticides are no longer manufactured, measures that are likely to be most effective are those that will address discharge from contaminated sites through control and management. Measures likely to effectively reduce these persistent pollutants will address erosion and run-off from urban and rural areas, soil disturbance from new construction in contaminated

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[46] e.g. PFNA, PFOSA and PFHpA

[47] e.g. Dieldrin, Endrin, Mirex, Chlordane, DDT, Heptachlor, Lindane

areas, long-term storage in barns, and sediment dredging in rivers. Measures most likely to achieve reduction include:

- Agricultural pesticide waste collection events or required producer responsibility for the full life-cycle of a pollutant;
- Use of regulatory, voluntary, or incentive-based approaches to improve and expand stream bank stabilization and erosion control activities;
- Technological innovation for new ways to treat (i.e., detoxify and decrease quantities of) persistent pollutants safely;
- Expedited removal for contaminated areas; and
- Supporting activities such as assessment to identify specific contaminated sites and monitoring to measure effectiveness of reduction activities.

Dioxins and Furans. Dioxins and furans are not commercial chemical products but are trace level unintentional byproducts of most forms of combustion and several industrial chemical processes. Because dioxins and furans are widely distributed throughout the environment in low concentrations, measures likely to be most effective for reduction are those that focus on control and management of highly contaminated sites and reducing open burning. Measures most likely to achieve reduction include:

- Regulatory pollutant control, such as continued bans and restrictions on residential burning; and
- Supporting activities such as assessment to identify specific contaminated sites and monitoring to measure effectiveness of reduction activities.

Pollutants with moderate potential to cause harm but few opportunities to reduce at the source

Some Legacy Pesticides. Some pesticides banned for production and use pose moderate potential to cause harm because they have lower PBT scores than other legacy pesticides. Like other legacy pesticides, these persistent pollutants may be released into the environment when contaminated soil or sediment are disturbed through erosion, new construction or sediment dredging in rivers. Stores of unused legacy pesticides are a potential source of these persistent pollutants to the environment. Because legacy pesticides are no longer manufactured, measures likely to be most effective are those that address discharge from contaminated sites through control and management. Other measures likely to be effective in reducing these persistent pollutants may address erosion and run-off from urban and rural areas, soil disturbance from new construction in contaminated areas, long-term storage in barns, and sediment dredging in rivers. Measures most likely to achieve reduction include:

- Measures similar to for those for other legacy pesticides. (See page 46.)

Polychlorinated Naphthalenes (PCNs). PCNs are legacy pollutants historically used as lubricants and insulators for electrical units prior to their replacement by PCBs. These global pollutants may be released into the environment from old equipment or products containing PCNs, or as unintentional by-products of high temperature industrial processes including incineration. Stores of unused mixtures containing PCNs are another potential source of these persistent pollutants to the environment. Because PCNs have not been manufactured since the 1970s, measures likely to be most effective are those that reduce new discharge of these legacy pollutants through management and control of contaminated sites. Measures most likely to achieve reduction include:

- Supporting activities such as assessment to identify specific contaminated sites and monitoring to measure effectiveness of reduction activities.

All priority persistent pollutants

Persistent pollutants should be addressed comprehensively, rather than on a pollutant-by-pollutant, environmental media-by-environmental media, or agency-by-agency basis. Meaningful reductions in the amount of persistent pollutants in the environment, and particularly exposure to people and animals, can only be achieved this way. This report presents one way to holistically assess pollutants' potential to cause harm and opportunities to reduce pollutants at their source based on available information. Future efforts should also aim to address persistent pollutants in Oregon's air and land environments, in addition to addressing water pollution. Ongoing collaboration and partnerships to reduce persistent pollutants might include states working collaboratively on toxic chemical policy and data management activities to leverage resources and ensure consistency among states and agencies. DEQ is committed to using cross-agency coordination and partnerships to reduce toxic pollutants.

5.6 Conclusion

This DEQ report focuses on the persistent pollutants that pose potential and known threats to human and aquatic life if they enter Oregon's waters. It concludes that pollution prevention activities to address priority persistent pollutants should be an essential component of environmental programs at DEQ and elsewhere. All Oregonians can take steps to limit the generation of, exposure to, and movement of these pollutants. Information in this report can provide a basis for continuing discussions about identifying and reducing priority persistent pollutants in Oregon's waters. Additionally, this report contributes significantly to DEQ's work with Oregonians to develop a comprehensive toxics reduction strategy for the State of Oregon and our environment.

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7 Abbreviations Used in Text

ATSDR	U.S. Agency for Toxic Substances and Disease Registry
CASRN	Chemical Abstract Service Registry Number
CDC	U.S. Centers for Disease Control and Prevention
D4	octamethyl-Cyclotetrasiloxane
D5	decamethyl-Cyclopentasiloxane
DEQ	Oregon Department of Environmental Quality
DOD	Department of Defense
DOE	Department of Energy
HBCD	Hexabromocyclododecane (a brominated flame retardant)
HPV	High Production Volume (chemicals)
HSIS	Hazardous Substance Information Survey
HSWA	Hazardous and Solid Waste Amendments
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level (U.S. EPA for drinking water)
NCEA	EPA's National Center for Environmental Assessment
NWIS	National Water Information System
ORD	EPA's Office of Research and Development
ORS	Oregon Revised Statutes
P3L / P3 List	Priority Persistent Pollutant List (required by SB 737)
PAH	Polycyclic Aromatic Hydrocarbon
PBDE	Polybrominated Diphenyl Ethers
PBT	Persistent, Bioaccumulative, and Toxic (chemical)
PCB	Polychlorinated Biphenyl
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic acid
PURS	Oregon Pesticide Use Reporting System
RCRA	Resource Conservation and Recovery Act
RoC	U.S. Dept. of Health and Social Services' Report on Carcinogens
SB 737	Oregon Senate Bill 737
SDWA	Safe Drinking Water Act
TRI	Toxics Release Inventory (U.S. EPA program)
UIC	Underground Injection Control
U.S. EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WWTP	Wastewater Treatment Plant