FACT SHEET FOR
WILLAPA GRAYS HARBOR OYSTER GROWERS ASSOCIATION
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
(NPDES) PERMIT NO. WA0039781

October 24, 2014

PURPOSE OF THIS FACT SHEET

This fact sheet explains and documents the decisions the Department of Ecology (Ecology) made in drafting the proposed National Pollutant Discharge Elimination System (NPDES) Permit for the Willapa Grays Harbor Oyster Growers Association (WGHOGA).

This fact sheet complies with Section 173-220-060 of the Washington Administrative Code (WAC), which requires Ecology to prepare a draft permit and accompanying fact sheet for public evaluation before issuing an NPDES permit.

Ecology makes the draft permit and fact sheet available for public review and comment at least 30 days before issuing the final decision on permit issuance. Copies of the fact sheet and draft permit for Burrowing Shrimp Control Using the Pesticide Imidacloprid, NPDES Permit WA0039781, are available for public review and comment. For more details on preparing and filing comments about these documents, please see **Appendix B - Public Involvement Information**.

After the public comment period closes, Ecology will summarize substantive comments and provide responses to them. Ecology will include the summary and responses to comments in this fact sheet as **Appendix D - Response to Comments**, and publish it when issuing the final NPDES permit. Ecology generally will not revise the fact sheet after the Draft Permit has been made available for public comment. The full document will become part of the legal history contained in the facility's and Ecology's permit file.

SUMMARY

Since at least the 1940s, two native species of burrowing shrimp (ghost shrimp, *Neotrypaea californiensis* and mud shrimp, *Upogebia pugettensis*) have caused impacts to Pacific Coast commercial clam and oyster production by disrupting the structure and composition of the substrate, causing these shellfish to sink and suffocate. Until recently, commercial shellfish growers in Willapa Bay and Grays Harbor, Washington, have used the N-methyl carbamate insecticide "carbaryl" to control burrowing shrimp. The Willapa-Grays Harbor Oyster Growers Association (WGHOGA) is now seeking permit approval to use the neonicotinoid class of insecticide[1] "imidacloprid" as a replacement for carbaryl for burrowing shrimp control in the aquatic environment of these two estuaries.

[1] Neonicotinoids are a class of neuro-active insecticides chemically similar to nicotine. Neonicotinoids were developed in large part because they show reduced toxicity compared to previously used organophosphate and carbamate insecticides. Most neonicotinoids show much lower toxicity in birds and mammals than insects, but some

WGHOGA has requested issuance of a NPDES permit for the purpose of allowing applications of imidacloprid on up to 2,000 acres per year of shellfish beds on which clams and oysters are commercially grown: permitting application on up to 1,500 acres per year in Willapa Bay, and up to 500 acres per year in Grays Harbor. These applications would be made using adaptive management principles, as described in an Integrated Pest Management (IPM) Plan to be reviewed by Ecology.

The proposed action is to allow the discharge of imidacloprid, through development of an NPDES individual permit, for the purpose of managing burrowing shrimp populations in Willapa Bay and Grays Harbor. The objective of the proposed action is to preserve and maintain the beneficial uses of Willapa Bay and Grays Harbor.

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breakdown products are toxic (Lee Chao and Casida 1997, as cited in http://en.wikipedia.org/wiki/Neonicotinoid, September 14, 2014). The neonicotinoid imidacloprid is currently the most widely used insecticide in the world (Yamamoto 1999, as cited in http://en.wikipedia.org/wiki/Neonicotinoid, September 14, 2014).

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I INTRODUCTION

The Federal Clean Water Act (FCWA, 1972, and later amendments in 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One mechanism for achieving the goals of the Clean Water Act is the National Pollutant Discharge Elimination System (NPDES), administered by the federal Environmental Protection Agency (EPA). The EPA authorized the state of Washington to manage the NPDES permit program in our state. Our state legislature accepted the delegation and assigned the power and duty for conducting NPDES permitting and enforcement to Ecology. The Legislature defined Ecology's authority and obligations for the wastewater discharge permit program in 90.48 Revised Code of Washington (RCW).

The following regulations apply to Individual NPDES permits:

- Procedures Ecology follows for issuing NPDES permits [chapter 173-220 Washington Administrative Code (WAC)]
- Water quality criteria for surface waters (chapter 173-201A WAC)
- Water quality criteria for ground waters (chapter 173-200 WAC)
- Whole effluent toxicity testing and limits (chapter 173-205 WAC)
- Sediment management standards (chapter 173-204 WAC)
- Submission of plans and reports for construction of wastewater facilities (chapter 173-240 WAC)

These rules require WGHOGA to obtain an NPDES permit before discharging pollutant to state waters. They also help define the basis for limits on each discharge and for performance requirements imposed by the permit.

Under the NPDES permit program and in response to a complete and accepted permit application, Ecology must prepare a draft permit and accompanying fact sheet, and make them available for public review before final issuance. Ecology must also publish an announcement (public notice) telling people where they can read the draft permit, and where to send their comments, during a period of 30 days (WAC 173-220-050). (See **Appendix B-Public Involvement Information** for more detail about the public notice and comment procedures). After the public comment period ends, Ecology may make changes to the draft NPDES permit in response to comment(s). Ecology will summarize the responses to comments and any changes to the permit in **Appendix D**.

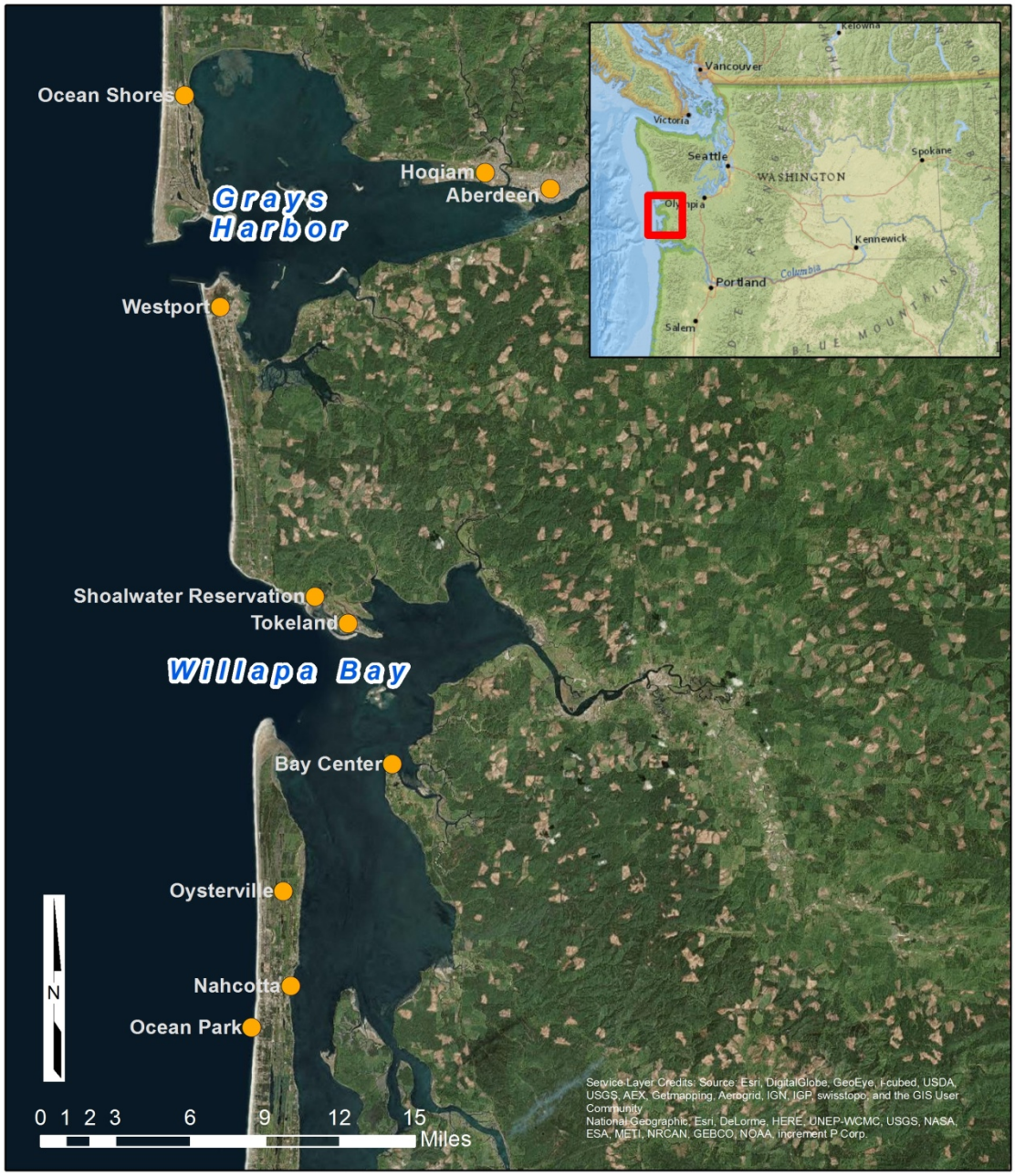
II BACKGROUND INFORMATION

Table 1 - General Facility Information

Facility Information	
Applicant	Willapa/Grays Harbor Oyster Growers Association (WGHOGA)

Facility Information	
Facility Name and Address	• Willapa Bay and Grays Harbor, Washington • These large estuaries are located in Pacific County and Grays Harbor County, respectively, on the Pacific Ocean coast in the southwest corner of the State.
Contact at Facility	Name: Don Gillies, President Telephone #: 360-875-9964
Responsible Official	Name: Don Gillies Title: President Address: P.O. Box 3 Ocean Park, WA 98640 Telephone #: 360-875-9964
Industry Type	Shellfish Farming
Type of Treatment	Pesticide
SIC Codes	0273, 0913
NAIC Codes	112512
Facility Location (NAD83/WGS84 reference datum)	Latitude: Longitude:
Discharge Waterbody Name and Location (NAD83/WGS84 reference datum)	Willapa Bay Latitude (decimal degrees): 46.37, 46.75 Longitude (decimal degrees): -124.05, -123.84 Grays Harbor Latitude (decimal degrees): 46.86, 47.04 Longitude (decimal degrees): -124.16, -123.84
Permit Status	
Application for Permit Submittal Date	July 1, 2013

Figure 1 - Facility Location Map



A. <u>Facility Description</u>

History

Willapa Bay and Grays Harbor are highly productive estuaries. Willapa Bay produces approximately 65 percent of the oysters and 13 percent of the clams harvested in Washington State. The combined oyster harvest from Willapa Bay and Grays Harbor constitutes approximately 25 percent of total oyster landings in the United States. The majority of oysters are raised directly on the substrate from subtidal elevations to about

the +3.5-foot mean lower low water (MLLW) elevation level in the intertidal region. There are a total of about 25,622 acres of deeded and classified oyster grounds in Willapa Bay (NMFS, April 28, 2009) (see Figure 2), of which approximately 9,000 acres are currently farmed (CSI 2013). There are approximately 3,995 acres of tidelands owned or leased for commercial shellfish aquaculture within Grays Harbor: 3,088 acres in North Bay and 907 acres in South Bay (NMFS, April 28, 2009) (see Figure 3), of which approximately 900 acres are currently farmed for the commercial production of oysters and clams (CSI 2013). In addition, the Washington Department of Fish and Wildlife (WDFW) manages approximately 10,000 acres of oyster reserve tidelands in Willapa Bay—land originally set aside and State ownership retained to assure that a supply of seed oysters is maintained. The Washington Department of Natural Resources (WDNR) also leases some additional subtidal and intertidal areas for the cultivation of shellfish in Willapa Bay and Grays Harbor.

Willapa Bay oyster cultivation began before statehood in Washington. Prior to statehood, oysters were cultivated by obtaining native oyster seed from "natural oyster beds" and moving them to other intertidal areas controlled by various growers and companies. At the time of statehood (November 11, 1889), the new constitution claimed all tidelands as State property. The first Legislative session after statehood (1889–1890) allowed those oyster growers who had been transferring shellfish to other intertidal areas the right to purchase these holding and growing areas. These were referred to as the "artificial oyster beds" to distinguish them from the "natural oyster beds" that remained under State ownership. Private ownership of tidelands obtained under this initial Legislative action was transferable (Shotwell 1977).

In 1895, the Washington State Legislature acted to permit the sale of State tidelands to be used exclusively for the planting of oysters. The Bush and Callow Acts permitted deeded ownership of these intertidal areas. These original Acts were modified occasionally by the State Legislature. In 1919, the Acts were changed so that any edible shellfish could be cultivated on the deeded areas, not only oysters.[2] In 1927, a limiting clause was inserted that retained oil, gas and mineral rights for the State on the privately-held tidelands. In 1935, after the successful introduction of the Japanese (Pacific) oyster, the Legislature precluded any additional sale of shellfish culture areas but preserved all of the rights that had been acquired under the original Acts (Shotwell 1977).

[2] The Legislative act to authorize growing any edible shellfish on deeded tidelands is significant to the WGHOGA proposal for the use of imidacloprid for burrowing shrimp control on areas commercially grown for clams as well as on areas commercially grown for oysters.

Figure 2 – Willapa Bay Tidelands

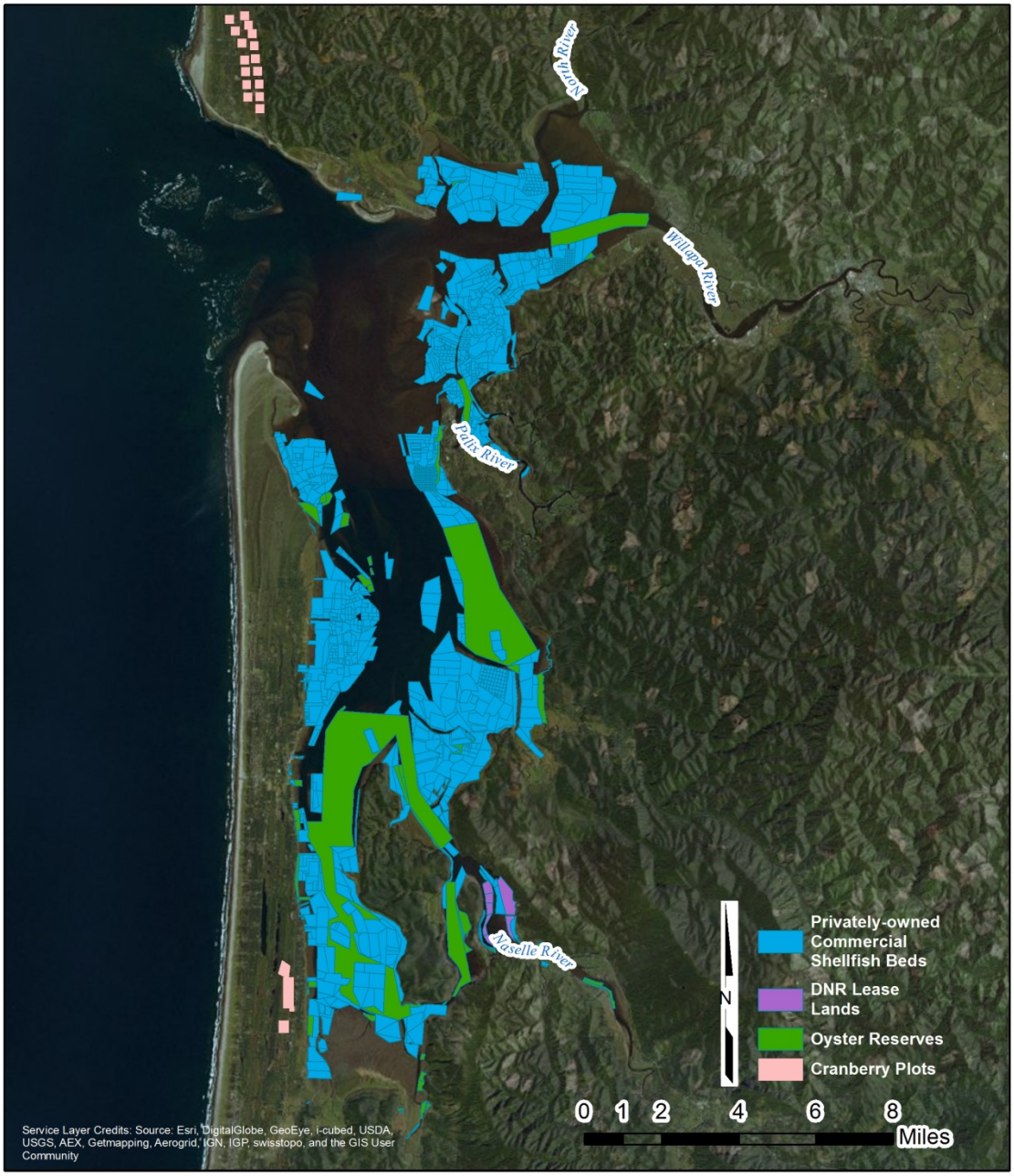
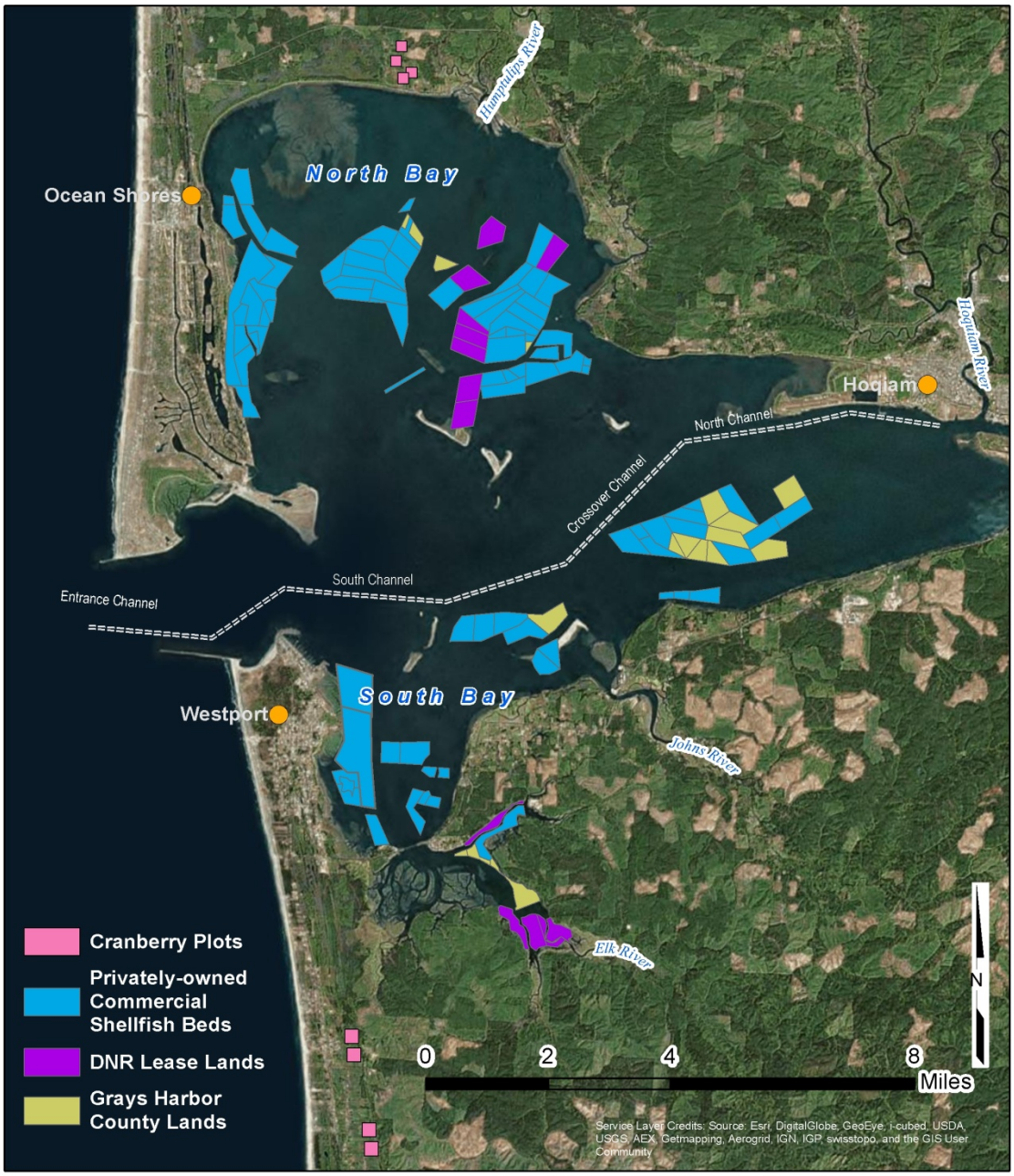


Figure 3 – Grays Harbor Tidelands



During the period 1910 to 1926, ownership of about 50 percent of the unused deeded land in Willapa Bay reverted to Pacific County through foreclosure for taxes. The oyster industry declined during this period due to the failure of the Eastern oyster that was being transplanted from the East Coast of the United States. Introduction of the Japanese oyster in the late 1920s started what was effectively a new industry for the West Coast. In Willapa Bay, the increase in deeded acreage to current levels (approximately 25,622 acres) was a composite of previously deeded land still in private ownership, oyster land held by Pacific County, and eligible State-owned tideland that had not been purchased prior to this period and was still available from the State (WDC 1986, as cited in WDF/WDOE 1992).

After introduction of the Pacific Oyster in Willapa Bay, production increased through the 1930s and into the 1940s. From 1940 to 1947, oyster production averaged nearly one million gallons per year in Willapa Bay (two to three times the average annual volume during the 15-year period between 1973 and 1987). A steady decline in oyster production began in the late 1940s and continued into the mid-1970s (Shotwell 1977). Several factors likely influenced this decline, such as the uncertainty and expense of oyster seed supply in the late 1960s and early 1970s. However, the major decline between 1950 and 1965 was in large part due to burrowing shrimp that began a rapid expansion at that time as observed by Willapa Bay and Grays Harbor oyster farmers and WDFW biologists (R. Wilson undated, c. August 1995).

It was recognition of the destructiveness of the two burrowing shrimp species[3] during the 1950s that prompted WDF personnel to begin testing various methods of control. The insecticide carbaryl (for which the trade name was Sevin) has been permitted for burrowing shrimp management since 1963 in Washington State. For more information on carbaryl see http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/oyster/oyster_index.html

Of the approximately 25,562 acres of recognized oyster growing area in Willapa Bay deeded to private owners by the State, the oyster industry was, in 2012–2013, actively cultivating shellfish on about 9,000 acres (CSI 2013), or approximately 35 percent of that area. Nearly 12,000 acres or 45 percent of the deeded intertidal shellfish beds now lie fallow but are still considered potentially productive (Shotwell 1977). About 4,000 acres (15 percent) were considered by Shotwell to have never been useable or productive.

The fallow but once productive areas have been rendered unproductive for several reasons, including the adverse effects of burrowing shrimp. Seed beds, grow-out beds, and/or harvest beds can become unusable within a few months or a few years depending upon the shrimp population levels in the shellfish beds, shrimp population levels on abutting beds, and other factors. NPDES Waste Discharge Permit WA0039781 (2006) established criteria for treating burrowing shrimp populations in ***commercial shellfish beds*** with carbaryl that included a requirement for the population density to exceed 10 burrows per square meter. Beds that reach this density are not suitable for commercial

[3] As noted, two species of thalassinid burrowing shrimp cause problems for oyster growers in Washington State: the ghost shrimp *Neotrypaea californiensis*, and the mud shrimp *Upogebia pugettensis*. Both dig extensive burrows in intertidal sediments, undermining the substrate and causing oysters to sink and die. Unless specifically distinguished in the text, the term "burrowing shrimp" is used to apply to both ghost shrimp and mud shrimp.

production of shellfish without burrowing shrimp control. Without the ability to manage burrowing shrimp, shellfish beds would begin to degrade until they reach a point where they cannot be farmed (personal communication with WGHOGA members, February 2014).

At the time of this writing, much of the once-used, deeded commercial shellfish tidelands in Washington State remain heavily populated by burrowing shrimp, which contribute to the soft sandy or muddy substrates that are unsuitable for shellfish production.

Description of Shellfish Aquaculture

The description of shellfish aquaculture presented in this Section, and in Subsections 2.5.1 and 2.5.2 below, is derived primarily from the National Marine Fisheries Service (2009) *Endangered Species Act − Section 7 Programmatic Consultation, Biological and Conference Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation: Nationwide Permit 48, Washington*. Refinements have been added from the video documentary series *Willapa Bay Oysters* (Cox 2013), and with input from WGHOGA members.

Hatchery and Nursery Operations: Oysters and clams are grown from seed that is caught as wild spat[4] onto "cultch" (mother shell) [5] that is set out expressly for this purpose, or from seed produced in hatchery and nursery operations. Use of wild stock is relatively rare in most parts of the West Coast, but is still practiced extensively in Willapa Bay oyster culture where many areas commercially grown for oysters are established naturally from spawning of the oysters currently cultured in the bay. In Willapa Bay, oyster spawning occurs July through August, with spat settling out two to three weeks after spawning occurs.

Shellfish Bed Characteristics: Productive commercial shellfish ground is dependent on a number of variables, including salinity, temperature, substrate quality, water quality, current flow, and wind exposure. WDFW developed a rating index to classify shellfish ground based on its ability to naturally produce harvestable shellfish. This index is used by WDNR as a tool for the purpose of setting lease rates, but it is also used informally by growers who own their tidelands (personal communication with a WGHOGA member, July 31, 2014). Classifications range from 1 for ground that recruits natural seed and grows clams and oysters to harvest, to 5 which is ground that does not naturally recruit or have the realistic ability to grow shellfish to harvest. Several species of shellfish grow on Type 1 ground at the same time. Harvest is aligned with the seed catching events. Type 5 ground is considered buffer ground that the grower can use to catch product that drifts off the area they are farming. General references aligned with the ability of a bed to produce shellfish include natural seed ground; marginal, relay, or grow-out ground (used to store oysters while a fattening bed is prepared to plant them to); fattening or harvest ground. All of these beds can recruit and grow-out clams, or other species of shellfish as well as oysters (personal communication with a WGHOGA member, July 31, 2014).

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[4] "Spat" as used in this document refers to the spawn of oysters, or the larval stage of oysters, particularly when these organisms settle onto a point of attachment and begin to develop a shell.

[5] Clam larvae do not require "cultch" (mother shell), but can be set on screens in an up-well or flow-through system.

Activities: Crews must walk and work on areas grown with oysters and clams and in immediately adjacent areas to perform almost all activities that occur on the beds. These include bed preparation, inspection and maintenance during grow-out, and harvest. At some sites, tidelands are accessed directly from adjacent upland areas. Workers and equipment sink deeply into the softened sediments of areas with high populations of burrowing shrimp.

Ecology of Oyster-Dominated Communities: A diverse assemblage of plants and animals are associated with oyster beds. These include plants and animals attached to oyster shell, such as red algae, barnacles, and mussels, in addition to animals that live under and around the shell, such as crabs and various fish species. The composition of oyster-dominated communities is a reflection of the diversity of micro-habitats associated with oysters.

Oyster beds provide important ecosystem services such as water filtration, resulting in decreased suspended solids, turbidity, and increased denitrification; habitat for epibenthic invertebrates such as crabs; carbon sequestration; and stabilization of adjacent habitats and the shoreline (Grabowski and Peterson 2007). They provide habitat for other molluscs, polychaetes, and crustaceans (Lenihan et al. 2001, Rothschild et al. 1994), and refuge habitat for juvenile fish and mobile crustaceans (Coen et al. 1999, Grabowski et al. 2005).

Important elements that appear to affect the nature and extent of oyster-dominated communities include physical factors such as the character of the bottom; sedimentation; temperature; biological factors such as food, predators and disease; and other factors such as pollution. Oysters grow well on hard, rocky bottom or on semi-hard mud firm enough to support their weight. Shifting sand and soft mud is usually unsuitable for oysters. A firm bottom of fine gravel, sand, mud or any combination of these three sediment types provides optimum conditions (Quayle 1969). Sedimentation is also an important factor, as rapid settling of suspended material can be highly destructive to an oyster community. Ideal conditions are found when silt does not settle on live oysters (Galtsoff 1964).

Ecology of Clam Communities: As with oyster-dominated communities, clam communities are associated with a large assemblage of plants and animals. These include animals that live under and around the shell, such as crabs and various fish species. Clams are subject to predation by a wide variety of predators such as moon snails, and some crab species (e.g. red rock crab and Dungeness crab; Anderson et al. 1982).

Manila clams (*Venerupis philippinarum*) are generally found on intertidal beaches that are protected from heavy wave action and in gravel substrates with small amounts of mud, sand, and shell (Simenstad and Fresh 1995; Anderson et al. 1982). They are found in the high intertidal zone between +0.5 to +4.0 feet MLLW tidal elevation (personal communication with a WGHOGA member, May 28, 2014). As with oysters, the nature and extent of clams are affected by physical factors such as food, predation, substrate and pollution (Anderson et al. 1982).

Oyster Culture Methods

The Pacific oyster (*Crassostrea gigas*) is the predominant species of oyster cultivated in Willapa Bay and Grays Harbor. The native oyster (*Ostrea lurida*), Kumamoto oyster

(*Crassostrea sikamea*), Eastern (a.k.a. American) oyster (*Crassostrea virginica*), and European flat oyster (*Ostrea edulis*) are also grown in small numbers.

Different approaches can be taken in bed preparation, seeding, grow-out, and harvesting depending upon the target market, substrate characteristics, predator population, and environmental conditions. For instance, bag, rack-and-bag, and suspended culture methods are typically employed to grow single oysters for the half-shell market. Oysters for the shucked-meat market can be grown in clusters, so the method is determined primarily by environmental conditions such as substrate composition and the presence or absence of certain pests and predators. Suspended cultures, such as long-line and stake culture, are primarily used in areas that are not suitable for bottom culture.

Oyster culture activities are predominantly performed during tides that are low enough to expose the culture bed. These tides occur for a period of several days each lunar month (29 days)—near midnight in December, near noon in June, and at corresponding intermediate times in other months. During these low tides, the workers may typically be on the bed for 3 to 6 hours, depending on tidal elevations.

Oyster Bottom Culture: This method is used to grow oysters directly on the bottom. It has been used for more than a century and is the most widespread form of shellfish cultivation still used at the present time. Beds are selected based on factors such as substrate conditions that would support shellfish throughout their growth cycle, food availability, tidal depth, and wind and wave exposure. Beds are monitored during the grow-out cycle to inspect for pests and predators, debris that may have drifted onto the bed, shifting bed drains that can bury shellfish, and similar effects. Deeded tidelands that are owned by commercial shellfish growers are marked at their corners with wood, PVC pipe or other types of stakes/markers so they can be located at high tide when the beds are covered with water. Other types of markers may be used for defining actual areas to be worked. These are often color-coded so the farmer can locate specific beds for harvesting or bed maintenance activities.

Seed oysters attached to cultch may be hosed off the deck of barges or cast by shovel onto marked beds at an approximately even rate to achieve optimum densities and distribution across the bed. In some cases, farms also rely on natural setting of oyster seed. If the "natural set" method of seeding is used, oyster shells are barged to the site and then spread across the seed bed at high tide when larvae monitoring indicates that the larvae are ready to set (attach) to the shells. If bottom culture is done with grow-out bags (as described below), seed is placed in reusable plastic net bags closed with plastic ties or galvanized metal rings. The bags are placed in the intertidal zone directly on the ground during a low tide. Bags are held in-place using an anchor of some type that is capable of restraining the bags in severe weather conditions.

Oysters may be transplanted from one site to another at some point during grow-out. For example, oysters may be moved from an initial growing area to "fattening" grounds[6] where higher levels of plankton and nutrients are found, allowing the oysters to grow to a market quality. Growers conduct their operations in accordance with applicable transfer

[6] Fattening grounds are typically located near the entrance to the harbor, on tidelands most exposed to the flush of ocean currents that enter the bay on each tide cycle.

permits, regulations, and requirements when transplanting oysters from one area to another.

In areas where the substrate is soft, the oysters sink into the mud. This usually occurs in response to substrate bioturbation caused by ghost shrimp and mud shrimp (collectively known as "burrowing shrimp"). Oysters must stay on the surface to survive. When they sink, they may be periodically drug out with a harrow to pull them up out of the mud. However, if the burrowing shrimp populations have not been controlled, harrowing to lift oysters to the surface would be ineffective, as they would sink again and suffocate due to the soft substrate.

During hand harvest, workers hand-pick oysters into bushel-sized containers at low tide.

In mechanical harvest, a harvest bag is lowered from a barge or boat by boom crane or hydraulic winch at high tide and pulled along the bottom to scoop up the oysters. Where feasible, the area may be hand-harvested at low tide afterwards to pick up any remaining oysters.

Single oysters cultured loose on the bottom are often hand-harvested into mesh bags or baskets to minimize handling and damage to shells. When single-oyster culture on the bottom is done in hard plastic mesh bags, the bags are simply loaded into a boat or (during low tide) into a wheelbarrow for transport to shore, then transported to processing plants or to market.

Oyster Stake Culture: Beds are prepared for stake culture during low tides by removing debris and pests. This often includes control of burrowing shrimp because high shrimp densities result in stakes leaning or falling over, causing the crop to be lost as it becomes buried. Crop also becomes dislodged from the stakes during grow-out and falls to the bottom. There can be significant losses with this culture method if burrowing shrimp densities are not controlled.

During low tide, short stakes approximately 30 to 36 inches (76 to 91 cm) in length are driven into the ground approximately 2 feet apart to allow good water circulation and easy access during harvest. The stakes are driven to a depth of 15 to 18 inches (38 to 46 cm) to keep them in place.

Stakes may be seeded in hatchery setting tanks before being planted in the beds or bare stakes may be planted in areas where there is a reliable natural seed set. Bare stakes might be planted during the prior winter to allow barnacles and other organisms to attach to the stakes, increasing the surface area available for setting oyster spat. An alternative method of seeding is to attach from one to several pieces of seeded cultch to each stake.

Stakes are left in-place through a 2- to 4-year growing cycle. Each piece of seeded cultch attached to stakes grows into a cluster of market-sized oysters suspended above the mud and above most pests. In areas where natural spawning occurs, multiple-year classes of oysters grow on the stakes with smaller, younger oysters growing on top of older oysters.

Oyster Long-line Culture: Stakes of metal or PVC pipe are stuck in the ground in rows by hand during low tides. These pipes are typically 30 inches (76 cm) in length and are sunk 15 inches (38 cm) into the sediment. Polypropylene or nylon lines in lengths of

approximately 100 feet with seeded oyster cultch attached at approximately one-foot intervals are pulled into place, attached to the stakes, and suspended above the tideland for grow-out. The material and labor costs of long-line culture exceed those of bottom culture, and up to 30 to 50 percent of the oysters typically drop from the lines (personal communication with Coast Seafoods, as cited in Booth 2010).

Oysters grown in this culture method grow in clusters supported by the long-lines, which keep them from sinking into soft substrate and protect them from certain pests and predators. As with stake culture, control of burrowing shrimp is required to prevent stakes from leaning or falling over. Oysters are allowed to grow out over a period of two to three years. Long-lines are checked periodically during low tides to ensure that they remain secured to the PVC pipe and that the PVC pipe remains in-place.

Long-line cultured oysters may be harvested by hand or by machine. Hand harvest entails cutting oyster clusters off lines by hand at low tide and placing the clusters in harvest tubs equipped with buoys for retrieval at high tide by a vessel equipped with a boom crane or hydraulic hoist. The oysters are then barged to shore. Smaller operations carry the tubs off the beach by hand.

With mechanical harvesting, buoys are attached at intervals along the lines at low tide. On a high tide, the buoys are hooked to a special reel mounted on a vessel that pulls the lines off the stakes and reels them onto the flat deck of the boat. The oyster clusters are then cut from the lines, barged to shore, and transported to processing plants or to market.

In some areas, silt may build up on the substrate of long-line culture beds as a result of wave and wind action. These beds may be leveled manually at the end of a growing cycle, or they may be left fallow to level naturally as a result of wind and wave action. Most residual oysters ("drop-offs") dislodged from the lines during the previous growing cycle are removed from the ground prior to replanting. These actions are performed during low tides. As with any off-bottom culture method, drop-off oysters are a significant portion of the total crop yield. This portion of the crop is lost in areas of high burrowing shrimp, populations, so control is required in order to make this culture method economically viable.

After a harvest, some growers pull all the pipe stakes from the bed, harvest residual drop-off oysters using bottom culture methods, and drag the ground to level it and remove sediment build-up before putting the stakes back in for the next cycle. Other growers leave the stakes in-place from cycle to cycle, depending on conditions in their growing area.

Oyster Suspended Culture: Suspended culture methods include the use of lantern nets, bags, trays, cages or vertical ropes or wires suspended from surface long-lines, or to a lesser extent, from rafts. These methods are used in deeper water so that the structures remain suspended through the tidal cycle. Such areas are not realistically available within Willapa Bay and Grays Harbor due to lack of depth and exposure to severe weather. Thus, suspended culture methods generally are not used in the intertidal areas that are subject to control of burrowing shrimp. However, in the event that this method were used over tidelands, there could be significant oyster loss due to storms, equipment damage, and similar occurrences. In such cases, oysters would be lost if burrowing shrimp densities in the substrate were high enough to bury the drop-off crop.

Surface long-lines are heavy lines suspended by floats or buoys attached at intervals along the lines, anchored in-place at each end. Lantern nets, adopted from Japanese shellfish culture, are stacks of round mesh-covered wire trays enclosed in tough plastic netting. The nets, bags, trays, cages, or vertical ropes or wires are hung from the surface long-lines under the floats or buoys, or from rafts. This method utilizes deeper channel areas, remains visible during all tidal elevations, and must address navigational lane blockage issues.

Single oysters are regularly sorted and graded throughout the growth cycle. Every 3 or 4 months, the trays are pulled up, the stacks are taken apart, oysters are put through a hand- or mechanical-grading process, the trays are restocked, stacks are rebuilt and de-fouled and returned to the water. Oysters grown on vertical lines grow in clusters and require little attention between seeding and harvesting.

A vessel equipped with davits and winches works along the lines, and the trays, nets or bags are detached from the line one by one and lifted onto the boat. The gear is washed down as it is pulled onboard. Oysters are emptied from the gear and placed into tubs, then cleaned and sorted onboard the harvest vessel, on an on-site work raft, or at an off-site processing facility.

Oysters grown using suspended culture may be transplanted to an intertidal bed for two to four weeks to "harden." Hardening extends the shelf-life of suspended culture oysters by conditioning them to close their shells tightly when out of the water, so they retain water in the shell. Natural wind and wave energy acts to literally harden the shell, making it less prone to chipping, breakage, or mortality during transport. Once hardened, the oysters are re-harvested using bottom culture harvest methods. Alternatively, oysters grown by suspended culture may be hung from docks in shallow water where tidal cycles condition them to close their shells when exposed.

Oyster Rack-and-Bag Culture: Beds are prepared for rack-and-bag culture during low tides by removing debris and pests. The tideland may be marked with stakes for working purposes. During low tides, some operations install lines and PVC pipe or metal stakes on the bed to secure the bags. Alternately, wood or metal racks may be used to support the bags off the ground. Racks with legs may be placed directly on the bottom, or supports may be driven into the bottom. Bags are typically attached to racks with reusable plastic or wire ties.

Single-set oyster seed is placed in reusable plastic net bags (or "purses"), closed with plastic ties or galvanized metal rings. Oysters grow out in the bags directly on the substrate or on the metal or wooden racks. Some growers attach a float to each bag so that it rotates with each tide. This keeps the shell margin smooth and creates a deeper-bodied oyster that is more attractive for the half-shell market. Rack-and-bag culture operations are checked periodically during low tides to ensure that the bags remain secured to the racks. During harvest, bags are released from supports (if any), loaded onto a boat, or (during low tides) into a wheelbarrow for transport to shore, then transported to processing plants or to market.

All bottom culture and off-bottom culture methods rely on a stable tideland substrate in order to function through the grow-out cycle. Burrowing shrimp may impact oyster crops

directly by causing the shellfish to sink in the softened substrate, or indirectly by causing the off-bottom support gear to fail in the unstabilized substrate.

Use of Carbaryl: Shellfish growers in Willapa Bay and Grays Harbor have used the pesticide carbaryl to control burrowing shrimp as part of oyster aquaculture management operations since 1963. These locations are the only U.S. marine tidelands where the use of carbaryl has been permitted. Ecology NPDES Permit No. WA0039781 allows treatment of up to 600 acres annually in Willapa Bay, and up to 200 acres annually in Grays Harbor, at a rate of 8 pounds of active ingredient per acre. The permit specifies spraying periods during low tides, July through October. The following website has more information regarding carbaryl use in Willapa Bay and Grays Harbor: http://www.ecy.wa.gov/programs/wq/pesticides/final_pesticide_permits/oyster/oyster_index.html

Clam Culture Methods

The general description of clam culture provided below is derived from the *Final Environmental Impact Statement: Management of Zostera japonica on Commercial Clam Beds in Willapa Bay, Washington* (Ecology, March 26, 2014). The description of ground culture and bag culture methods is summarized from NMFS (2009), as previously cited.

The Manila clam (*Venerupis philippinarum*) was introduced to the west coast of North America in the 1930s and 1940s. There is speculation as to exactly how the Manila clam was introduced, whether it was in ballast water or in shipments of oyster seed from Japan. The majority of Willapa Bay's Manila clam production comes from farming on privately-owned or leased tidelands. During the initial years of commercial harvest, the beds were managed to produce a self-sustaining amount of clams. By the 1970s, predator exclusion nets were employed to increase yields. In the 1980s, growers began to occasionally supplement natural sets with hatchery-raised juvenile clams (Dewey 2013). In order to increase natural recruitment and survival of hatchery seed, the substrate is often enhanced with gravel and/or shell (Thompson 1990). This method was initially developed in Willapa Bay in the mid-1970s by WDFW when it used gravel to enhance a recreational harvest area on the west side of Long Island. The substrate provides an optimal recruitment surface as well as protection from predators.

Clam crops are grown on a three to five-year rotation, depending on the substrate and the desired size of mature product. The tidal range at which clams are typically cultivated is approximately +0.5 to +4.0 feet MLLW.[7] Natural recruitment is sometimes supplemented with hatchery seed. Ideally, clams that have reached the proper size are harvested and two to four smaller age-classes will be left in the substrate to grow and mature in subsequent years. The vast majority of clams are harvested by hand using short-handled rakes. Clam culture activities are predominantly performed during tides that are low enough for workers to access the beds on foot.

Ground Culture: Beds are prepared for ground culture in a number of ways depending on the location. Bed preparation increases the chances of seed recruitment and survival. Preparatory work performed at low tide may include raking debris, adding gravel and/or

[7] Natural oyster seed beds also occur in this tidal range, and oyster hatchery seed can be grown-out within this tidal range (personal communications with WGHOGA members, May 28, 2014 and June 18, 2014).

crushed shell to create more suitable substrate, and sampling salinity and water quality parameters.

When graveling, a method termed "frosting" is used, several light layers are placed over a period of several weeks in order to minimize the burying impact on the benthic and epibenthic habitat. Other bed preparation measures may include laying down netting to protect against predators such as crab and ducks, and marking bed boundaries. Many growers remove the predator netting within a few days of planting clam seed, after the clams have had time to burrow sufficiently into the substrate to avoid most predators, and to minimize the chance that netting will become dislodged and drift away.

Typically, clam seed is planted in the spring and early summer. Most of the clam seed comes from West Coast hatchery and nursery facilities, although natural sets of clams occur in some areas. Clam seed sizes and methods of seeding vary, depending on site-specific factors such as predators and weather conditions. Planting methods include: hand-spreading seed at low tide on bare, exposed substrate; hand-spreading seed on an incoming tide when the water is approximately 4 inches deep; hand-spreading seed on an outgoing tide when the water is approximately 2 to 3 feet deep; or spreading seed at high tide from a boat.

After each growing season, surveys and sampling are typically conducted during low tides to assess seed survival and spreading adequacy, and to estimate harvest yield for the upcoming year. Surveys determine whether additional seeding is required to supplement a natural set or poor hatchery seed survival. The goal is to maintain the optimum sustainable productivity of the growing ground.

Before harvest begins, bed boundaries are typically staked and any remaining predator netting is folded back during low tide. Harvesting crews typically hand-dig clams during low tides, using a clam rake. Market-sized clams are selectively harvested, put in buckets, bagged and tagged, and transported to processing plants. Undersized clams are left in beds for future harvest. Harvested clams are generally left in net bags in wet storage, either in marine waters or upland tanks filled with seawater, to purge sand for at least 24 hours.

Bag Culture: Prior to setting clam bags on tidelands, debris is removed from the area to be planted and shallow (typically 2- to 4-inch) trenches may be dug during low tide with rakes or hoes to provide a more secure foundation for setting down the clam bags.

Clam seed (typically 5 to 8 millimeters or 0.2 to 0.3 inches in size) is placed in reusable plastic net bags closed with plastic ties or galvanized metal rings. Substrate, consisting of gravel and shell fragments, may be added to the bags. Bags may be placed in shallow trenches during low tide and allowed to "silt-in" (i.e., burrow into the substrate). Bags may be held in place with 4- to 6-inch metal stakes, placed by hand. Bags are monitored during low tides throughout the grow-out cycle to make sure they are properly secured, and turned occasionally to optimize clam growth.

When the clams reach market size, the bags are removed from the growing area. Harvesting occurs when there is 1 to 4 feet of water so that sand and mud that accumulated in the bags during grow-out can be sieved from the bags in-place. Bags are transported to a processing site. Any added substrate may be separated for later reuse.

Policy Background for Commercial Shellfish Aquaculture

The National Oceanic and Atmospheric Association (NOAA) launched the National Shellfish Initiative in 2011. The goal of this initiative is "*to increase shellfish aquaculture for commercial and restoration purposes, thereby stimulating coastal economies and improving ecosystem health*." The initiative "*recognizes the broad suite of benefits provided by shellfish aquaculture and aims to increase shellfish production and wild shellfish populations in U.S. coastal and marine waters*." Under this Initiative, NOAA and its partners committed to enhancing shellfish restoration and farming, and to support the authorization of shellfish sanctuaries and increase aquaculture permits and leases.

Washington State launched the Washington Shellfish Initiative in December 2011. The Washington Shellfish Initiative is a convergence of NOAA's "*National Shellfish Initiative and the State's interest in promoting a critical clean water industry*." This initiative "*encompasses the extraordinary value of shellfish resources on the coast" and "[a]s envisioned, the initiative will protect and enhance a resource that is important for jobs, industry, citizens, and tribes*." The Washington State legislature has further expressed a policy preference for shellfish aquaculture in RCW 15.85.010. This statute states, in part:

> *The legislature declares that aquatic farming provides a consistent source of quality food, offers opportunities of new jobs, increased farm income stability, and improves balance of trade. The legislature finds that many areas of the state of Washington are scientifically and biologically suitable for aquaculture development, and therefore the legislature encourages promotion of aquacultural activities, programs, and development with the same status as other agricultural activities, programs, and development within the state. The legislature finds that aquaculture should be considered a branch of the agricultural industry of the state for purposes of any laws that apply to or provide for the advancement, benefit, or protection of the agriculture industry within the state*.

Economics

Willapa Bay and Grays Harbor are highly productive estuaries. Willapa Bay produces approximately 65 percent of the oysters and 13 percent of the clams harvested in Washington State[8]. Willapa Bay is the largest producer of farmed oysters in the United States. Combined with Grays Harbor, this area along the southwest Washington coast produces approximately 25 percent of all oysters in the United States. Shellfish aquaculture is the largest private employer in Pacific County and a significant private

[8] Production statistics for bivalve aquaculture in Washington and other west coast states are not well documented (DeFrancesco and Murray 2010). Not all methods of culture are included in the statistics, and units of measure are inconsistent among the agencies and organizations that record these data. For example, the Pacific Coast Shellfish Growers Association (PCSGA) reports clam and oyster production in live-weight/in-shell pounds (DeFrancesco and Murray 2010), versus only gallons of shucked meat reported by the U.S. Department of Agriculture, National Agricultural Statistics Service (2013). All statistics reviewed during preparation of this EIS, however, show Washington as the major producer of bivalve commodities in western states that include Oregon, California and Alaska, with Willapa Bay/Grays Harbor as the major producing area among all of these.

employer in Grays Harbor County. Oyster cultivation has traditionally been the primary fishery in Willapa Bay. Shellfish aquaculture is one of the major industries in southwest Washington, and has increased in relative importance following declines in the timber and fishing industries.

In 2013, Northern Economics prepared an economic impact assessment of aquaculture in Washington, Oregon, and California for the Pacific Shellfish Institute (PSI) (Northern Economics 2013). This assessment included an input-output analysis modeling tool to measure the economic effects of aquaculture by tracking the flow of money within specified economic regions. The input-output analysis determined that for every dollar spent by shellfish growers, a total of $1.82 worth of economic activity is generated in Washington. In addition, every dollar spent by shellfish growers generates approximately $0.76 in wages, and for every $1 million spent by the industry, nearly 27 jobs are created. Based on these calculations, the PSI study (Northern Economics 2013) estimated that shellfish farmers in Washington spent approximately $101.4 million in the Washington economy in 2010, which in turn generated approximately $184 million in economic activity. Shellfish farmers generated 1,900 direct jobs and paid $37 million in labor income in 2010, and they generated 810 additional jobs through indirect or induced activity. Further, the PSI study found that shellfish aquaculture in Pacific County in 2010 generated more than $90 million in total economic output, 1,580 jobs, and more than $45 million in labor income. In Grays Harbor, shellfish aquaculture generated almost $12 million in total economic output, 210 jobs, and almost $6 million in labor income in 2010. Not captured in the PSI study are the economic benefits from shellfish aquaculture in the form of "upstream" jobs created for trucking companies, air freight, wholesalers, retail outlets and restaurants that sell and serve the farmed shellfish (personal communication with PSI Executive Director, June 26, 2014).

If burrowing shrimp are not effectively controlled, then commercial shellfish production in Willapa Bay and Grays Harbor will likely be seriously reduced. The *Final Environmental Impact Statement: Use of the Insecticide Sevin to Control Ghost and Mud Shrimp in Oyster Beds of Willapa Bay and Grays Harbor* (WDF and WDOE 1985) estimated a worst case scenario of a 70 to 80 percent reduction in oyster production without burrowing shrimp control. Growers currently estimate that they would experience a 60 to 80 percent reduction, and the Washington State University Pacific County Extension Director estimates that the bay-wide loss of clams and oysters in Willapa Bay would be on the order of 80 to 90 percent without pesticide treatments for the control of burrowing shrimp (personal communication with Dr. Kim Patten). These estimates are conservative in relation to the reduced production figures in Oregon following the cessation of carbaryl use, where oyster production declined by 90 percent between 1984 and 1999 (USDA NASS Oregon Field Office and Oregon Department of Agriculture 2013).[9]

In recent years, with the substantial increase in the recruitment of burrowing shrimp, growers realize that commercial clam production is equally at risk. A WGHOGA member confirmed that the method of loss (substrate subsidence and bivalve suffocation)

[9] Oregon oyster production statistics for 2012 are 50 percent less than production in 1984 (USDA NASS Oregon Field Office and Oregon Department of Agriculture 2013), though for reasons that appear to be unrelated to burrowing shrimp population levels, burrowing shrimp control (or lack thereof), or alternative shellfish culture techniques.

is the same for clams as it is for oysters, and that without treatment for burrowing shrimp on areas commercially grown for clams, the clam industry would decline at a rate comparable to that estimated for the oyster industry, or be lost altogether except for some small incidental harvest areas where clams may be a secondary crop to oyster seed (personal communication with a WGHOGA member, May 28, 2014).

B. Burrowing Shrimp

Ghost Shrimp Characteristics

Ghost shrimp (*Neotrypaea californiensis*) have a pale pink body with a large, broad abdomen. The first pair of legs have well-developed claws that are slightly dissimilar (females) or very unequal (males). Mature adults range from 2 to 4 inches (51 to 102 millimeters [mm]) in length. The lifespan of ghost shrimp is approximately four to five years (Dumbauld et al. 1996).

Ghost shrimp are selective deposit feeders and isolate their food particles by sorting, rasping, or sucking food from the surfaces of sediment particles. Benthic microalgae and bacteria are important sources of food for ghost shrimp (Wolff 1983, as cited in WDF and WDOE 1992). Although classified as deposit feeders, a substantial portion of the food of ghost shrimp may come directly from the water column (Bird 1982). Ghost shrimp feed by continually digging in sandy sediments and accumulating detrital particles on appendage hairs. The organic material is ingested when these hairs are cleaned. Since ghost shrimp prefer clean, well-sorted sand rather than muddy substrates, they must process a large amount of sediment (Bird 1982).

Ghost shrimp construct complex, deep burrows (up to 1 meter [m] or approximately 3 feet deep; Dumbauld et al., unpublished), that are more temporary than those of mud shrimp (Suchanek 1985, as cited in WDF and WDOE 1992). Excavated sediment and feces are deposited at burrow entrances, forming conspicuous mounds that gradually raise the level of the tidal flat. Oyster growers and biologists have observed that the burrowing habits of ghost shrimp tend to soften a sand flat: the shrimp remove binding particles of silt, clay, and organic material and deposit these particles with excavated sand as unconsolidated sediment on the surface where it is subject to removal by tides and waves.

Ghost shrimp mature at 18 to 24 months, at which time egg-bearing females may be less than 30 mm (1.15 inches) in total length. Female ghost shrimp in the Pacific Northwest can be egg-bearing from April to August (Feldman 2000). The principal breeding period for ghost shrimp in the Pacific Northwest is late spring and early summer, when the water temperature begins to warm. Ghost shrimp can produce three or four major broods of planktonic larvae every six weeks from March through August (McCrow 1972). Larvae pass through five planktonic zoeal stages, lasting about 6 weeks, in nearshore coastal waters (Johnson and Gonor 1982). Summer high tides carry some larvae into coastal estuaries where they settle on suitable substrate.

Bird (1982, as cited in WDF and WDOE 1985) found that female ghost shrimp mature and produce eggs at about 24 months in Oregon estuaries. Growth rates ranged from 15.7 to 22.4 mm (0.6 to 0.85 inch) per year depending on location. The annual rate of recruitment of ghost shrimp to Oregon estuaries was correlated with the density of adult shrimp. Larval recruitment tended to be greatest to areas where there were established

adult populations. Juveniles were most abundant in areas with fewer adults present (Bird 1982).

Ghost shrimp create dense beds of up to 400 shrimp per square meter (m^2) (Dumbauld et al., unpublished) in the mid-intertidal zone of many Washington and Oregon sandflats, and are usually not as abundant in the lower intertidal and subtidal (Bird 1982). Previous studies of population trends in Willapa Bay and Yaquina Bay, Oregon suggest that ghost shrimp populations have been declining in both bays since the mid-1990s in Willapa Bay, and since 2005 in Yaquina Bay. A decrease of 67 percent was seen in the Palix River area of Willapa Bay between 2006 and 2009 (Dumbauld et al., unpublished). However, more recent data suggests that a large recruitment of shrimp has occurred in the past 3 years: 2011 through 2013 (Dumbauld et al., unpublished, WGHOGA personal communication).

MacGinitie (1934) suggested that colonies of ghost shrimp in California (Elkhorn Slough) are cyclic in abundance. This cycle may take as long as 10 years, depending on factors such as distance from the ocean and presence of other macroinvertebrates. Such cyclic changes were not observed in Oregon estuaries (Bird 1982; Posey 1985a and 1985b); however, they are a feature of other decapod populations (Cheney and Mumford 1986).

Mud Shrimp Characteristics

Mud shrimp (*Upogebia pugettensis*) are usually reported to be smaller than ghost shrimp, at about 50 to 60 mm (approximately 2 to 2.5 inches) in length. However, in Willapa Bay, they are the same size or larger than ghost shrimp (Rudy and Rudy 1983). A mud shrimp is bluish in color with green and orange variants, and their claws are equal in size. Mud shrimp live for approximately four to five years (Dumbauld et al. 1996).

Mud shrimp build shallow U-shaped or Y-shaped burrows (Suchanek 1985, as cited in WDF and WDOE 1992) in the middle to low intertidal zone (Dumbauld et al. 1996). Their burrows are more complex than those of ghost shrimp, and usually have three surface openings (MacGinitie and MacGinitie 1968). As their name indicates, mud shrimp prefer a muddier habitat with sediments that are less well-sorted than those inhabited by ghost shrimp (Bird 1982). There have also been observations of both ghost shrimp and mud shrimp occupying the same areas. Mud shrimp are generally more common, however, farther from the mouths of estuaries (Bird 1982, as cited in WDF and WDOE 1992).

Mud shrimp are suspension feeders, feeding on phytoplankton, zooplankton, bacteria and detritus that are suspended in the water column (Posey 1985a). They cycle water through their burrows and remove food particles from this water. Other examples of suspension feeders are the Pacific oyster, clams, bay mussel, barnacles and many polychaetes (Wolff 1983, as cited in WDF and WDOE 1992).

Compared to ghost shrimp, mud shrimp significantly increase the organic content of the sediments. The shrimp secrete organic material to cement their burrow walls and deposit undigested organic material as feces at the burrow entrances (Bird 1982).

Mud shrimp delay reproduction until their third year, at which time egg-bearing females are more than 60 mm (2.3 inches) in total length (Bird 1982). Mud shrimp are egg-

bearing during winter and early spring (October to March) (Bird 1982; and Dumbauld 1988 personal communications, as cited in WDF and WDOE 1992). Bird (1982) found that mud shrimp post-larvae settle to the bottom in late winter and early spring. These young-of-the-year grow to about 0.7 to 1.1 inches (17 to 28 mm) by the following winter. Females grow by about one inch (26 mm) per year and produce eggs when they reach about 2.5 inches (60 mm) in length.

Burrowing, Water Movement, and Water Quality Effects

The rate at which two other species of burrowing shrimp (*Callianassa japonica* and *U. major*) moved water through their burrows was measured by Koike and Mukai (1983) and Mukai and Koike (1984) under simulated, *in-situ* conditions. Estimated flow rates created by burrowing shrimp at 20.5 degrees Centigrade (approximately 69 degrees Fahrenheit) were 0.7 to 1.5 liters per day for ghost shrimp and 0.3 to 0.8 liter per day for mud shrimp. Water volumes of 1.5 to 3.5 liters were cycled through burrows daily by burrowing shrimp in the tropics (Colin et al. 1986). In samples taken 10 centimeters above the bottom, the suspended sediment load of water over areas with high populations of burrowing shrimp was about three times that found over control (i.e.,lower shrimp population) areas. Suchanek (1983, as cited in WDF and WDOE 1992) measured suspended sediment quantities of up to 2.59 kilograms (kg) per m^2 (18.7 pounds [lbs] per square foot) per day for a shallow-water tropical species. These observations implied that callianassids make a major contribution to total suspended particles in the water column (Colin et al. 1986).

Available evidence suggests that burrowing shrimp act as “ecosystem engineers” by recycling nutrients that might normally be trapped in sediments. Callianassids ingest organic matter and excrete ammonium and phosphorus that is pumped out of their burrows into the water column (WDF and WDOE 1992). Work by D’Andrea and DeWitt (2009) suggests that the presence of mud shrimp can affect inorganic nitrogen fluxes across the sediment-water interface and increase benthic respiration rates. Dissolved inorganic nitrogen fluxes can be fifteen times greater in areas where mud shrimp are present. Mud shrimp can, effectively, increase carbon and nitrogen fluxes by 1.9 and 3.7 times, respectively (D’Andrea and DeWitt 2009). Mud shrimp can also alter nutrient porewater concentrations in the sediments.

Interaction of Burrowing Shrimp with Other Mudflat Organisms

Burrowing shrimp are considered ecosystem engineers because of their ability to control and structure the benthic community. Burrowing shrimp greatly modify the substrate, and enhance nutrient and carbon fluxes (D’Andrea and DeWitt 2009; DeWitt et al. 2004; Aller et al. 1983; Webb and Eyre 2004). DeWitt et al. (2004) have estimated that burrowing shrimp have the capacity to bury, remineralize, and recycle higher levels of organic matter than occurs on tide flats without burrowing shrimp or oysters. Burrowing shrimp may act to buffer estuaries from the adverse effects of nutrient enrichment, providing a way of managing nutrients in the environment. There is also a reduced risk of hypoxia and anoxia in sediments inhabited by burrowing shrimp because they are able to rapidly recycle enhanced primary production and detritus from the tide flat surface. DeWitt et al. (2004) suggest that burrowing shrimp provide beneficial ecosystem services by decreasing the effects of eutrophication and supplying dissolved organic nitrogen for primary and secondary productivity within a tide flat food web. These ecosystem benefits

may be particularly important in El Niño years when biological productivity decreases due to the lack of upwelling (Stenseth et al. 2002), resulting in lower concentrations of nutrients including dissolved inorganic nitrogen (DIN) (DeWitt et al. 2004). In these circumstances, burrowing shrimp may contribute nitrogen that is important to primary and secondary production. This also becomes important in areas of estuaries with low concentrations of DIN. Burrowing shrimp act to alter local food webs through consumption of phytoplankton and benthic microalgae (Dumbauld et al., unpublished). They also alter habitat structure by displacing seagrasses (Dumbauld and Wyllie-Echeverria 2003). They can also become prey for larger consumers such as crabs, birds, and fish (Dumbauld et al. 2008, Posey 1986).

Bird 1982 and Posey (1985) reported that burrowing shrimp can significantly affect the benthic community in which they live. High densities of ghost shrimp reduce both species composition and abundance of other types of invertebrates in benthic communities. Other studies found burial of invertebrates and general sediment disturbance by burrowing shrimp can substantially affect the composition of infaunal and epifaunal invertebrates in the sediments (Dumbauld et al. 2001; Ferraro and Cole 2007; Posey 1986). Deposit-feeding polychaetes, bivalves, tube-dwelling tanaids and amphipods (e.g., *Corophium* spp.), and other sedentary species were reduced in numbers in areas where dense populations of ghost shrimp were present. Reductions resulted from the frequency of sediment disruption, resuspension of fine particles, and increased soft sediments (Dumbauld et al., unpublished). Mud shrimp cause less sediment disturbance than ghost shrimp and appear to have less effect on other invertebrate organisms.

As noted, burrowing shrimp can make sediments too soft and unstable for clam and oyster survival. It is estimated that burrowing shrimp have eliminated commercial shellfish production on more than 3,000 acres of tide lands in Willapa Bay and Grays Harbor (i.e., approximately 25 percent of the historically-farmed acreage) (Burrowing Shrimp Control Committee 1992). This acreage might be reclaimed if burrowing shrimp could be suppressed to low densities, allowing the return of fine surface sediments and associated microbial, macroinvertebrate, and vegetative communities (Booth and Wilson 2002).

Interactions of Burrowing Shrimp and Eelgrass

Two species of eelgrass occur in Willapa Bay and Grays Harbor: The native eelgrass *Zostera marina* and the non-native eelgrass *Zostera japonica*. The native eelgrass *Zostera marina* is an important part of the tide flat ecosystem in Willapa Bay and Grays Harbor. It contributes to a healthy functioning ecosystem that also includes shellfish beds and mud/sand flats. Eelgrass habitats are highly productive and provide structure and refuge for many species of fish and invertebrates, foraging habitat for migratory waterfowl, and spawning substrate for forage fish like Pacific herring (Dumbauld et al. 2003; Wyllie-Echeverria et al. 2009; Wyllie-Echeverria et al. 2004; Phillips 1984). Eelgrass does this by helping to stabilize the sediment and by reducing tidal current speed (Wyllie-Echeverria et al. 2009). In Willapa Bay, eelgrass provides habitat for many species of benthic invertebrates, including Dungeness crabs, polychaete worms, bivalves, and settling planktonic larvae (Hosack et al. 2006). Eelgrass also provides nursery and feeding habitats for juvenile salmon and Dungeness crab (Thom et al. 2003).

Burrowing shrimp act to limit eelgrass presence by disrupting the sediment and making it too soft for eelgrass roots and rhizomes (Dumbauld and Wyllie-Echeverria 2003; Hosack et al. 2006). Dumbauld and Wyllie-Echeverria found a strong increase in eelgrass abundance in areas where carbaryl was experimentally applied to burrowing shrimp. WGHOGA members have observed that the reduction of eelgrass from areas with high levels of burrowing shrimp is somewhat dependent on the shrimp species present (personal communication with a WGHOGA member, June 15, 2014). In addition, the increased turbidity and sedimentation associated with burrowing shrimp also hinder eelgrass growth by decreasing the ability of the plants to photosynthesize (Dumbauld and Wyllie-Echeverria 2003). This is likely elevation-dependent, with increased turbidity affecting the lower depth distribution of eelgrass. Thus, eelgrass present at lower elevations is likely to be affected more than eelgrass present at higher elevations.

C. Description of the Receiving Water

Willapa Bay

The Willapa Basin consists of six watersheds: the North, Willapa, Palix, Nemah, Naselle, and Bear Watersheds. The drainage basin is approximately 1,865 km^2 (720 square miles) in area. The main tributaries to Willapa Bay are the North, Willapa, and Naselle Rivers. The Palix River is a minor contributor to the mean daily runoff. Riverine input has a significant influence on circulation and water exchange in Willapa Bay (Jennings et al. 2003 as cited in ENVIRON 2012).

The relatively shallow bay has approximately 45,000 acres exposed at low tide with much of the remaining surface area, except for channels, covered by 1 to 6 feet of water. It consists of three main channels 10 to 20 meters (32.8 to 65.6 feet) deep, surrounded by extensive tidal flats (Banas et al. 2004). The tide is mixed-semidiurnal and tidal levels in the bay vary from 14 to 16 feet (Banas et al. 2004; Banas et al. 2007). The range from mean higher high water to mean lower low water is approximately 11.5 feet (Banas et al. 2007). During a complete tidal cycle, about 45 percent of the water in the bay is exchanged into the Pacific Ocean (NMFS, April 28, 2009). Willapa Bay opens to the Pacific Ocean at its northwestern corner through a broad, shallow pass about 6 miles wide between Cape Shoalwater and Leadbetter Point.

River input and ocean water properties are highly correlated with atmospheric conditions on seasonal and event scales (Banas et al. 2007). In the summer, coastal upwelling is driven by southward large-scale winds, bringing cold, salty, nutrient-rich water, and coastal phytoplankton blooms into the estuary (Hickey and Banas 2003; Banas et al. 2007). In general, riverflow and terrestrial inputs of nutrients to Willapa Bay are very low in comparison to tidal circulation, especially in the summer, but rivers may provide some nutrients during the winter and spring (Ruesink et al. 2003). Therefore, Willapa Bay acts more like an unstratified, riverless tidal lagoon than a partially-mixed estuary (Banas et al. 2004).

Willapa Bay is generally considered to be among the most biologically productive estuaries of the Pacific Coast of the United States. Unpolluted water and good circulation account for this productivity and resulting commercial and recreational benefits (WDF and WDOE 1992). Principal water quality parameters are shown in Table 1.

Table 2 - Willapa Bay Water Quality Parameters (WDF and WDOE 1992)

Feature	Range of Values
Temperature	3° C to 20.4° on the Willapa River; 7.2° C to 17.4° C at Toke Point; high of 21.4° C at the WDF Shellfish Laboratory at Nahcotta.
Dissolved Oxygen	Generally above 6 mg/L; occasionally levels of 5 mg/L are recorded in the Willapa River; usual summer levels are 6 to 8 mg/L.
Salinity	Ranges from 7.5 parts per trillion (ppt) on the surface to 25 ppt at 20 feet at the same time and place; salinities near the entrance to the Bay are 30 ppt or more.
Turbidity	2 to 30 JTU in the open bay, with averages of 6.6 JTU on the surface and 8.0 JTU at 20 feet.

Sediment porewater in the Willapa Bay marine intertidal mudflats where imidacloprid would be applied has a pH range from 7.3 to 7.6 (ENVIRON 2012).

The Ruesink Lab describes Willapa Bay as "chemically pristine but biologically transformed." There are low levels of industrial ***pollutants***, bacterial loads, and nutrient runoff—advantages of a low human population density on the land surrounding the bay combined with high tidal flushing. Sediment runoff from poor logging practices in the early 1900s probably occurred, but the impacts are not well documented. Pesticides and herbicides used by cranberry farmers have been found in runoff, but have not been traced to the bay (University of Washington, March 19, 2013). The waters of Willapa Bay are generally designated as Category 1[10] by Washington State Surface Water Quality Standards; however, there are multiple locations classified as Category 2, 3, 4A, and 5, indicating low to moderate levels of water quality impairment. The parameters in question are temperature, dissolved oxygen, fecal coliform bacteria, and carbaryl (WDOE 2012 ***303(d) listings***).

Multiple types of pesticides have been used to control pest species in Willapa Bay. The pesticide carbaryl (trade name Sevin) has been applied to commercial shellfish beds for the control of burrowing shrimp since 1963. And the herbicides Rodeo (Roundup) and imazapyr have been used to eradicate the invasive species smooth cordgrass *Spartina alterniflora* (University of Washington, March 19, 2013). Imazamox has been used to control the non-native eelgrass *Zostera japonica* on commercial clam beds in Willapa Bay beginning in Spring of 2013.

The growth and condition of Pacific oysters and estuarine biota in Willapa Bay are partially influenced by the influx of nutrients from upwelling of cold oceanic waters that are well-documented features of the southern Washington Coast (Banas et al. 2004). In the summer, phytoplankton biomass and production in Willapa Bay are high near the

[10] Waters that meet State standards for clean waters.

mouth and low in the interior. This causes rapid depletion of nutrients and a decline in phytoplankton biomass in the estuary (Banas et al. 2007). Studies have shown that the intertidal benthic grazers in Willapa Bay can account for most of the loss of phytoplankton biomass. It has been suggested that cultivated Pacific oysters are likely a significant consumer in the phytoplankton budget of the bay (Banas et al. 2007).

Incidences of coastal upwelling are frequent but unpredictable. El Niño events may periodically interfere with this upwelling, reducing the nutrients in the bay, and reducing phytoplankton production as a result. These events are related to extraordinary meteorological changes in equatorial weather involving a significant weakening of the trade winds. This causes the sea water to warm and the sea level to rise over large areas of the Pacific. One manifestation of an El Niño in the northeast Pacific is an extended period of warmer water (+1 to +2° Centigrade) off the coast (Reed 1984 as cited in WDF and WDOE 1985). This warmer water inhibits cold water upwelling which limits the amount of nutrients available to nearshore and estuarine biota. It was observed that populations of burrowing shrimp increased in Willapa Bay following the 1982 and 1957–58 El Niño events (WDF and WDOE 1985).

Grays Harbor

Grays Harbor is a shallow, bar-built estuary, approximately centrally located on the West Coast of Washington, north of Willapa Bay. Depths average less than 20 feet, with depths at the entrance reaching a maximum of 80 feet. The navigation channel is dredged annually to a depth of 30 feet. Freshwater inputs to Grays Harbor are attributed to the Chehalis, Hoquiam, Wishkah, Humptulips, Johns, and Elk River systems with a combined drainage basin area of approximately 2,550 square miles. The Chehalis River provides approximately 80 percent of the freshwater input to Grays Harbor (NMFS, April 28, 2009).

The three corners of Grays Harbor are defined by North Bay which receives the waters of the Humptulips River; South Bay into which the Elk and Johns Rivers flow, and East Bay (Aberdeen) into which the Chehalis River flows. At mean higher high water (MHHW), Grays Harbor is approximately 54,708 acres in size (WDOE 1983, as cited in WDF and WDOE, June 1985).

Grays Harbor differs from Willapa Bay in several important aspects, including geography, water quality, the extent of oyster cultivation, the presence of a larger human population, and the presence of heavy industry. Pacific oyster culture in Grays Harbor is limited to North Bay and South Bay and the immediate vicinity of these bays because water quality is unsuitable for shellfish culture in the eastern area of the harbor. Principal water quality parameters are shown in Table 2.

Table 3 - Grays Harbor Water Quality Parameters (WDOE 2007a)

Feature	Range of Values
Temperature	10.3 to 18.8° C
Dissolved Oxygen	Generally below 7.3 mg/L

Feature	Range of Values
Salinity	Ranges from 26 to 33 practical salinity units (psu)[11], with 20 psu at the mouth of the Chehalis River.

The Grays Harbor estuary is a partially mixed system in which tides dominate over river flows, causing nearly complete mixing of fresh water and salt water. During summer months, the low freshwater inflow and the large estuary volume contribute to poor circulation in the central portion of the bay (WDOE 1983, as cited in WDF and WDOE, June 1985). Most of Grays Harbor water is clean with little contamination. However, there is some contamination, especially in the lower Chehalis River near Cosmopolis. This area is approximately 16 miles from the commercial shellfish beds in North Bay and South Bay, near the entrance to (west end of) the harbor. The waters of Grays Harbor are generally designated as Category 1 by Washington State Surface Water Quality Standards; however, there are two locations classified as Category 2 and one location classified as Category 5. The parameters in question are ammonia-N, temperature, copper (inner harbor), and fecal coliform (Corps of Engineers, Seattle District 2011).

On June 9, 1989, Ecology listed eight pulp mills as violating water quality standards for the priority pollutant TCDD, a dioxin. At that time, the Weyerhaeuser Paper Company (in Cosmopolis) and ITT Rayonier (in Hoquiam) were discharging to inner Grays Harbor. Their effluent and sludge contained measurable quantities of dioxin. Dioxins are common by-products of a number of human and natural activities, including combustion and incineration, forest fires, chlorine bleaching of pulp and paper, certain types of chemical manufacturing and processing, and other industrial processes. Dioxins are of concern because they are toxic contaminants that last a long time in the environment and can build up in aquatic organisms, becoming more concentrated as they move through the food chain. Ecology developed a Total Maximum Daily Load (TMDL)[12] for inner Grays Harbor that set a waste load allocation for dioxin discharged into the water body. EPA approved this TMDL in June 1992 (Ecology TMDL projects summary, January 22, 2014).

Grays Harbor has also been listed under Section 303(d) of the Federal Clean Water Act as not meeting water quality standards for fecal coliform bacteria because of inadequate control of point or non-point sources. Fecal coliform is a type of bacteria common in human and animal waste. It can make people sick and cause the closure of shellfish harvesting beds. Bacteria can enter water bodies from untreated or partially treated discharges from wastewater treatment plants, from improperly functioning septic systems, and from livestock, pets and wildlife. Fecal coliform enters Grays Harbor from a variety of dischargers, including the municipal sewage treatment plants in the cities of

[11] Practical salinity units (psu) are approximately equal to parts per thousand (ppt). PSU's are used in modern oceanography as the recognized, preferred units for salinity measurement.

[12] TMDL is a calculation of the maximum amount of a pollutant that can be present in a water body segment and still allow attainment of water quality standards, and an allocation of that amount to the point sources of the pollutant. The TMDL takes into account critical conditions such as high and low flows and seasonal variations in water quality. The waste load allocation in a TMDL is implemented through NPDES permits to point source dischargers. There is no Federal regulatory requirement to implement the allocation to non-point sources of the pollutant (EP National Water Quality Assessment Report, http://www.epa.gov/waters/ir/attains_q_and_a.html).

Aberdeen, Hoquiam, Ocean Shores, and Westport (Ecology TMDL projects summary, January 22, 2014).

Shellfish growers in the outer harbor experience temporary closures at times due to violations of fecal coliform discharge limits in existing point source permits. Limited sampling data also indicate that non-point sources of fecal coliform may be a concern in outer areas of Grays Harbor. Fecal coliform contributions were also traced to the Chehalis River due to stormwater runoff, as well as Grass Creek, Johns River, and the City of Grayland. Non-point contributions, possibly from on-site sewage disposal (OSSD) systems and farm operations, were also found during a shoreline survey conducted by the Washington Department of Health in 1994 (Ecology TMDL projects summary, January 22, 2014).

Ecology conducted a fecal coliform study in Grays Harbor in 2000, after which it developed a TMDL report in 2001. Wasteload allocations (WLA) for fecal coliform bacteria were determined for rivers and creeks that discharge to Grays Harbor, and for the Weyco pulp mill. Environmental Protection Agency (EPA) approved the TMDL with the amended WLA in January 2004 (Ecology TMDL projects summary, January 22, 2014).

The Washington Department of Health (DOH), Office of Shellfish and Water Protection, is responsible for providing sanitary control of molluscan shellfish (oysters, clams, and mussels). The program works closely with Tribes, local health jurisdictions, volunteer groups, State and Federal agencies and commercial shellfish growers. A key component of this program is Growing Area Classification. There are two Classified Growing Areas within Grays Harbor County: Grays Harbor (the Bay) and the Pacific Coast (North Beach). Recreational and commercial razor clam harvest protection is vital to the local and State economy (Grays Harbor County, June 2012).

The Grays Harbor Marine Resources Committee (MRC), affiliated with the Washington Sea Grant Program, serves the community by providing technical assistance and educational activities to commercial and sports fishermen, seafood processors and retailers, fish and shellfish growers, coastal planners, marina operators, recreational boaters, teachers, students, and others who use, manage, or simply enjoy the marine resources of the area. The MRC conducts water quality sampling projects in Grays Harbor, the current focus of which is on ocean acidification and harmful algal blooms. A similar MRC has been established for Willapa Bay.

Ocean acidification, generally described as the reduction of pH in marine waters, is the result of increased levels of atmospheric carbon dioxide (CO_2). Increased atmospheric CO_2 results in more CO_2 in ocean waters where it leads to reductions in pH. According to the National Oceanic and Atmospheric Administration (NOAA) Pacific Marine Environmental Laboratory, oceanic pH levels (surface water) have dropped from 8.21 to 8.10 since the industrial revolution. Deeper waters tend to have even lower pH levels, so that when deep water is brought to the surface during coastal upwelling, more significant reductions in pH can result. A reduction in pH constitutes an increase in acidification, which can lead to detrimental impacts to many marine species; specifically, those that rely on calcification to grow shells or body structures like shellfish. Recent research has identified the larval stage of bivalves as highly vulnerable, because acidic waters can lead to the death of developing larvae (Grays Harbor County MRC). Because this can lead to a

reduction in wild or hatchery production of shellfish, commercial shellfish growers buffer the seawater in their hatchery operations to counteract the effect.

During 2009 water quality monitoring at the Westport station, northerly winds created coastal upwelling events that pushed low pH, low dissolved oxygen (DO), and low temperature waters into the Grays Harbor estuary. These values moderated by the time the water reached sampling stations in North Bay and South Bay. From the limited dissolved CO_2 numbers observed in 2009, Grays Harbor had not yet at that time demonstrated corrosive or low pH in commercial shellfish growing areas. Additional sample collections were planned in subsequent years (Grays Harbor County MRC).

The Pacific Shellfish Institute (PSI) conducted water quality sampling in Grays Harbor in 2009 and 2010 for comparison with oyster larval recruitment and spatfall (settling of oyster larvae), open-ocean water quality and upwelling events (PSI, April 2011). Field sampling locations were situated in remote sites in North Bay (at Lone Tree Oyster facility along the Campbell Slough), and in South Bay (at Brady's Oyster facilities on the Elk River channel). YSI water quality sondes (data loggers) were placed near the entrance to the harbor at the U.S. Coast Guard Westport station to monitor incoming and outgoing waters at a 1 m (approximately 3-foot) depth, collecting continuous Dissolved Oxygen (DO), pH, Salinity, Temperature, Oxidation Reduction Potential (ORP), and Chlorophyll data. YSI data at the Westport station displayed a heavily oceanic influence where pH dropped as temperature decreased and salinity increased during the summers of 2009 and 2010. This was directly attributed to coastal upwelling events spurred by north winds.

Water samples were collected weekly at the North Bay and South Bay sites for bacteria, nutrients, DO and CO_2/pH during peak incoming tides. CO_2/pH data collected at these two Grays Harbor sites in 2010 displayed variations over time. In North Bay, omega aragonite levels[13] closely followed salinity trends: when salinity levels increased (i.e., when saltwater inflow into the bay was stronger), so did omega aragonite levels. When local river discharges of freshwater dropped off near the end of June, salinities and omega aragonite values started to increase at North Grays Harbor. South Grays Harbor displayed similar results but the trends were not as strong (PSI, April 2011).

During both 2009 and 2010, DO data indicated differences between the North Bay and South Bay stations, where South Bay exhibited a stronger oceanic influence. When upwelling events occurred, DO levels dropped noticeably in South Bay but not in North Bay. This trend was also observed in salinity and temperature measurements taken at these sites; salinity was consistently lower and temperature was consistently higher in North Bay. Overall, DO values were never low enough for concern at these locations (PSI, April 2011). This is likely due to the shallow and generally well-mixed water, and strong tidal exchange with the Pacific Ocean.

[13] Omega aragonite values are a means to quantify how likely aragonitic calcium carbonate is to dissolve or precipitate. The lower the omega aragonite value, the harder it is (i.e., the more energy it takes) to form a shell using aragonitic calcium. This is thought to be especially detrimental to oyster larvae which depend more on this type of calcium during their development (Burke Hales, personal communication, as cited in PSI, April 2011). Frequently, when CO_2 values increase, pH values drop and so does omega aragonite. As a rough rule, when omega aragonite values are below 1, oyster larvae have a decreased chance of survival (PSI, April 2011).

Increases in nutrient levels above natural levels can result in excessive plant and algae growth, a process called eutrophication. Grays Harbor and Willapa Bay have a low to moderate risk of eutrophication (PSAT 2007, as cited in USFWS, March 24, 2009). This is due, in part, to the high tidal flushing of both estuaries. Nutrient data did not exhibit consistent trends with water quality data or setting success of shellfish larvae during 2009 and 2010, although ammonium, silicate, and nitrate levels did consistently increase with increasing fresh water input to North Bay and South Bay of Grays Harbor (PSI, April 2011).

Proposed Discharge

At the time of this writing two forms of imidacloprid are labeled for use on burrowing shrimp in commercial shellfish beds: Protector 2F (a "flowable" product), and Protector 0.5G (a granular product). The flowable product would most often be used in aerial applications by helicopter. These applications would occur on a limited number of days each year during very low tides. The granular application of imidacloprid would be preferred when much or all of the area to be treated retains standing water even at low tide. The granular product sinks through standing water before dissolving and releasing imidacloprid into the water column just above the sediment surface. Protector 2F and Protector 0.5G would only be applied in Willapa Bay and Grays Harbor under the proposed NPDES permit issued by Ecology. WGHOGA proposes to apply imidacloprid within the tidal range of -2 feet MLLW to +4 feet MLLW.[14]

The EPA FIFRA label restricts discharge to 0.5 pounds of ***active ingredient*** per acre. This would allow a maximum discharge of 750 pounds of active ingredient in Willapa Bay and 250 pounds of active ingredient in Grays Harbor annually, if applied to the maximum allowed acreage in the proposed permit.

FIFRA Registration Restrictions

Conditional ***Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)*** Registrations for imidacloprid have been issued to WGHOGA, one for the granular formulation of the product (No. 88867-1 for Protector 0.5G; USEPA 2013a), and one for the flowable formulation (No. 88867-2 for Protector 2F; USEPA 2013a). The labeling requirements listed on the registrations control when and under what conditions these products can be applied, mixed, stored, loaded or used. This section summarizes controls, safety precautions, and mitigation measures that are required by the imidacloprid FIFRA Registrations regardless of additional conditions that would be imposed through Ecology's NPDES permit.

The application period authorized by the FIFRA Registrations is April 15th through December 15th. No bed may be treated with imidacloprid if it contains shellfish within 30 days of harvest. The

The FIFRA Registrations include several "Application Instructions" that function as Best Management Practices (BMPs). These include:

[14] Plauché and Carr letter to Greg Zentner, Department of Ecology, November 7, 2013 re: WGHOGA NPDES Application: clarifying information to supplement the July 1, 2013 application.

- All ground (tidelands) to be treated must be properly staked and flagged to protect adjacent shellfish and water areas. For aerial applications, the corners of each plot must be marked so the plot is visible from an altitude of at least 500 feet.

- A single application of imidacloprid per treated commercial shellfish bed at up to 0.5 pound active ingredient per acre (a.i./ac) is allowed per year.

- The imidacloprid application rate shall not exceed 0.5 pound a.i./ac.

- Aerial applications must be on beds exposed at low tide.

- Applications from a floating platform or boat may be applied to beds under water (at periods other than low tide) using a calibrated granular applicator.

- A 100-foot buffer zone must be maintained between the imidacloprid treatment area and the nearest shellfish to be harvested within 30 days when treatment is by aerial spray; a 25-foot buffer zone is required if treatment is by hand spray if the nearest shellfish bed is to be harvested within 30 days.

- Drift potential is lowest between wind speeds of 3 to 10 mph. Accordingly, the average wind speed at the time of application is not to exceed ten mph to minimize drift to adjacent shellfish and water areas when applied by air.

- Imidacloprid shall not be applied when winds are greater than 10 mph, during gusty conditions, or during temperature inversions. (Temperature inversions begin to form as the sun sets and often continue into the morning.)

- Applications shall be made at the lowest possible height (by helicopter, ground or barge) that is safe for the operation and that will reduce exposure of the granules to wind.

- When applications of Protector 0.5G (i.e., the granular form of imidacloprid) are made crosswind, the applicator must compensate for displacement by adjusting the path of the application equipment upwind. Swath adjustment distance should increase with increasing drift potential.

- Helicopters used to apply either Protector 0.5G or Protector 2F shall be equipped to minimize spray drift. The best drift management strategy and most effective way to reduce drift potential is to apply large droplets that provide sufficient coverage and control. Droplet size can be controlled by using high flow-rate nozzles, selecting the number and type of nozzles, nozzle orientation, and controlling pressure appropriate for the nozzle type.

- Aerial applications shall not be made on Federal holiday weekends.

- Comply with the mixing and loading requirements of the FIFRA Registrations: use of a properly designed and maintained containment pad for mixing and loading of a pesticide into application equipment is recommended. If a

containment pad is not used, maintain a minimum distance of 25 feet between mixing and loading areas and potential surface to groundwater conduits.

- All mixers, loaders, applicators, and handlers must comply with the Personal Protective Equipment (PPE) specifications in the FIFRA Registrations: long-sleeved shirt and long pants; shoes plus socks; chemical-resistant gloves; chemical-resistant apron when mixing, loading, or cleaning up spills or equipment; protective eyewear; and a dust mask (when using Protector 0.5G).

- Comply with the user safety recommendations of the FIFRA Registrations: wash hands thoroughly with soap and water before eating, drinking, chewing gum, using tobacco, or using the toilet.

- Comply with the storage and disposal requirements of the FIFRA Registrations.

The public notification requirements (for which WGHOGA would be responsible) specified in the imidacloprid FIFRA Registrations include public access area postings (i.e., signs). At the time of aerial applications, all public access areas within one-quarter mile and all public boat launches within one-quarter mile radius of any bed scheduled for treatment shall be posted. Public access areas shall be posted at 500-foot intervals at those access areas more than 500 feet wide. "WARNING" or "CAUTION" signs shall say *"Imidacloprid will be applied for burrowing shrimp control on [date] on commercial shellfish beds. Do not Fish, Crab, or Clam within one-quarter mile of the treated area."* The location of the treatment area would be included on the sign. Signs shall be posted at least two days prior to aerial treatment and shall remain for at least 30 days after treatment. The Permittee would be responsible for posting, maintaining, and removing these signs. The WGHOGA proposal (described in Section 2.8.3.3 below) includes some additional, more specific notification procedures.[15]

Washington State Department of Agriculture Approval of Registration

The Washington State Department of Agriculture (WSDA) has approved the application for registration of Protector 0.5G (EPA Reg. No. 88867-1) and Protector 2F (EPA Reg. No. 88867-2) in Washington that was submitted by the Willapa Grays Harbor Oyster Growers Association (WGHOGA). This decision was based, in part, on the studies and risk assessments submitted by the WGHOGA, and subsequently reviewed by George Tuttle (WSDA Environmental Toxicologist). These registrations are effective through December 31, 2015, unless they are cancelled by the WGHOGA or the WSDA. The WSDA may renew the registration in 2016 provided that WGHOGA provides requested information.

[15] If a Sediment Impact Zone (SIZ) is defined to implement Alternative 3, Ecology would make a reasonable effort to identify and notify all landowners, adjacent landowners, and lessees potentially affected by the SIZ in accordance with WAC 173-204-415(2)(e). This notification would be in addition to the public notice requirements for chemical applications for which WGHOGA would be responsible.

D. Imidacloprid

Background

WGHOGA has expressed concern that without the ability to control burrowing shrimp the oyster and clam industry in Willapa Bay and Grays Harbor will decline significantly. Studies have been done on the impacts of imidacloprid application in Willapa Bay and Grays Harbor, as allowed by the Experimental Use section of the current NPDES permit for the pesticide carbaryl. These studies helped to inform the Risk Assessment done by Compliance Services International and funded by WGHOGA. The Risk Assessment can be found here: http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/docs/ImidaclopridRiskAssessment.pdf.

As ***State Environmental Policy Act (SEPA)*** lead agency, Ecology has made the determination that the issuance of this permit could have significant adverse environmental impact and determined that an Environmental Impact Statement (EIS) was required. At Ecology's request, shellfish growers prepared a draft EIS for the discharge of imidacloprid to manage burrowing shrimp on oyster and clam beds. Though Ecology has requested that WGHOGA prepare the EIS, it will be an Ecology document that will meet the requirements and standards of the agency. The EIS analyzes alternatives for burrowing shrimp management including a no action alternative, use of the pesticide carbaryl in combination with an integrated pest management approach, and the use of the pesticide imidacloprid with an integrated pest management approach. The EIS is the SEPA documentation for decision makers to make an informed decision on whether to issue this permit. Ecology made the draft EIS document available on its website at: http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/index.html.

The risk assessment and the burrowing shrimp EIS provide a comprehensive overview of imidacloprid and its use in a marine/estuarine environment. Ecology provides a short summary of imidacloprid below, but refers the reader to the above documents for a more thorough evaluation of imidacloprid toxicities and effects.

Mode of Action

Imidacloprid is a member of the neonicotinoid class of pesticide. Like the other neonicotinoids, imidacloprid shares structural similarity and a common mode of action with the tobacco toxin, nicotine (CEPA-DPR, 2006). The toxicity of imidacloprid is based on interference of the neurotransmission in the nicotinic cholinergic nervous system. Imidacloprid binds to the nicotinic acetylcholine receptor (nAChR) at the neuronal and neuromuscular junctions in insects and vertebrates. The nAChR is an ion channel, which endogenous agonist is the excitatory neurotransmitter acetylcholine (ACh). The receptor normally exists in a closed state, however, upon ACh binding, the complex opens a pore and becomes permeable for cations. The channel openings occur in short bursts, which represent the lifetime of the receptor-ligand complex. ACh is then rapidly degraded by the enzyme acetylcholinesterase (AChE). In contrast, imidacloprid bound to the nAChR is inactivated very slowly. Prolonged activation of the nAChR by imidacloprid causes desensitization and blocking of the receptor and leads to paralysis and death (CEPA-DPR, 2006).

Field Studies

2011 Field Studies: Experimental trials aimed at determining efficacy, environmental fate and transport, and the biological effects of imidacloprid were performed in 2011. These trials were conducted in Willapa Bay, with the study sites chosen to meet the specific criteria of ownership by a WGHOGA member; adequate densities of burrowing shrimp; adequate distance from previous or planned applications of carbaryl on commercial shellfish beds (>0.5 mile); no previous applications of carbaryl to the tested sites within the past 20 years, if ever (personal communication with Dr. Kim Patten, WSU Pacific County Extension Director, May 29, 2014);[16] accessibility; and desirable characteristics of elevation, vegetation, and substrate that are similar to commercial shellfish beds and that were consistent among the study sites. In addition, treatment and control plots had to be adequately separated to prevent cross contamination (>500 meters). These criteria limited the study sites to two locations within Willapa Bay. The first was located off Rosario Beach on the western side of the Bay Center Peninsula on the eastern shore of the Bay (Bay Center) and the second was located east of the main channel of the Cedar River after it enters the northern part of the bay (Cedar River). At Bay Center, both the granular (Mallet) and flowable (Nuprid) formulations of imidacloprid were used, while at Cedar River only Nuprid was used (Booth 2014). A total of 51.38 acres of commercial shellfish beds were treated with imidacloprid, 29.54 acres with Nuprid and 21.84 with Mallet (Patten 2011). These studies did not have an approved Sampling and Analysis Plan from the Department of Ecology.

The Bay Center site contained sandy sediments common to many of the commercial shellfish beds in Willapa Bay and Grays Harbor. The Cedar River site had higher levels of organic matter in the sediments. Results for the two sets of sites were different for some of the factors being analyzed. Where different, they are presented separately in the sections below.

Megafauna Sampling and Analyses: Effects of imidacloprid on epibenthic megafauna (Dungeness crab and fish) were assessed by counting all affected megafauna species on and within 150 feet of the site. Any species exhibiting signs of paralysis or were dead by any cause, directly or indirectly related to treatment (e.g. bird predation of crabs exhibiting paralysis) were considered to be affected. The number of affected Dungeness crab per site ranged from 0 to 19 and the number of affected crab per acre ranged from 0.87 to 3.8 where the treatment site was greater than four acres. There were no affected fish found on the sites following any treatment (Patten 2011).

Efficacy: Efficacy across all sites and treatments ranged from 42 to 96 percent burrow reduction, with highest efficacy on sandy sites with no vegetation and lowest on silty sites and vegetated sites. Studies conducted in 2011 also noted that applications to sites heavily vegetated with eelgrass were problematic due to the lack of site drainage in these areas. These results indicated that eelgrass may impair efficacy by limiting chemical access to shrimp burrows, and by preventing burrow collapse following treatment, thus allowing affected shrimp to recover once paralysis has ceased (Patten 2011).

[16] Treatment sites selected for experimental trials were generally not premium shellfish ground and had not previously been treated with carbaryl.

Sediment Porewater Results: Average imidacloprid concentrations within the sediment porewater ranged from 24 to 154 ppb immediately after treatment. These concentrations decreased to 8 to 20 ppb one day after treatment and to 0-0.5 ppb at 56 days after treatment.

Epibenthic and Benthic Invertebrate Sampling and Analyses: Epibenthic and benthic invertebrates were sampled at one day before and at 14, 28, and, for Bay Center only, 56 days after treatment. These sampling durations are timed to permit sampling at low tide events following the initial application, and for 14 days, to allow animals killed by imidacloprid to decompose so that they are not confused with live animals taken at the time of collection. Four on-plot stations were sampled in each treatment plot, with four or five replicate core samples at each station.

In general, the impact of imidacloprid was assessed by comparing each of nine endpoints: absolute abundance, taxonomic richness, and Shannon diversity were calculated separately for each of three primary taxonomic groups: polychaetes, mollusks, and crustaceans. At each post treatment interval (14, 28, and sometimes 56 days after treatment), the value of each of the nine endpoints in the treated plot at each study site (Bay Center or Cedar River) was compared to the same endpoints in the respective control plot.

A consistent problem in the 2011 trials was that the number of invertebrates on the control and treatment plots was not similar to one another at the time of imidacloprid application. This makes interpretation of subsequent differences between treated and control sites more difficult and requires further site specific analysis to determine if a treatment effect on the benthic community had occurred. The problem was especially evident in Cedar River where some species were as much as 30 times more abundant in the treatment plot than in the control plot at the time of imidacloprid application. Ecology performed a site specific analysis of the Cedar River study data and determined that a treatment effect on the benthic community was evident at both 14 and 28 days for polychaete and crustacean abundance.

In general, before imidacloprid application, the control and treatment plots at the Bay Center sites were similar for about half of the absolute abundance, taxonomic richness, and diversity metrics for crustaceans, polychaetes, and mollusks. Statistical tests for treatment effects of imidacloprid were more definitive for these measures than for metrics that were not similar before treatment. Regardless, the analysis of the data collected from the Bay Center area could not differentiate between a treatment effect and natural variation. That is, the invertebrates on the treatment and control sites were similar enough that the data showed no statistical differences after 14 and 28 days, demonstrating that the treatment plot had recovered or that recolonization had occurred.

Before imidacloprid application, invertebrates on the control and treatment plots at the Cedar River site were statistically different for five of the nine endpoints that were examined. Polychaetes and crustaceans, in particular, were far more abundant on the treatment plot than at the control plot. In part, this was likely due to differences in vegetation levels and tidal elevations between the control and treatment plots. The differences between the plots were great enough to make any interpretation of invertebrate numbers after imidacloprid application difficult. Results of the analyses

showed a decrease in abundance for most crustacean and polychaete species on the treatment plot, while a general increase was seen in the control plot. These differences were seen at both 14 and 28 days after treatment. While not conclusive, these results are consistent with an interpretation that imidacloprid reduced the number of polychaetes and crustaceans on the treatment plot, and that the decline lasted for at least 28 days following treatment, at least for some species. Subtle differences in temperature, tidal elevation, and vegetation accounted for some differences between the treated and control site as well. A treatment effect was not evident for the three endpoints for molluscs (abundance, taxonomic richness, and Shannon diversity), or for richness and diversity in polychaetes or crustaceans.

Given the observed treatment effect and poor initial match between the treatment and control sites in Cedar River in 2011, another study in the Cedar River area is planned for the summer of 2015. This study will again examine whether a treatment effect of imidacloprid application can be detected in invertebrate populations. Because imidacloprid may be more persistent in sediments with higher silt content (Grue and Grassley 2013), a focus of the study will be to look at the interaction between the organic content of the sediment in the treatment site(s) and the persistence of imidacloprid and its potential effects on invertebrates.

2012 Field Studies: Experimental trials aimed at determining efficacy, environmental fate and transport, and the biological effects of imidacloprid were performed in 2012 under an Ecology-approved Sampling and Analysis Plan (Hart Crowser 2012). The scope of these trials was to determine the magnitude, extent and duration of imidacloprid exposure from an application of imidacloprid for the control of burrowing shrimp. This study was also designed to measure one of the degradation products of imidacloprid: imidacloprid-olefin. The specific components of this study included:

- Measurement of pre- and post-application water column concentrations of imidacloprid and imidacloprid-olefin;
- Measurement of whole sediment imidacloprid and imidacloprid-olefin concentrations;
- Measurement of sediment porewater imidacloprid and imidacloprid-olefin concentrations;
- Evaluation of binding of imidacloprid and imidacloprid-olefin to sediments;
- Measurement of imidacloprid and imidacloprid-olefin concentrations in eelgrass tissues;
- Whole sediment characterization (texture, total organic carbon, dissolved organic carbon);
- Evaluation of the efficacy of imidacloprid in controlling burrowing shrimp; and
- Evaluation of the effects of imidacloprid on benthic invertebrate communities.

The 2012 experimental trials were conducted in Willapa Bay and the study sites were selected with specific criteria in mind. Treatment and control sites were located in two areas of Willapa Bay. The first location was between Sandy Point and Ramsey Point in the east side of the bay, below the south fork of the Palix River (Palix). The second location was south of Leadbetter Point and Grassy Island on the north end of the Long Beach peninsula (Leadbetter). Limited sampling also occurred in one small plot near Cedar River. Treatment occurred in August of 2012. Study site criteria included ownership by a WGHOGA member; adequate densities of burrowing shrimp; adequate distance from previous or planned applications of carbaryl on commercial shellfish beds (>0.5 mile); no previous applications of carbaryl within the past 20 years, if ever (personal communication with Dr. Kim Patten, WSU Pacific County Extension Director, May 29, 2014);[17] accessibility; replication of a commercial-scale application; and desirable characteristics of elevation, vegetation, and substrate that are similar to commercial shellfish beds and that were consistent within the study area. In addition, treatment and control plots had to be adequately separated to prevent cross contamination (>500 meters). All treatment and control plots were seven to ten acres in size. Both the granular (Mallet) and flowable (Nuprid) formulations of imidacloprid were used in these trials.[18]

The following screening values were used to determine when levels of imidacloprid in various sample types were high enough to potentially result in environmental consequences:

- Surface water – 3.7 ppb (screening value);
- Sediment – 6.7 ppb (laboratory quantitation limit)
- Sediment porewater – 0.6 ppb (screening value); and
- Eelgrass tissue – 10 ppb (laboratory quantitation limit).

The surface water screening value was derived using EPA guidance (USEPA 1985) on water quality criteria and the sediment porewater screening value is a conservative concentration based upon chronic effects NOEC in 21-day toxicity studies (Ward 1991).

Water Column Sampling and Analyses: Water column samples were collected within each treatment plot, as well as at 60, 120, 240, and 480 meters (m) (197, 394, 787, and 1,575 feet, respectively) from the plot edge on the upstream and downstream side of the plot. Samples were collected as the first advancing tide moved across the treatment area and onto surrounding areas. When drainage channels were present, samples were taken in the drainage channels at distances mentioned above. Some drainage channel samples were collected from water draining from the treated area soon after treatment. Nuprid was sprayed on treatment plots that were exposed from an outgoing tide. Mallet was applied to treatment plots with 0.5 to 3 feet of water on them during an outgoing tide.

[17] Treatment sites selected for experimental trials were generally not premium shellfish ground and had not previously been treated with carbaryl.

[18] Mallet and Nuprid used during the experimental trials are the same as the imidacloprid products for which FIFRA Conditional Registrations were issued June 6, 2013: Protector 0.5G and Protector 2F, respectively.

Samples were collected prior to and approximately two hours following application of imidacloprid.

Concentrations of imidacloprid were generally highest in drainage channels associated with Nuprid, with a maximum observed value of 4,200 ppb at 60 m (197 feet), and 120 ppb at 480 m (1,575 feet). Based on the study design, it was expected that the highest concentrations of Nuprid would be found in the drainage channels. In contrast, Mallet concentrations were much lower approximately two hours after application. Only 2 of 13 samples were above the quantitation limits and both were below 1.0 ppb.

The results of the water column sampling showed that many offsite locations upslope of the treatment area were found to have at least some concentration of imidacloprid during the first advancing tide that passed over the treated area. Outside of the drainage channels, Nuprid concentrations reached a maximum of 900 ppb, with concentrations as high as 200 ppb at a distance of 480 m (1,575 feet). Mallet concentrations reached 130 ppb at a distance of 60 m (197 feet) and no concentrations above the screening criteria at further distances. The average olefin detection was 1.8 percent of the corresponding imidacloprid measure. Olefin concentrations ranged from 0.08 to 3.6 ppb.

<u>Sediment and Sediment Porewater Sampling and Analyses</u>: Sediment samples were collected for whole sediment and sediment porewater analysis within each treatment plot and from three transects on the high elevation (direction of tidal flow) side of the treatment plot at 60, 120, 240, and 480 m (197, 394, 787, and 1,575 feet, respectively) from the plot edge. When drainage channels were present, samples were taken in the drainage channels at distances mentioned above. One pre-treatment sample was taken. Samples were also collected on days 1, 14, 27, and 56 after application.

The maximum concentration of imidacloprid found in sediment porewater on treatment plots one day post-application was 261 ppb. In general, imidacloprid concentrations were greater on the Nuprid-treated beds compared to the Mallet-treated beds. By 14 days post-application, imidacloprid residues in sediments and sediment porewater were reduced by 96.5 percent (maximum 9.1 ppb). Concentrations of imidacloprid within porewater samples collected at high elevation transects off the treatment plots largely followed the pattern of the residues within the water column samples. Analysis have suggested that 0.5 to 2 percent of the imidacloprid observed in the inundation water passing a given position will subsequently be observed in the sediment porewater 1 to 3 days post-application (Grue 2012). Analyses of whole sediment samples indicate 89 to 98 percent of the imidacloprid deposited on the treatment plots had moved off-site in the first 24 hours (see Grue and Grassley 2013 and Hart Crowser 2013 for more details). See Chapter 3 for discussions of potential impacts to non-target plants and animals.

<u>Eelgrass Sampling and Analyses</u>: Eelgrass (*Zostera marina* or *Zostera japonica*) samples were collected within and outside of the treatment plots prior to treatment, and 1, 14, and 28 days post-treatment. Detection of imidacloprid at levels above the laboratory quantitation limit (10 ppb) was found only on the first

day post-treatment, with a maximum concentration of 120 ppb. Seven out of 20 eelgrass samples had detectable concentrations of imidacloprid on the first day post-treatment.

Sediment Binding Rates: Whole sediment binding rates of imidacloprid were calculated for 51 samples. A binding rate of 50 percent indicates that half the total imidacloprid is contained within the solid and liquid fractions, but does not indicate that the concentration within the solid and liquid fractions are equal (e.g., the solid fraction may have 20 percent of the imidacloprid while the liquid fraction has 30 percent). Initial bind rates ranged from 17.4 to 39.5 percent at the Palix River and Leadbetter Point treatment plots, while the Cedar River treatment plot had an initial binding rate of 89.8 percent. Approximately 30 to 90 percent of the imidacloprid remaining in the sediment one day after treatment is bound to the sediment, rather than present in the pore water. The proportion of imidacloprid bound to the sediment increased through successive sample collections at 14, 28, and 56 days post-treatment, meaning that there was less imidacloprid present in the porewater. Thus, although imidacloprid levels in sediments declined in both sediment and sediment pore water, the declines occurred more readily in the pore water fraction.

Data on sediment binding of imidacloprid indicate that it binds more readily to sediments that are higher in total organic carbon (TOC) (e.g. at the Cedar River treatment plot), and appears to be more persistent, than in sediments with lower concentrations of TOC (Palix River and Leadbetter Point treatment sites). At the Cedar River site, the concentration of imidacloprid bound to sediment decreased from approximately 28 percent one day after treatment to approximately ten percent 56 days after treatment. At the other two sites with lower TOC, imidacloprid concentrations had declined to less than five percent only 28 days after treatment (Grue and Grassley 2013).

Megafauna Sampling and Analyses: Dungeness crab and fish were counted on the day of application and again 24 hours after treatment. Counts were made at low tide along 3- to 7-m (10- to 23-foot)-wide transects that crossed and extended 50 m (164 feet) on each side of the plots. Species, size, incidence of paralysis, and cause of death were recorded. The average across all sites and treatments was two affected crab per acre. The highest count was 3.4 affected crab per acre. Bird predation of crab impacted by paralysis appeared to be the main cause of crab mortality. However, crushing of crab with the ATV during imidacloprid application was also a significant cause of loss.[19]

Fish mortality ranged from 0 to 0.1 per acre. These results could have been due to chance (e.g., a dead fish drifted into the sample area on the tide, or to fish crushed by the ATV during imidacloprid application). The results do not indicate that imidacloprid application resulted in more than incidental mortality of any fish species.

[19] There is a certain amount of crab mortality on tidelands that have not been treated with imidacloprid or had ATV traffic. The mortality numbers reported here are the numbers above control sites.

Birds were observed foraging on and nearby the sites following treatments. No birds exhibiting behaviors consistent with exposure to a pesticide (e.g., confusion, poor balance, paralysis) were observed (Patten 2013). In addition, the tidelands outside the treated area were mapped two weeks post-treatment. The presence of dead commensal clam shells (i.e., clams that live with burrowing shrimp) indicated the pattern and range of significant offsite chemical movement. For the most part, these affected areas were confined to a narrow band around treated plots, with an average 15 percent increase in area beyond what was treated.

Efficacy: Efficacy across all sites ranged from 65 to 84 percent burrow reduction. Efficacy was reduced at sites with significant eelgrass coverage. Some areas immediately outside the treated areas exhibited some level of burrowing shrimp reduction.

Epibenthic and Benthic Invertebrate Sampling and Analyses: Epibenthic and benthic samples were collected both within and adjacent to the treatment area, using a grid-based sampling approach. Epibenthic and benthic invertebrates were sampled prior to the application of imidacloprid and at 14 and 28 days post-treatment. In general, imidacloprid effects were assessed for nine endpoints (absolute abundance, taxonomic richness, and Shannon diversity for each of three primary taxonomic groups: polychaetes, molluscs, and crustaceans) by comparisons in the treated plots to the same endpoints in the control plots at each post-treatment interval (14, 28, and sometimes 56 days post-treatment).

In general, non-target effects on the epibenthic and benthic invertebrates from imidacloprid were absent to minimal[20] based on the statistical analyses requested by Ecology. Polychaete abundance, richness, or diversity at the treatment sites could not be differentiated from abundance, richness, and diversity at the control site 14 days after treatment (see Hart Crowser 2013 for more details). Molluscs at one treatment site showed post-application declines, which could indicate an effect of imidacloprid; however, other factors may help account for incremental changes in abundance, richness and diversity in this taxon and location, particularly as no declines in mollusc abundance, richness, and diversity were found at the second site. Imidacloprid application did not affect the richness or diversity of crustaceans, but abundance did show a treatment effect. The composite result from the analysis of invertebrate endpoints is that imidacloprid application exhibited limited effects in both space and time. In most comparisons of data from the treatment and control plots, a treatment effect of imidacloprid could not be demonstrated for the invertebrate endpoints being tested, (see Hart Crowser 2013 and Booth 2013 for more details).

Ecology reviewed the results of the 2012 experimental trials and determined that, based on the current review of those studies, "Imidacloprid impacts to benthic and epibenthic communities appear to be minor based on the Sediment Management Standards regulatory framework. The dynamic estuarine environment provides conditions for rapid recolonization of treated plots at this level of treatment. The Sediment Management Standards allow minor impacts within an authorized ***Sediment Impact Zone (SIZ)***,

[20] Minimal effects to epibenthic and benthic invertebrates means that if these organisms are affected by imidacloprid, they recover and recolonize quickly (i.e., within 30 days).

provided other conditions are met, including notification and Best Management Practices (BMP) to minimize the extent and duration of the Sediment Impact Zone (WAC 173-204-410)" (Ecology Memo July 30, 2013).

Effects

The characteristics of imidacloprid and its effects are briefly and concisely described below without overly technical information. This summarized information is based primarily on technical review found in the *Risk Assessment for Use of Imidacloprid to Control Burrowing Shrimp in Shellfish Beds of Willapa Bay and Grays Harbor, WA* (Compliance Services International, June 14, 2013). Additional detailed technical supporting information can be found in that document.

Imidacloprid is moderately to highly effective at controlling burrowing shrimp in marine environments. The efficacy of imidacloprid to control burrowing shrimp varies with substrate type, with better control on sandy substrates versus those with more silt and organic matter (K. Patten, unpublished data). In addition, eelgrass cover appears to interfere with imidacloprid adsorption into sediments (Patten 2013; Grue and Grassley 2013). Laboratory studies of the toxicity of imidacloprid to juvenile and adult ghost shrimp suggest that surface water concentrations high enough to kill the shrimp directly within 96 hours are orders-of-magnitude greater than the magnitude and duration of exposure the shrimp likely receive in the field following experimental applications (C. Grue, University of Washington, unpublished data). Reasons for the observed efficacy in the field are not clear; however, it is thought that immobilization of the shrimp during a period of temporary paralysis following exposure to imidacloprid may result in burrow collapse and/or sufficient degradation in water quality (e.g., dissolved oxygen levels) that the shrimp cannot survive.

Field data from imidacloprid trials in Willapa Bay show that the chemical dissipates in surface water and sediment porewater and is usually analytically undetectable within 24 to 48 hours after application in surface water, and up to 28 days in sediment porewater. In addition, imidacloprid is typically undetectable in porewater at distances as far as 480 meters from the application area for time periods greater than 24 hours after application. Imidacloprid can bind to sediment particles leading to a longer residence time (persistence) in some sediment types. Binding rates depend upon many factors, including sediment type, temperature, pH, salinity, alkalinity, redox potential, solar radiation, biological activity, dissolved oxygen, DOC, and TOC (Felsot and Ruppert 2002; Grue and Grassley 2013).

Eight imidacloprid degradation products have been identified as a result of imidacloprid hydrolysis, photolysis, and soil and microbial degradation. Two of these degradation compounds, imidacloprid olefin, and 5-hydroxy imidacloprid were identified by EPA as being of interest due to potential toxicity. One of these degradates, imidacloprid-olefin, was analyzed during 2012 research efforts (Grue & Grassley 2013; Hart Crowser 2013). Of the samples analyzed for imidacloprid-olefin concentrations, less than 20 percent resulted in detectable concentrations of imidacloprid-olefin and these ranged from 0.08 to 3.6 ppb. Imidacloprid-olefin was found in surface water, sediments, and sediment porewater; it was undetectable in eelgrass tissue. Despite numerous attempts, the necessary laboratory standards to test for 5-hydroxy imidacloprid could not be found or

synthesized. Subsequent analysis suggests that this degradation product is likely unstable and has a very short half-life in the environment (Hart Crowser 2012).

Although field studies in Willapa Bay demonstrated that imidacloprid can affect non-target invertebrate species, in most instances such effects were limited or statistically undetectable (Patten 2013; Booth 2013; Hart Crowser 2013. Other studies have concluded that imidacloprid has low impact effects on non-target species such as fish, Dungeness crabs, some aquatic invertebrates, and seagrasses (Patten 2013; CSI 2013). Studies from Willapa Bay indicate that mortality of Dungeness crabs after exposure to imidacloprid is due to predation during temporary paralysis rather than death from the chemical itself (Patten 2013).

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III. AQUATIC PESTICIDE LEGAL HISTORY

A. The Federal Clean Water Act (CWA)

The Federal Clean Water Act [CWA, 1972, and later modifications (1977, 1981, and 1987)], established water quality goals for navigable (surface) waters of the United States. One of the mechanisms for achieving the goals of the Clean Water Act is the NPDES system of permits, which the United States Environmental Protection Agency (EPA) administers. The EPA has delegated responsibility for administering the NPDES permit program to the State of Washington. EPA delegated authority to Ecology based on chapter 90.48 RCW that defines Ecology's authority and obligations in administering the NPDES permit program. Ecology does not have authority to issue NPDES permits to federal facilities or to "Indian Country" as defined in 18 USC Sec. 1151.

B. Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

The following excerpt is from EPA's 2010 NPDES Pesticides General Permit Fact Sheet and explains FIFRA:

> *EPA regulates the sale, distribution, and use of pesticides in the U.S. under the statutory framework of the Federal Insecticide, Fungicide, and Rodenticide Act of 1979, to ensure that when used in conformance with the label, pesticides will not pose unreasonable risks to human health and the environment. All new pesticides must undergo a registration procedure under FIFRA during which EPA assesses a variety of potential human health and environmental effects associated with use of the product. Under FIFRA, EPA is required to consider the effects of pesticides on the environment by determining, among other things, whether a pesticide will perform its intended function without unreasonable adverse effects on the environment, and whether when used in accordance with widespread and commonly recognized practice [the pesticide] will not generally cause unreasonable adverse effects on the environment.* 7 U.S.C. 136a(c)(5).
>
> *In performing this analysis, EPA examines the ingredients of a pesticide, the intended type of application site and directions for use, and supporting scientific studies for human health and environmental effects and exposures. The applicant for registration of the pesticide must provide specific data from tests done according to EPA guidelines.*
>
> *When EPA approves a pesticide for a particular use, the Agency imposes restrictions through labeling requirements governing such use. The restrictions are intended to ensure that the pesticide serves an intended purpose and avoids unreasonable adverse effects. It is illegal under Section 12(a)(2)(G) of FIFRA to use a registered pesticide in a manner inconsistent with its labeling. States have primary authority under FIFRA to enforce "use" violations, but both the States and EPA have ample authority to prosecute pesticide misuse when it occurs.*
>
> *After a pesticide has been registered, changes in science, public policy, and pesticide use practices will occur over time. FIFRA, as amended by the Food Quality Protection Act of*

> *1996, mandates a registration review program, under which [EPA] periodically reevaluates pesticides to make sure that as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the statutory standard of no unreasonable adverse effects to human health or the environment. [EPA] is implementing the registration review program pursuant to Section 3(g) of FIFRA and will review each registered pesticide every 15 years to determine whether it continues to meet the FIFRA standard for registration. Information on this program is provided at http://www.epa.gov/oppsrrd1/registration_review/.*

FIFRA, as administered by the EPA and the Washington State Department of Agriculture (WSDA), requires that all persons that apply pesticides classified as restricted use be certified according to the provisions of the act, or that they work under the ***direct supervision*** of a certified ***applicator***. In Washington pesticides labeled for aquatic use are classified as restricted use pesticides [Chapter 16-228-123(1)(d) WAC]. Commercial and public applicators must demonstrate a practical knowledge of the principles and practices of pest control and safe use of pesticides, which they accomplish by means of a "core" examination. In addition, applicators using or supervising the use of any restricted use pesticides purposefully applied to standing or running water (excluding applicators engaged in public health related activities) must pass an additional exam to demonstrate competency as described in the code of federal regulations as follows:

> *Aquatic applicators shall demonstrate practical knowledge of the secondary effects which can be caused by improper application rates, incorrect formulations, and faulty application of restricted pesticides used in this category. They shall demonstrate practical knowledge of various water use situations and the potential of downstream effects. Further, they must have practical knowledge concerning potential pesticide effects on plants, fish, birds, beneficial insects, and other organisms which may be present in aquatic environments. Applicants in this category must demonstrate practical knowledge of the principals of limited area application (40 CFR 171.4).*

Any person wishing to apply pesticides to waters of the state must obtain an aquatic pesticide applicator license from WSDA or operate under the supervision of an ***aquatic licensed pesticide applicator***. See www.agr.wa.gov/PestFert/LicensingEd/Licensing.htm for information on Washington licensing requirements and testing.

C. Headwaters, Inc. v. Talent Irrigation District

In May 1996, as part of routine vegetation management, the Talent Irrigation District (TID) in southern Oregon applied the pesticide acrolein to a system of irrigation canals. Acrolein-treated water discharged into a fish-bearing creek causing a fish kill. Subsequently, Headwaters, Inc. and Oregon Natural Resources Council filed a Clean Water Act citizen suit against the TID for applying a pesticide into a system of irrigation canals without an NPDES permit.

The Ninth Circuit Court in *Headwaters, Inc. v. Talent Irrigation District* found that the applicator should have obtained coverage under an NPDES permit prior to application of aquatic pesticides to an irrigation canal. The decision addressed residues and other products of aquatic pesticides.

Reversing a district court's opinion, the Ninth Circuit Court held that application of the pesticide in compliance with the FIFRA labeling requirements did not exempt TID from having to obtain an NPDES permit and that the irrigation ditches were "waters of the United States" under the CWA (March 12, 2001).

Based on the TID court decision, Ecology, with advice from the Washington State Office of the Attorney General, determined that all pesticide applications to state surface waters required coverage under NPDES permits. Ecology issued its first NPDES general permits for pesticide applications to Washington's surface waters in 2002. Prior to 2001, Ecology regulated the application of aquatic pesticides to most surface waters by issuing administrative orders (called Short-Term Modifications of Water Quality Standards) to Washington-state licensed applicators. Since the Talent decision, there have been further court challenges about the applicability of NPDES permits to aquatic pesticide application as discussed below in this section of the Fact Sheet.

D. <u>League of Wilderness Defenders et al. v. Forsgren</u>

In the 1970s the Douglas fir tussock moth defoliated approximately 700,000 acres of Douglas fir in Idaho, Oregon, and Washington. In response to this outbreak, the United States Forest Service (USFS) developed a system to predict tussock moth outbreaks and control them via aerial spraying of insecticides. Based on its warning system, the USFS predicted an outbreak in 2000-2002 and designed a spraying program.

In 2002, the League of Wilderness Defenders et al. filed suit against the USFS for failing to obtain a NPDES permit under the Clean Water Act for the application of insecticides directly above surface waters. The USFS argued that any discharge of insecticides was nonpoint pollution and that the

The Ninth Circuit Court reversed a district court's opinion upon appeal. It held that aerial spraying (from an aircraft fitted with tanks) directly to, and over, surface water is a point source of pollution and requires an NPDES permit.

E. <u>Fairhurst v. Hagener</u>

The Montana Department of Fish, Wildlife, and Parks (Department) began a ten-year program to reintroduce threatened native westslope cutthroat trout into Cherry Creek. The Department used antimycin-A, a piscicide, to remove nonnative trout from Cherry Creek over several years, after which they planned to reintroduce native trout.

The Department was sued under the citizen suit provision of the CWA for failing to obtain an NPDES permit before applying antimycin-A to surface waters. During summary judgment, the district court decided in favor of the Department. On appeal, the Ninth Circuit court affirmed the district court's opinion. The Ninth Circuit opined that:

> *A chemical pesticide applied intentionally, in accordance with a FIFRA label, and with no residue or unintended effect is not "waste", and thus not a "pollutant" for the purposes of the Clean Water Act. Because the Department's application of antimycin-A to Cherry Creek was intentional, FIFRA compliant, and without residue or unintended effect, the discharged chemical was not a pollutant and the Department was not required to obtain a NPDES permit.*

Neither the Court nor the EPA offered any guidance regarding which pesticide applications would result in no residue or unintended effect.

F. Northwest Aquatic Ecosystems v. Ecology, Washington Toxics Coalition

In February 2006, the Pollution Control Hearings Board (PCHB) issued a final order in Case #05-101, *Northwest Aquatic Ecosystems v. Ecology, Washington Toxics Coalition*. This case focused on a number of issues, one of which was whether an NPDES permit is required for the use of federally registered pesticides since the Ninth Circuit Court ruled in *Fairhurst v. Hagener*.

The PCHB ruled on summary judgment that the *Fairhurst* decision does not provide a blanket exemption for the application of aquatic pesticides. Pesticides must meet identified conditions before Ecology can consider it outside the category of a pollutant under the CWA. The pesticide must:

(1) Be applied for a beneficial purpose.

(2) Be applied in compliance with FIFRA.

(3) Produce no pesticide residue.

(4) Produce no unintended effects (Fairhurst, 422 F.3d at 1150).

Northwest Aquatic Ecosystems failed to provide any evidence specifically addressing how the use of the aquatic herbicides diquat and endothall on the proposed sites would meet the four conditions identified in *Fairhurst.* In the absence of such evidence, *Fairhurst* provided no basis for the PCHB to conclude that an NPDES permit is not required for the proposed pesticide applications.

G. EPA Final Rule

In November 2006, EPA issued a final rule under the CWA entitled *Application of Pesticides to Waters of the United States in Accordance with FIFRA.* This rule replaced a draft interpretive statement EPA issued in 2003 concerning the use of pesticides in or around waters of the United States. The rule stated that any pesticide meant for use in or near water, applied in accordance with the FIFRA label, is not a pollutant under the CWA. Therefore, such applications are not subject to NPDES permitting.

After EPA issued the rule, Ecology met with stakeholders to seek input on how it should regulate the use of aquatic pesticides. Ecology also provided the public with a three-week comment period. Stakeholders affiliated with each of the seven affected permits (Mosquito, Noxious Weeds, Aquatic Plant and Algae, Irrigation, Oyster Growers, Fish Management, and Invasive Moth) commented. The consensus of these stakeholders was that Ecology should continue to issue joint NPDES/state waste permits to regulate aquatic pesticide applications.

To apply a pesticide to the water, state law requires the applicator to obtain a short-term modification of the water quality standards from Ecology. Ecology issued site-specific short-term modifications using an administrative order until 2001, when this process was challenged. Currently, the only legal vehicle for implementing a short-term modification is a permit. State law defines only two types of permits for surface water discharges: NPDES (federal) and State Waste

Discharge (state). Because of stakeholder consensus and the need for a permit to implement short-term modifications, Ecology decided that Washington would continue to use NPDES permits as the legal vehicle to regulate the use of aquatic pesticides in and around Washington state waters. Ecology believes that these permits provide the best protection of water quality, human health, and the environment.

H. National Cotton Council et al. v. EPA

In November 2006, EPA issued a final rule under the CWA that determined that pesticides applied in accordance with the FIFRA label are exempt from NPDES permitting requirements. Petitioners filed for review of EPA's final rule in 11 of the 12 federal circuit courts that are able to hear regulatory arguments. The federal courts combined the petitions into one case within the Sixth Circuit Court.

The Sixth Circuit Court made several findings. First, it agreed with the Ninth Circuit (*Fairhurst v. Hagener*) that if an applicator intentionally applies a chemical pesticide to water for a beneficial purpose, and the chemical leaves no waste or residue after performing its intended purpose, the discharge would not require an NPDES permit.

Second, the Court found excess pesticides and residues that make their way into waters during and after any pesticide application constitute wastes under the CWA and must have NPDES permit coverage before discharge occurs.

Finally, the Sixth Court determined that because EPA's final rule exempted discharges that the plain reading of the CWA includes as requiring an NPDES permit, the rule could not stand.

After a later motion, the Sixth Circuit granted EPA a stay on the effective date of this ruling for 24 months to allow the agency time to develop an NPDES permit for aquatic pesticide discharges. EPA issued its general permit on October 31, 2011, for the discharge of pesticides to manage aquatic plants and algae, aquatic animals, mosquitoes and flying insects, and forest canopy pests. In Washington, EPA's general permit covers aquatic pesticide activities conducted on federal facilities, on federal lands when federal entities conduct or authorize the treatment, and on tribal facilities and lands. The state regulates aquatic pesticide application to all other lands/waters.

IV. REGULATORY INFORMATION

A. Regulatory Pollution Reduction Requirements

Federal and state regulations require that effluent limits in an NPDES permit must be either technology-or-water-quality-based.

- Technology-based limitations are based upon the methods available to treat specific pollutants. Technology-based limits are set by EPA and published as a regulation or Ecology develops the limit on a case-by-case basis (40 CFR 125.3, and chapter 173-220 WAC).

- Water quality-based limits are calculated so that the effluent will comply with the Surface Water Quality Standards (chapter 173-201A WAC), Ground Water Standards (chapter 173-200 WAC), Sediment Quality Standards (chapter 173-204 WAC) or the National Toxics Rule (40 CFR 131.36).

- Ecology must apply the more stringent of these limits to each parameter of concern. These limits are described below.

B. Technology-Based Water Quality Protection Requirements

Sections 301, 302, 306, and 307 of the CWA establish discharge standards, prohibitions, and limits based on pollution control technologies. These technology-based limits are *best practical control technology* (BPT), *best available technology economically achievable* (BAT), and *best conventional pollutant control technology economically achievable* (BCT). Permit writers may also determine compliance with BPT/BAT/BCT using their *best professional judgment* (BPJ). EPA has stated that for pesticide application to water (in its aquatic pesticide NPDES general permit issued October, 2011) that technology-based requirements are Best Management Practices (BMPs); not numeric limits.

Washington has similar technology-based limits that are described as ***all known, available, and reasonable methods of control, prevention, and treatment* (*AKART*)** methods. State law refers to AKART under RCW's 90.48.010, 90.48.520, 90.52.040, and 90.54.020. The federal technology-based limits and AKART are similar but not equivalent. Ecology may establish AKART:

- For an industrial category or in an individual permit on a case-by-case basis.
- That is more stringent than federal regulations.
- That includes BMP's such as prevention and control methods (e.g., waste minimization, waste/source reduction, or reduction in total contaminant releases to the environment).

Ecology and EPA concur that AKART may be equivalent to Best Professional Judgment (BPJ) determinations.

Historically, EPA has regulated the pesticide application industry under FIFRA. EPA developed label use requirements to regulate the use of pesticides. EPA also requires the pesticide manufacturer to register each pesticide, provide evidence that the pesticide will work as promised, and minimize unacceptable environmental harm.

The Pesticide Management Division of the Washington State Department of Agriculture (WSDA) ensures that applicators use pesticides legally and safely in Washington. WSDA registers pesticides for use in Washington (in addition to EPA registration); licenses pesticide applicators, dealers and consultants; investigates complaints such as label violations; maintains a registry of pesticide sensitive individuals; and administers a waste pesticide collection program. These duties are performed under the authority of the ***Washington Pesticide Control Act*** (chapter 15.58 RCW), the ***Washington Pesticide Application Act*** (chapter 17.21 RCW), the General Pesticide Rules (chapter16-228 WAC), the Worker Protection Standard (chapter 16-233 WAC) and a number of pesticide and/or county specific regulations (http://agr.wa.gov/PestFert/Pesticides/default.htm).

The standards for environmental protection are different between the CWA and FIFRA. In compliance with the *National Cotton Council, et al. v. EPA* court decision, all aquatic pesticide applications in the United States occur under NPDES permits (as of October 31, 2011). EPA-delegated states, such as Washington, developed their own state NPDES permits for these activities. EPA developed a general aquatic pesticide NPDES permit for the non-delegated states

and federal and tribal lands not delegated under state permitting authority. In Washington, all aquatic pesticide activities taking place on tribal lands must follow EPA permitting guidelines. All federal agency actions taken by federal agencies on federal lands must occur under the EPA permit. Aquatic pesticide applications occurring on federal lands where the federal agency is not the decision maker or applicator may occur under state NPDES permits instead of the EPA permit (by agreement between EPA and Ecology).

After the *Headwaters Inc. v. Talent Irrigation District* decision (2001), Ecology regulated aquatic pesticide application under NPDES permits. Ecology issued its first aquatic pesticide permits in 2002. Since 2002, Ecology has revised and reissued several of its aquatic pesticide permits. It is Ecology's intent that if the proposed permit is issued, it will authorize burrowing shrimp management using the aquatic pesticide imidacloprid in a manner that complies with federal and state requirements.

All wastewater discharge permits issued by Ecology must incorporate requirements to implement reasonable prevention, treatment, and control of pollutants. Ecology acknowledges that applicators could treat the pollutants addressed in this permit only with great difficulty due to the diffuse nature and low concentrations that exist after the pesticides have become waste. The *Headwater, Inc. v. Talent* ruling established that aquatic pesticides become waste in the water after the pesticide has performed its intended action and the target organisms are controlled or if excess pesticide is present during treatment.

C. Experimental Use Permits

Entities operating under WSDA-issued ***experimental use permits*** (WSEUP) need coverage under this permit. WSDA requires WSEUP for all research experiments involving pesticides that are not federally registered or for uses not allowed on the pesticide label. WSDA experimental use permits limit the area that a Permittee can test to one acre or less. WSDA grants experimental use permits for gathering data in support of registration under FIFRA Section (3) or Section 24(c).

When a researcher conducts a test on more than one surface acre of water (per pest), he or she must operate under a federal experimental use permit as well as a ***state experimental use permit***. Any person may apply to the EPA for a federal experimental use permit for pesticides. These permits are usually valid for only one year. Persons holding a federal experimental use permit must also apply for and obtain a state experimental use permit before initiating any shipment of the pesticide to Washington. Ecology requires coverage under the appropriate aquatic pesticide permit for persons operating under a federal experimental use permit.

D. Water Quality-Based Requirements

Surface Water Quality-Based Effluent Limits

The Washington State Surface Water Quality Standards (chapter 173-201A WAC) were designed to protect existing water quality and preserve the beneficial uses of Washington's surface waters. Waste discharge permits must include conditions that ensure the discharge will meet established surface water quality standards (chapter 173-201A-510 WAC). Water quality-based effluent limits may be based on an individual waste load allocation or on a waste load allocation developed during a basin-wide TMDL study.

Ecology conditions NPDES and waste discharge permits in such a manner that authorized discharges meet water quality standards. The characteristic beneficial uses of surface waters include, but are not limited to, the following: domestic, industrial and agricultural water supply; stock watering; the spawning, rearing, migration and harvesting of fish; the spawning, rearing and harvesting of shellfish; wildlife habitat; recreation (primary contact, sport fishing, boating, and aesthetic enjoyment of nature); commerce; aesthetics and navigation.

Numeric Criteria for the Protection of Aquatic Life and Recreation

Numeric water quality criteria are published in the Water Quality Standards for Surface Waters (chapter 173-201A WAC). They specify the levels of pollutants allowed in receiving water to protect aquatic life and recreation in and on the water. Ecology uses numeric criteria along with chemical and physical data for the wastewater and receiving water to derive effluent limits in the discharge permit. When surface water quality-based limits are more stringent or potentially more stringent than technology-based limits, the discharge must meet the water quality-based limits.

The EPA has published 91 numeric water quality criteria for the protection of human health that are applicable to dischargers in Washington State (40 CFR 131.36). EPA designed these criteria to protect humans from exposure to pollutants linked to cancer and other diseases, based on consuming fish and shellfish and drinking contaminated surface waters. The Water Quality Standards also include radionuclide criteria to protect humans from the effects of radioactive substances.

Narrative Criteria

Narrative water quality criteria (e.g. WAC 173-201A-240(1); 2006) limit the toxic, radioactive, or other deleterious material concentrations that may be discharged to levels below those which have the potential to:

- Adversely affect designated water uses.
- Cause acute or chronic toxicity to biota.
- Impair aesthetic values
- Adversely affect human heath

Narrative criteria are statements that describe the desired water quality goal, such as waters being “free from” pollutants such as oil and scum, color and odor, and other substances that can harm people and fish. Ecology uses these criteria for pollutants for which numeric criteria are difficult to specify, such as those that offend the senses (e.g., color and odor). Narrative criteria protect the specific designated uses of all freshwaters (WAC 173-201-A-200; 2006) and of all marine waters (WAC 173-201A-210; 2006) in the state of Washington.

Antidegradation Analysis and Antidegradation Plan

The following narrative represents Ecology's antidegradation analysis and antidegradation plan for the Burrowing Shrimp Management on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor Individual Permit. The purpose of Washington's Antidegradation Policy (WAC 173-201A-300-330; 2006) is to:

- Restore and maintain the highest possible quality of the surface waters of Washington.
- Describe situations under which water quality may be lowered from its current condition.
- Apply to human activities that are likely to have an impact on the water quality of surface water.
- Ensure that all human activities likely to contribute to a lowering of water quality, at a minimum, apply AKART.
- Apply three Tiers of protection (described below) for surface waters of the state.

Tier I ensures existing and designated uses are maintained and protected and applies to all waters and all sources of pollution. Tier II ensures that dischargers do not degrade waters of a higher quality than the criteria assigned unless such lowering of water quality is necessary and in the overriding public interest. Tier II applies only to a specific list of polluting activities. Tier III prevents the degradation of waters formally listed as "outstanding resource waters" and applies to all sources of pollution.

Ecology has determined that a Tier II analysis is not required in association with activities regulated under a short-term modification (chapter 173-201A-410 WAC). This is supported by language in Ecology's guidance document on implementing Tier II antidegradation requirements that indicates such a plan may not be required. Ecology *Supplementary Guidance Implementing the Tier II Antidegradation Rules* dated September 2011 (https://fortress.wa.gov/ecy/publications/SummaryPages/1110073.html).

Short-Term Water Quality Modification Provisions

The short-term water quality modification provision of the draft permit allows the authorized discharges to cause a temporary diminishment of some designated beneficial uses while it alters the water body to control burrowing shrimp on oyster and clam beds in Willapa Bay and Grays Harbor. The conditions of this permit constitute the requirements of a short-term water quality modification.

A short-term exceedance only applies to short lived (hours or days) impairments, but short-term exceedances may occur periodically throughout the five-year permit term. Short-term exceedances may also extend over the five-year life span of the permit (long-term exceedance) provided the Permittee satisfies the requirements of chapter 173-201A-410 WAC.

Washington's Water Quality Standards include 91 numeric health-based criteria that Ecology must consider when writing NPDES permits. The EPA established these criteria in 1992 in its National Toxics Rule (40 CFR 121.36). Ecology has determined that the Permittee's discharge does not contain chemicals of concern based on existing data or knowledge.

E. Sediment Management Standards

The aquatic Sediment Management Standards (chapter 173-204 WAC) protect aquatic biota and human health. Under these standards, Ecology may require a Permittee to evaluate the potential for the discharge to cause a violation of sediment standards (chapter 173-204-400 WAC). Readers may obtain additional information about sediments at the Aquatic Lands Cleanup Unit website www.ecy.wa.gov/programs/tcp/smu/sediment.html.

The Sediment Impact Zone would authorize impacts to sediment quality on commercial clam and oyster aquaculture plots, which qualify to receive imidacloprid treatment under the conditions of this permit, allowing a temporary exceedance of the sediment quality standards (SQS) threshold of WAC 173-204-320 through 173-204-340 but not to exceed minor effects to the environment.

Ecology will only authorize sediment impact zones so as to minimize the number, size, and adverse effects of all zones, with the intent to eliminate the existence of all such zones whenever practicable. The department shall consider the relationship between environmental effects, technical feasibility and cost in determining whether it is practicable to minimize and/or eliminate sediment impact zones.

Ecology shall implement the standards of WAC 173-204-400 through 173-204-420 so as to prevent the creation of new contaminated sediment cleanup sites identified under WAC 173-204-520.

F. Ground Water Quality Standards

The Ground Water Quality Standards, (chapter 173-200 WAC), protect beneficial uses of ground water. Permits issued by Ecology must not allow violations of those standards. This permit does not allow the use of any pesticides expected to contaminate groundwater. In the event there are additional concerns, Ecology can issue orders requiring groundwater monitoring for imidacloprid under this permit.

G. SEPA Compliance

Because this is a new use of an aquatic pesticide in a sensitive environment, as lead agency, Ecology determined that this activity will have a significant adverse environmental impact and required that the applicants, WGHOGA, develop an EIS for this activity. The EIS must meet Ecology standards as an Ecology document. The EIS is the SEPA compliance for the issuance of this permit.

H. Endangered and Sensitive Species

EPA has implemented an Endangered Species Protection Program (ESPP) to identify all pesticides that may cause adverse impacts on threatened/endangered species and to implement measures that will mitigate these impacts. When the ESPP identifies an adverse impact, it

requires use restrictions to protect these species at the county level. EPA will specify these use restrictions on the product label or by distributing a county-specific Endangered Species Protection Bulletin. Bulletins are enforceable under FIFRA. General Condition G9 of the proposed NPDES Waste Discharge Permit No. WA0039781 requires the Permittee to comply with all applicable federal regulations. See www.epa.gov/espp/frequent-ques.htm for more information.

The U.S. Fish and Wildlife Service and National Marine Fisheries Service are involved in EPA's processes to protect listed species and designated critical habitat in several ways: by consulting with EPA on specific endangered species concerns; by issuing Biological Opinions on certain species; or other ways, as necessary. For details on how EPA evaluates the potential risks from pesticides to listed species and consults with the Services, see their risk assessment process web page at www.epa.gov/espp/litstatus/riskasses.htm.

The southern distinct population segment of green sturgeon is an ESA threatened species found along the western coast of the USA, Canada, and Mexico. The term "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Green sturgeons are present in Willapa Bay, but do not spawn in Washington waters. According to a NOAA website, the principal factor in the decline of the green sturgeon on the west coast is reduction of the spawning area to a limited section of the Sacramento River. Scientists believe that green sturgeon mainly eat benthic invertebrates, which include both species of burrowing shrimp found in Willapa Bay and Grays Harbor.

> *"Willapa Bay, along with the Columbia River and Grays Harbor, is one of the estuaries where green sturgeon concentrate in summer. Generally, green sturgeon are more abundant than white sturgeon here (Emmett et al. 1991). Catches have declined from 3,000-4,000 fish per year in the 1960's to few or none in recent years. Much of this is probably due to reduced size limits and seasonal and area closures* (http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/greensturgeon.pdf)." *(WDFW 2002a)*

Ecology does not believe that the issuance of this permit would have a federal nexus that would trigger formal ESA consultation with the federal services.

The language that guides Endangered Species Act (ESA) species consultation is given below: SEC. 7. (a) FEDERAL AGENCY ACTIONS AND CONSULTATIONS.— (2) Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section. In fulfilling the requirements of this paragraph each agency shall use the best scientific and commercial data available. The full text can be found here: http://www.nmfs.noaa.gov/pr/laws/esa/text.htm#section7.

Though Ecology is the delegated authority for NPDES permitting in Washington State, Ecology is not a federal agency. The requirement for ESA consultation is for federal agencies. There are provisions for USFWS and NOAA/NMFS to raise concerns to EPA and Ecology about ESA species.

WAC173-220-070 requires that Ecology submit all draft individual NPDES permits for federal agency review and recommendations. Federal agencies include the EPA, the US Army Corps of Engineers, the US Fish and Wildlife Service, the National Marine Fisheries Service, and any other federal agency upon their request. Ecology also solicited input from federal resource agency scientists when drafting this permit.

I. Responsibility to Comply with Other Requirements

Ecology has established, and will enforce, limits and conditions in the permit for the discharge of aquatic pesticides registered for use by the EPA and the WSDA. EPA and WSDA will enforce the use, storage, and disposal requirements expressed on pesticide labels. The Permittee must comply with the pesticide label requirements (FIFRA) and all of the conditions of this general permit. The permit does not supersede or preempt federal or state label requirements or any other applicable laws and regulations.

J. Determination of Permit Development

WGHOGA submitted an application for an individual permit to discharge Imidacloprid to manage burrowing shrimp on ***commercial clam and oyster beds*** in Willapa Bay and Grays Harbor on July 1, 2013. Ecology made a preliminary determination to develop an individual permit for that activity (173-220WAC). Ecology provided public notice of its preliminary determination to interested parties, in the Washington State Register (WSR 14-20-123) and on its website (Chapter 173-220-050 WAC).

K. Technology-Based Water Quality Discharge Limits

1. NPDES permits are issued for a duration of five years pursuant to chapter 173-220-180 WAC.

2. Ecology determined that discharge of imidacloprid under the conditions of this permit will have minor effects to the environment and will require a SIZ and associated monitoring.

3. Ecology prohibits treatment that causes oxygen depletion to the point of stress or lethality to aquatic biota from plant die-off, unintended impacts to water quality or biota, or the mortality of aquatic vertebrates. After evaluating toxicity data, the EPA risk assessment, and other relevant documents, Ecology believes that imidacloprid treatments allowed under this permit would be highly unlikely to cause any of the above impacts to aquatic biota from treatment of burrowing shrimp on tide flats in Willapa Bay.

4. Ecology determined that, if used according to the EPA label and in compliance with the conditions of this general permit, Imidacloprid would not violate water quality standards. By approving the active ingredient rather than trademarked product, Ecology does not plan to conduct additional review for each new trade name of imidacloprid marketed.

5. Ecology proposes to allow the active ingredient imidacloprid in formulations labeled for aquatic use.

6. The Permittee may apply imidacloprid only when the ***action threshold*** is met. The shrimp burrow density shown to significantly impact oyster and clam aquaculture is ten

burrows per square meter. Ecology limited the application period to April 15 through December 15 and only one application per season per treated area. Limiting the treatment to one application per season, helps reduce the amount of pesticide applied per area.

7. To help control non-target impacts to nearby organisms through any spray drift that may occur through treatment activities, Ecology limited the aerial application to times when the wind speed is ten miles per hour or less.

8. Treated acreages are likely not completely contiguous, but rather consist of commercial clam and oyster beds from different areas within the two estuaries. Treatment can occur over an eight month time period so effects should be staggered. Growers expect that the acreage treated each year will vary.

9. To help limit impacts to shellfish that are ready for harvest, the Ecology permit will require compliance with label restrictions, including buffers. There will be 100-foot buffers from shellfish to be harvested within 30 days when treatment is done by aerial spray, and 25 foot buffers between ground broadcast treatments and shellfish that are within 30 days of harvest. To protect against potential groundwater contamination the permit will require 25 foot buffers between mixing and loading areas and potential surface to groundwater conduits. The pesticide must be mixed and loaded at least 25 feet away from surface to groundwater conduits such as field sumps, uncased wellheads, sinkholes and field drains.

V. MONITORING

RCW 90.48.260 gives Ecology the authority to establish inspection, monitoring, entry, and reporting requirements. WAC 173-220-210 gives Ecology the authority to require monitoring of treated waters to determine the effects of discharges on surface waters of the state.

With the exception of certain parameters (pH, temperature, alkalinity), Ecology requires that all monitoring data be analyzed and prepared by a laboratory registered or accredited for the active ingredient under the provisions of chapter 173-50 WAC, *Accreditation of Environmental Laboratories*.

A. Monitoring

Permittees must record the amount of pesticide active ingredient they use at each site, and the amount of acreage treated to Ecology in an annual report.

Monitoring must be done to assess imidacloprid in surface water and impacts to sediments. These impacts will be assessed using water quality monitoring and through establishment of a sediment impact zone.

Water quality monitoring will provide information to determine how quickly imidacloprid is diluted and moved off site through tidal action and current. Surface water sampling of imidacloprid will be required immediately post-treatment. This monitoring data will characterize the spatial extent, fate, and transport of imidacloprid following application, and help to determine if concentration are a concern for non-target organisms.

The formation of a sediment impact zone and associated monitoring will allow Ecology to determine whether imidacloprid is persisting in the sediments of the treatment area and evaluate the impacts to benthic invertebrates. Samples must be taken prior to treatment and 14 days post treatment. Impacts to sediments will be determined by measuring reduction in population and species richness of specified benthic invertebrates. If impacts to sediments are greater than what is defined as minor effect then the Permittee will be in violation of the permit.

B. Surface Water Quality Effluent Limits

A Sediment Impact Zone will be established as part of this permit in accordance with chapters 173-204-400 through 173-204-420 WAC. In considering a Sediment Impact Zone authorization and what constitutes a minor effect to sediment quality, Ecology considers the magnitude, spatial extent and duration of effects to the benthic and epibenthic community. These three aspects of effect will need to be considered together to determine what constitutes "minor effects."

The Sediment Management Standards (SMS) have two levels of protection described in the regulation:

1. Sediment Quality Standards (SQS) correspond to a "no effects" level.

2. Sediment Impact Zone Maximum (SIZmax) corresponds to the maximum "minor effects" level.

Discharges that are demonstrated to meet the SQS level of protection (have no effect on human health or biological resources) are considered to meet the SMS without further permit terms and conditions. Discharges that are demonstrated to have minor effects to the benthic community may be permitted if they meet the conditions of a Sediment Impact Zone (SIZ), and a SIZ is authorized in the permit. A discharge that has more than minor effects (exceeds SIZmax) would not be permitted.

For non-Puget Sound marine sediments, such as in Willapa Bay and Grays Harbor, Ecology determines on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of the regulation.[21] Another part of the rule also states Ecology's authority to make appropriate sediment management decisions on a case-specific basis using best professional judgment and latest scientific knowledge for cases where the standards of the regulation are reserved or not available.[22] The SMS further defines "no adverse effects" as no acute or chronic adverse effect to biological resources as measured by a statistically and biologically significant response relative to reference in any appropriate biological test as defined in chapter 173-204-200(3) WAC.

Puget Sound Marine Criterion in the Sediment Management Standards is not directly applicable to Willapa Bay and Grays Harbor. However, the criterion was considered, along with recent scientific literature, in developing the approach for interpreting the non-Puget Sound marine narrative criteria in Willapa Bay.

[21] WAC 173-204-320(1)(c)
[22] WAC 173-204-110(6)

For this permit, taxonomic richness (number of different species or taxa present) is used in addition to abundance (number of organisms) for the three taxonomic groups listed in the Puget Sound marine criterion – Polychaetes, Mollusks, and Crustaceans.

The benthic community metrics that Ecology will use to consider impacts include:

- Crustacean abundance and taxonomic richness
- Polychaete abundance and taxonomic richness
- Mollusk abundance and taxonomic richness

Consistent with the Puget Sound marine criteria, for each metric listed above, if the mean of a test site is 50 percent less than the mean of the control site, and the treatment mean is significantly less than the control using statistical comparisons, it will be considered an effect for that metric, thus in excess of the SIZmax criteria. In cases where the control and treatment sites are not equivalent prior to treatment, or if data are not normally distributed, alternative methods will be used, per Ecology guidance, to evaluate a treatment effect to the benthic community.

Because benthic invertebrates have high seasonal variability, comparison of the treatment site to a control or reference site is critical for interpreting the data. The treatment and control sites must be chosen carefully to ensure that they have similar characteristics and location so that they are likely to have similar benthic communities. Characteristics such as elevation, organic content, grain size, and vegetation may affect the benthic community. As part of the statistical analysis, the control and treatment sites will be sampled and analyzed prior to any pesticide application to determine if they have similar metrics.

When performing statistical tests, it is important to have enough samples to be able to detect a difference between the plots. If there is a lot of variability in the data and not enough samples, it is possible that a difference does exist between the plots but the sampling was not sufficient to detect it. Therefore, Ecology requires the Permittee collect a sufficient number of samples per benthic study to determine a 50 percent reduction compared to the control. When developing the sediment sampling and analysis plan, the number of samples needed to have sufficient power can be estimated by performing a power analysis based on the variability of data collected in previous seasons.

In cases where the control and treatment sites are different prior to any imidacloprid application, it is more complicated to determine effects from treatment from natural variability. In these cases, Ecology will perform a site-specific analysis look at trends over time and comparisons between the control and treatment sites.

Ecology's site-specific analysis will generally include the following components:

- Site characteristics
- Distribution of data on the treatment and control sites
- Data trends over time

- Benthic community composition and changes in community composition
- Characteristics of benthic organisms that account for significant differences between sites and dates.

For site specific evaluations, Ecology will provide a written summary of their analysis and conclusions for Permittee and public review.

C. SIZ Closure

The SIZ will be formally closed during the last year of the permit term. Application of imidacloprid after this time will not be authorized. Closure will encompass all plots treated with imidacloprid during the permit term up to 7,500 acres in Willapa Bay and 2,500 acres in Grays Harbor. SIZ closure monitoring will consist of natural attenuation of residual imidacloprid in the sediment and benthic monitoring to verify that the SIZ recovers to the SQS.

Natural attenuation describes the physical, biological, or chemical processes of removing imidacloprid from the sediment. Examples of natural attenuation include dilution and chemical degradation. Monitoring of natural attenuation will occur during closure until imidacloprid is no longer detected to the laboratory practical quantitation limit (PQL). Until closure can be obtained, the permit cannot be reissued.

D. Annual Operations Plan

An Annual Operations Plan (AOP) is required to be submitted and approved by Ecology prior to annual treatments. The AOP provides Ecology the ability to inform agencies and the public about proposed pesticide discharge activities that are scheduled to occur under this permit. Ecology will post the AOP to the Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor Individual Permit website. Posting of the AOP will give the public the ability to avoid areas where Imidacloprid may be applied. Additionally, the AOP gives Ecology the ability to ensure that acreage limitations within the permit are not exceeded. Acreage requested in the AOP does not have to be treated, although treatments to any area not in an approved AOP would be a permit violation.

The SIZ and an associated Sampling and Analysis Plan would also be approved through the AOP. This gives Ecology the ability to ensure that the appropriated monitoring will occur during treatments.

E. Integrated Pest Management

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, *organic* food production

applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

VI. ANNUAL PUBLIC NOTICE AND SHORELINE POSTING

A. Notification and Posting Requirements

The requirement of public posting in the proposed permit is consistent with posting and notification requirements in other aquatic pesticide permits. Ecology considered input from interested parties and Permittees when developing posting and notification requirements in its aquatic pesticide permits. Ecology based these requirements on its BPJ and the publics' right-to-know.

The intent of notification and sign postings is to make people aware of those activities taking place that have the possibility of affecting them. The public has the right to know about possible chemical applications so they can make informed decisions about limiting their exposure. Under this permit, treatment will typically occur on privately owned tidelands used for commercial shellfish farming. It is unlikely that public exposure to treated areas on these private tidelands would occur. Willapa Bay and Grays Harbor water is not potable. Ecology requires Permittees to post all public access areas within a quarter mile of the treatment site. Individuals wishing to prevent any contact with treated water or beds could avoid the area. Shellfish on treated beds cannot be harvesting within 30 days after treatment. Additionally, a 100 foot buffer zone must be maintained between the treatment area and the nearest shellfish to be harvested within 30 days when treatment is by aerial spray; a 25-foot buffer zone is required if treatment is by hand spray if nearest shellfish bed is to be harvested within 30 days. Signs will state that "Imidacloprid will be applied for burrowing shrimp control on (date) on commercial shellfish beds. Do not fish, crab or clam within one-quarter mile of the treated area."

VII. SPILL PREVENTION AND CONTROL

WAC 173-226-070 allows Ecology to place permit conditions to prevent or control pollutant discharges from runoff, spillage or leaks, sludge or waste disposal, or materials handling or storage. It also allows Ecology to require the use of BMPs that includes schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of the waters of the state. BMPs also include treatment requirements, operating procedures, and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. The Permittee must be prepared to mitigate for any potential spills and, in the event of a spill, perform the necessary cleanup, and notify the appropriate Ecology regional office (see RCW 90.48.080, and WAC 173-226-070).

A. Records

Ecology based this permit condition on its authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (chapter 173-220-210 WAC). Applicators must keep all records and documents required by this permit for five years. If there is any unresolved litigation regarding the discharge of pollutants by the Permittee, they must extend the period of record retention through the course of the litigation (chapter 173-220-210 WAC).

VIII. REPORTING

Special condition S5 of the permit contains specific conditions based on Ecology's authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (chapter 173-220-210 WAC).

A. Report Submittal

Permittees meet part of their reporting requirements through annual treatment reporting. Permittees must submit their signed Annual Report to Ecology by December 31st of each year.

B. Annual Operations Plan

The pre-treatment plan includes maps and acreages proposed for treatment during the upcoming season. The Annual Operations Plan will be used to ensure that action thresholds have been met for acreage proposed for treatment. This plan will also allow Ecology to ensure that the SAP will meet monitoring requirements.

C. Annual Report

The annual post-treatment report summarizes the amount of imidacloprid (in pounds of active ingredient) used during the course of each treatment season per coverage and locations where imidacloprid was used. All monitoring results are included in the annual report.

D. Noncompliance Notification

Chapter 173-220-150 (1) (c) WAC states that a discharge of any pollutant more frequently or at a level in excess of that authorized is a permit violation. Ecology requires that if a Permittee violates permit conditions, it must take steps to stop the activity, minimize any violations, and report those violations to Ecology. For pesticide applications authorized in the permit, applicators must report violations to the Aquatic Pesticide Permit Manager and the Regional Spills Hotline (ERTS Hotline) within 24 hours. This allows Ecology to determine if more action is necessary to mitigate the permit violation.

IX. GENERAL CONDITIONS

Ecology bases the General Conditions on state and federal law and regulations.

X. DUTY TO REAPPLY

All NPDES permits require Permittees to reapply for coverage 180 days prior to the expiration date of the general permit in accordance with 40 CFR 122.21 (d), 40 CFR 122.41(b), and chapter 173-220-180 WAC.

XI. PERMIT ISSUANCE PROCEDURES

A. Permit Modifications

Ecology may modify this permit to impose new or modified numerical limits, if necessary to meet Water Quality Standards for Surface Waters, Sediment Quality Standards, or Water Quality

Standards for Ground Waters. Ecology would base any modifications on new information obtained from sources such as inspections, imidacloprid monitoring, or Ecology-approved reports. Ecology may also modify this permit because of new or amended state or federal regulations. Ecology may terminate the permit if monitoring shows significant adverse impacts to non-target species from burrowing shrimp control treatments using imidacloprid.

B. Recommendation for Permit Issuance

The individual permit meets all statutory requirements for authorizing a wastewater discharge, including those limitations and conditions believed necessary to control toxics, protect human health, aquatic life, and the beneficial uses of waters of the State of Washington. Ecology proposes to issue this general permit for five years.

APPENDIX A - DEFINITIONS

All definitions listed below are for use in the context of this permit only.

303(d) Listings: Means the list of water bodies in Washington State that do not meet the current water quality standards set in Chapter 173-201A WAC.

Action threshold: The density or number of individuals in a pest population that trigger management activities.

Active ingredient: The ingredient(s) in a pesticide product that provides the pesticidal effects.

All known, available, and reasonable methods of prevention, control, and treatment (*AKART*): A technology-based approach to limiting pollutants from discharges. Described in chapters 90.48 and 90.54 RCW and chapters 173-201A, 173-204, 173-216 and 173-220 WAC.

Applicant: The Willapa Grays Harbor Oyster Growers Association.

Aquatic Licensed: Means as defined in WAC 16-228-1545(3)(u).

Beneficial uses: As defined in WAC 173-201A-200.

Commercial clam beds: Marine or estuarine areas where clams (excluding geoduck and oysters) are raised and harvested for commercial sale under a current Washington State business license.

Commercial shellfish beds: Marine or estuarine areas where clams (excluding geoduck) and oysters are raised and harvested for commercial sale under a current Washington State business license.

Direct Supervision: Means as defined in RCW 17.21.020(13).

Discharge: The addition of any pollutant to a water of the state.

Experimental Use Permit: Federal and state permits that allow the use of unregistered pesticides in the context of research and development for registration of the pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3, or for registration of a new use of a currently registered pesticide under FIFRA Section 3.
The Washington State Department of Agriculture would issue experimental use permits for aquatic applications limited to a maximum of 1.0 acre in size.
The U.S. Environmental Protection Agency would issue experimental use permits for aquatic applications that may exceed 1.0 acre in size.

Federal Insecticide, Fungicide, and Rodenticide Act (*FIFRA*): A set of EPA regulations that establishes uniform pesticide product labeling, use restrictions, and review of new pesticides.

Individual permit: A discharge permit specific to a single point source or facility.

Integrated Pest Management: RCW 17.15.010 defines integrated pest management to mean a coordinated decision-making and action process that uses the most appropriate pest control methods and strategy in an environmentally and economically sound manner.

Notice of Intent (*NOI*): The application form that Ecology specifies the applicant must use to apply for permit coverage.

Pesticide: Means as defined in RCW's 15.58.030(31) and 17.21.020(36)

Pesticide Applicator: An individual licensed by Washington Department of Agriculture under chapters 17.21 RCW and 16-228 WAC to apply pesticides.

Pollutant: Means any substance discharged that would alter the chemical, physical, thermal, biological, or radiological integrity of the waters of the state or would be likely to create and nuisance or renders such waters harmful, detrimental, or injurious to the public health, safety, or welfare, or to any legitimate beneficial use, or to any animal life, either terrestrial or aquatic. Pollutants include, but are not limited to the following: dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, pH, temperature, total suspended solids, turbidity, color, biological oxygen demand, total dissolved solids, toxicity, odor, and industrial, municipal, and agricultural waste.

Sediment Impact Zone: Means an area where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges and authorized by the department within a federal or state wastewater or storm water discharge permit, or other formal department authorization.

Sensitive, Threatened, or Endangered:

Sensitive: Any species that is vulnerable or declining and could become endangered or threatened in the state without active management or removal of threats.

Threatened: Any species likely to become endangered in Washington within the foreseeable future if factors contributing to its population decline or habitat degradation or loss continue.

Endangered: Any species in danger of becoming extinct or extirpated from Washington within the foreseeable future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

State Environmental Policy Act (SEPA): Chapter 43.21C RCW and Chapter 197-11 WAC.

State experimental use permit: A permit issued by WSDA that allows the use of pesticides that are not registered or labeled for a particular use pattern for the purposes of research and development.,

Surface waters of the state of Washington: Means all waters within the geographic boundaries of the state of Washington defined as "waters of the United States" in 40 CFR 122.2, and all waters defined as "waters of the state" in RCW 90.48.020 excluding underground waters. These include lakes, rivers, ponds, streams, inland waters, wetlands, and all other fresh or brackish waters and water courses within the jurisdiction of the state of Washington, plus drainages to those surface waters.

Treat: To apply a pesticide to a pest population.

Washington Pesticide Application Act: Chapter 17.21 RCW.

Washington Pesticide Control Act: Chapter 15.58 RCW.

Zostera japonica: A seagrass species in the family Zosteraceae listed as a Class C noxious weed in Washington.

In the absence of other definitions set forth herein, the definitions set forth in 40 CFR Part 403.3 or in chapter 90.48 RCW apply.

APPENDIX B - PUBLIC INVOLVEMENT INFORMATION

All comments about the proposed permit must be received or postmarked by 5:00 p.m. on December 08, 2014 to be considered.

Ecology has tentatively determined to issue the individual permit for the control of burrowing shrimp on commercial oyster and clam beds only in Willapa Bay and Grays Harbor.

Ecology published a Public Notice of Draft (PNOD) on October 15, 2014 in the Washington State Register. The PNOD informs the public that the draft permit and fact sheet are available for review and comment.

Ecology will also email the notice to those identified as interested parties.

Copies of the draft individual permit, fact sheet, and related documents are available for inspection and copying between the hours of 8:00 a.m. and 5:00 p.m. weekdays, by appointment, at the Ecology office listed below, may be obtained from Ecology's website, or by contacting Ecology by mail, phone, fax, or email.

Permit website: http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/index.html

Ecology Headquarters Building Address:

300 Desmond Drive
Lacey, WA 98504

Contact Ecology:

Department of Ecology
Water Quality Program
Attn: Imidacloprid Pesticide Permit Manager
P.O. Box 47775
Olympia, WA 98504-7775

Derek Rockett
Email: derek.rockett@ecy.wa.gov
Phone: 360-407-6697
Fax: 360-407-6305

Submitting Written and Oral Comments

Ecology will accept written comments on the draft individual permit for the control of burrowing shrimp using the pesticide imidacloprid and Fact Sheet. Ecology will also accept oral comments at the public hearing starting at 10:00 a.m. on December 2, 2014, at:

Willapa Harbor Community Center
916 W First Street
South Bend, WA 98586.

Comments should reference specific text when possible. Comments may address the following:

- Technical issues
- Accuracy and completeness of information

- Adequacy of environmental protection and permit conditions
- Any other concern that would result from the issuance of this permit.

Ecology prefers comments be submitted by email to derek.rockett@ecy.wa.gov

Ecology must receive written comments (via email or postmarked December 8, 2014) no later than 5:00 p.m. on December 8, 2014.

Submit written, hard copy comments to:

Derek Rockett
Department of Ecology
P.O. Box 47775
Olympia, WA 98504-7775

You may also provide oral comments by testifying at the public hearing. Written comments will receive the same consideration as oral testimony.

Open House, Workshop, and Public Hearing

Ecology will hold one combined open house, workshop, and public hearing on the draft individual permit, DEIS, and SIZ application. The purpose of the workshop is to explain the individual permit, and answer questions in order to facilitate meaningful testimony during the hearing. The purpose of the hearing is to provide an opportunity for people to give formal oral testimony and comment on the proposed permit, DEIS, and SIZ application. The open house, workshop, and public hearing will begin at 10 a.m. and conclude when public testimony is complete.

Open House, Workshop, and Public Hearing

December 2, 2014 (10:00 a.m.)
Willapa Community Center
916 W First Street
South Bend, WA 98586

Issuing the Final Permit

Ecology will make a determination whether to issue the final permit after it receives and considers all public comments. Ecology expects to make a decision on issuing the new individual permit in spring 2015. It would be effective one month after the issuance date.

For further information, contact Derek Rockett at derek.rockett@ecy.wa.gov, or 360-407-6697, or by writing to Ecology at the Olympia address listed above.

APPENDIX C - APPEAL

This permit may be appealed to the Pollution Control Hearings Board (PCHB) within 30 days of the date of receipt of the final permit. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2) (also see glossary).

To appeal, the following must be done within 30 days of receipt of this permit:

- File the appeal and a copy of this permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.

- Serve a copy of the appeal and this permit on Ecology in paper form - by mail or in person (see addresses below). **E-mail is not accepted**.

The appeal must also comply with other applicable requirements in chapter 43.21B RCW and chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive Southeast Lacey, Washington 98503 **Pollution Control Hearings Board** 1111 Israel Road Southwest, Suite 301 Tumwater, Washington 98501	**Department of Ecology** Attn: Appeals Processing Desk P.O. Box 47608 Olympia, Washington 98504-7608 **Pollution Control Hearings Board** P.O. Box 40903 Olympia, Washington 98504-0903

APPENDIX D - RESPONSE TO COMMENTS

Look for the Response to Comments document on the Control of Burrowing Shrimp using Imidacloprid on Commercial Oyster and Clam Beds in Willapa Bay and Grays Harbor Individual Permit web page: http://www.ecy.wa.gov/programs/wq/pesticides/imidacloprid/index.html