SEDIMENT IMPACT ZONE (SIZ) APPLICATION FOR DISCHARGE OF IMIDACLOPRID INTO GRAYS HARBOR

WILLAPA/GRAYS HARBOR OYSTER GROWERS ASSOCIATION

Basic Permit Information

1. Applicant's company name, contact person, address, and telephone number.

Willapa Grays Harbor Oyster Growers Association (WGHOGA)
Don Gillies, President
PO Box 3
Ocean Park, WA 98640
360.875.9964

2. NPDES permit number.

To Be Determined

3. The exact legal location of the existing or proposed discharge and a map of the discharge location.

The general discharge location for the SIZ will be commercial shellfish beds in Grays Harbor, Washington (Figure 1), between the tidal elevations of -2 ft MLLW to +4 ft MLLW. In any given year, the specific discharge locations will be determined based on shellfish grower plans for their seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the degree of burrowing shrimp infestation. An Annual Operations Plan (AOP) will be submitted to Ecology every year, prior to commencing treatment with imidacloprid. The AOP will specify the potential shellfish beds to be treated, including legal locations of potential treatment beds; total acreage; type of application (liquid or granular formulation; aerial application or ground/boat application); legal owner/lessee; and bed identification name.

Figure 1 – Grays Harbor Location Map

4. Annual area to be treated.

Under this SIZ application, and the proposed NPDES permit, WGHOGA is planning on treating up to 500 acres per year in Grays Harbor (approximately 1.5 percent of total tideland area exposed at low tide). The exact number will vary, depending on shellfish grower plans for their seed beds, grow-out sites, and fattening grounds; the efficacy of prior treatments; and the degree of burrowing shrimp infestation each year. The application rate, maximum annual acreage, treatment schedule, shrimp presence criteria, Best Management Practices, monitoring requirements, and safety precautions would be specified in the permit.

Discharge Characteristics

5. Chemical name and additional chemical information.

For this proposal, imidacloprid (common name and active ingredient) is registered as Protector 2F (21.4 percent, Nuprid, flowable) and Protector 0.5G (0.5 percent, Mallet, granular). The MSDS forms for these chemicals are attached as Appendix A. Imidacloprid will be applied at a rate of up to 0.5 lb active ingredient per acre (a.i./acre) for all treatment scenarios.

6. Chemical degradation products.

Imidacloprid is transformed into a series of degradation products in response to hydrolysis, photolysis, oxidation, and biochemical breakdown. From the degradation products identified in aerobic water and sediment studies, a degradation pathway has been proposed as shown on Figure 2. The compounds marked with an asterisk were found only in systems exposed to light. Under anaerobic conditions, imidacloprid-guanidine occurs as a major degradation product.

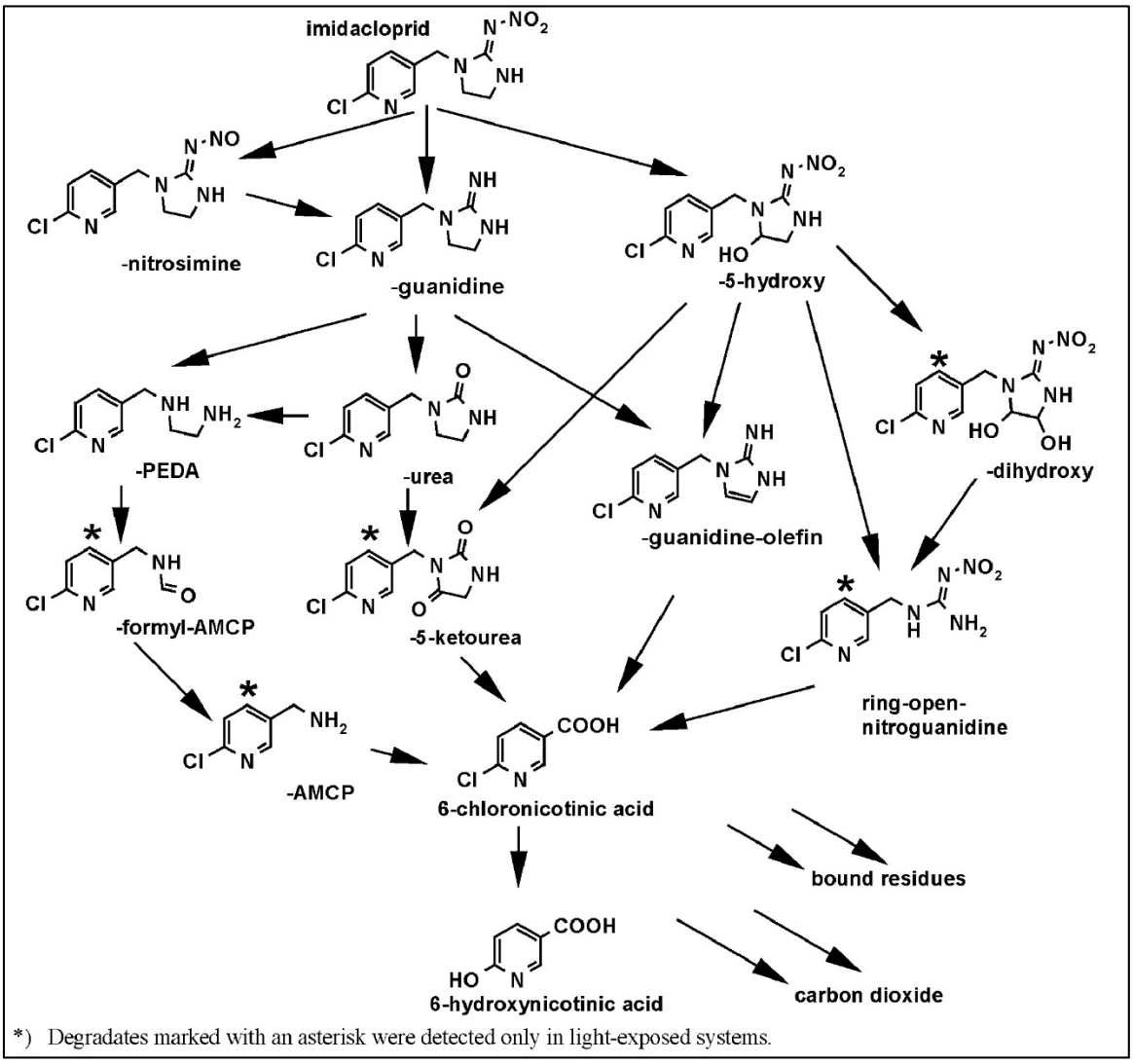

Figure 2 - Proposed Metabolic Pathway for Degradation of Imidacloprid in Aquatic Systems

Three major photo-degradation products: imidacloprid-guanidine, imidacloprid-olefin and imidacloprid-urea, as well as five minor ones: 3-amino-5-chloropyridine (AMCP); -formyl-AMCP; chloronicotinic acid; -dihydroxy-guanidine; and -ring-open-guanidine, have been identified as photo-transformation products of imidacloprid (Figure 3). The reaction course to chloronicotinic acid proceeds from the parent by stepwise photo-degradation with oxygen. No intermediates from this chain of reactions could be detected.

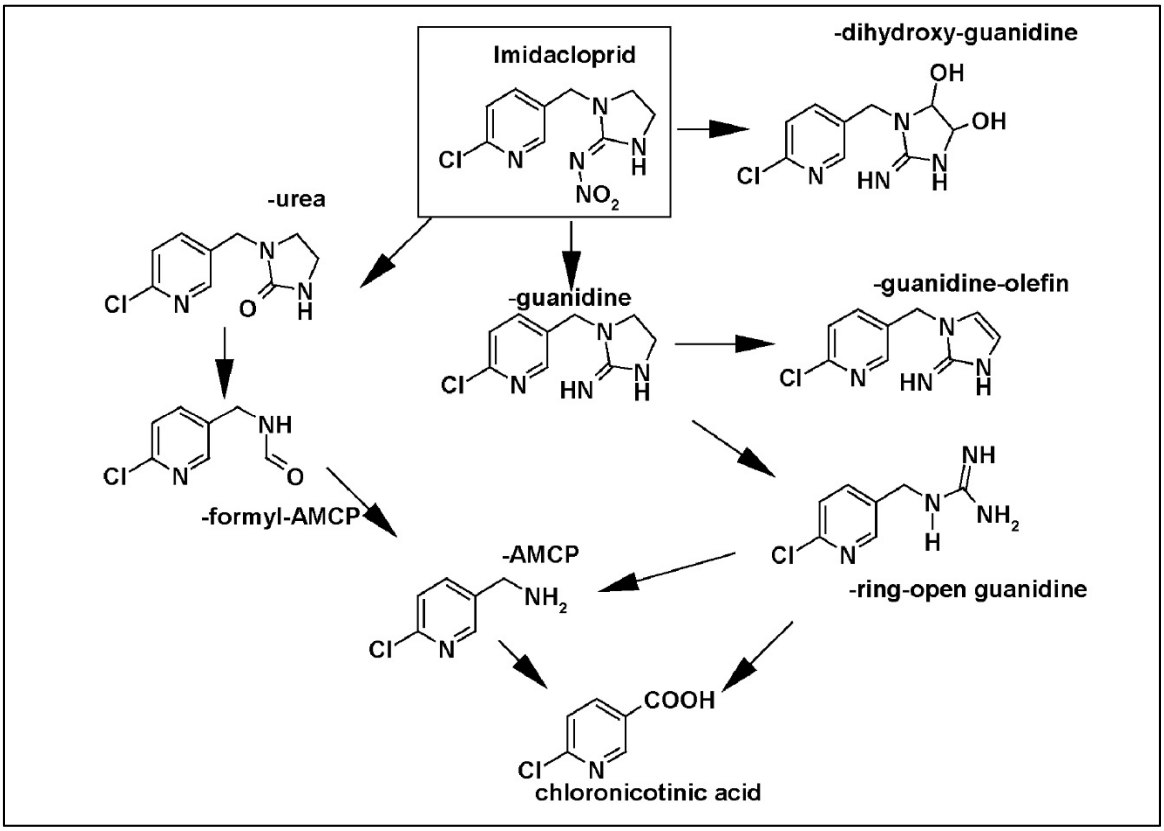

Figure 3 - Proposed Metabolic Pathway for Photo-Transformation in Water of Imidacloprid

The degradation and partitioning behavior of imidacloprid in the dark was studied in three natural systems of water and sediment. Imidacloprid disappears slowly from the water phases of water/sediment systems and is adsorbed to the sediment. Within the sediment, imidacloprid is degraded to imidacloprid-guanidine and other products to a minor extent, including 5-hydroxy imidacloprid. The calculated disappearance half-life (DT50 value) of imidacloprid in the dark has been estimated at between 32 and 142 days. One test using only pond water in the dark resulted in a half-life of 331 days.

Under more natural conditions, where sunlight is allowed to reach water-sediment systems, the half-life ranged from 4 to 20 days. The only major (>10 percent) degradation product in dark aquatic systems was imidacloprid-guanidine; while in illuminated aquatic systems, the guanidine, urea, and 6-chloro nicotinic acid compounds were all formed as major degradation products. The same primary compounds found in the illuminated aquatic systems were also observed in the aqueous photolysis study.

The degradation of imidacloprid in anaerobic systems was confirmed in two studies performed in the dark. At 20°C, imidacloprid had a half-life of 36 days, with imidacloprid-guanidine formed as the only major product. Under anaerobic conditions at 5°C, the reaction rate was slower (half-life of 95 days) with the same major degradate observed. Three outdoor pond studies were conducted and offer the opportunity

to assess the "real world" dissipation of imidacloprid in aquatic systems. One pond study conducted in Texas and two pond studies conducted in Germany gave evidence of a rapid dissipation. Half-lives for the aqueous phase and the total system were estimated to be 7–10 days and 10-20 days for the two studies conducted in Germany (European Food Safety Authority [EFSA] 2006).

Limited toxicity data are available to quantify the toxicity of degradation products or metabolites, as the majority of studies have focused on the parent compound imidacloprid. Several studies conducted on insects found that the 5-hydroxy derivative was 10–27 times less toxic than imidacloprid, while only the olefin derivative, which occurs as a metabolite in treated plants, has toxicity comparable to imidacloprid (Nauen et al. 1998; Suchail et al. 2001; Kagabu et al. 2004; SERA 2005; EFSA 2006; Tomalski et al. 2010). Toxicity studies of the metabolites imidacloprid-urea, 6 chloronicotinic acid, and imidacloprid-guanidine concluded none were as acutely toxic as technical grade imidacloprid to the midge (*C. tetans*) or amphipod (*H. azteca*; Bowers 1996a; Bowers and Lam 1998; Rooney and Bowers 1996; Dobbs and Frank 1996; Tomizawa and Casida 1999).

Thus, with the possible exception of olefin imidacloprid, existing studies indicate that degradation products are substantially less toxic that the parent compound. In addition, because these degradation products are, in turn, degraded by environmental factors (e.g., hydrolysis) or are metabolized in most organisms, additional toxicity due to degradation products alone is doubtful. Accordingly, the European Food Safety Authority and USFS have concluded that benchmark values for regulation of imidacloprid would be protective of its metabolites as well (SERA 2005; EFSA 2006).

7. Other effluent chemicals.

The nature of the inert components of imidacloprid is proprietary; therefore, there is little publicly available information regarding these components. The Protector 2F formulation contains glycerine (an EPA List 4A inert ingredient[1]) while Protector 0.5G contains N-methyl pyrrolidone (an EPA List 3 inert ingredient[2]). Neither formulation specifies the relative quantity of its identified inert compound.

8. Application methods.

Protector 2F (Nuprid; flowable formulation) would be used primarily in aerial applications by helicopter and would occur over bare sand during very low tides. Protector 0.5G (Mallet; granular formulation) would be applied over standing water. Both formulations may be applied using suitable equipment such as scows or shallow-draft boats; all-terrain vehicles equipped with a spray boom; backpack reservoirs with hand-held sprayers; and/or belly grinders.

Receiving Water and Sediment Characteristics

9. Navigation charts or other information on bathymetry.

Grays Harbor is one of the largest inlets in the United States. It has a spring tidal prism of 5.5 x 108 m3 (Cialone and Kraus 2001). Grays Harbor has expansive tidal flats, with approximately two-thirds of the bay emergent at low tide. The entrance channel to Grays Harbor is approximately 9 to 12 meters deep (Cialone and Kraus 2001). More than 80 percent of Grays Harbor is less than 20 feet deep MLLW, and more than 50 percent of the harbor has a depth of approximately 0 feet MLLW (USACE 2011). Grays

[1] EPA List 4A inert ingredients are defined as 'minimal risk inert ingredients'.
[2] EPA List 3 inert ingredients are defined as 'inerts of unknown toxicity'.

Harbor is dominated by tidal currents; however, high river flows can control currents in the upper estuary, and the locations of shoals are constantly shifting (USACE 2012).

10. Current velocities and direction near the discharge locations.

A tidal circulation model from 1999 (Cialone and Kraus 2001) shows that the strongest flood currents are found on the north side of the inlet, while ebb currents are generally uniformly distributed. Flood current velocities range from 66 cm/sec on the south side of the inlet to 120 cm/sec on the north side of the inlet. Ebb currents have the greatest influence in Grays Harbor and increase wave height 0.5 to 1.5 meters. Flood currents increase wave height at the seaward end of the entrance due to a local bathymetry-induced flow reversal and reduce wave height (flatten waves) further inside the inlet entrance. Water level has a minimal impact on waves in the inlet entrance, but does control wave transformation in the back bay (Cialone and Krause 2001).

The morphology of the harbor is determined by differences in the capacity of harbor inflows (flood currents) and waves to transport sediment into the harbor and outflows (ebb currents) to transport sediment out of the harbor. Grays Harbor is generally dominated by tidal currents, but high flows on the Chehalis River can control currents in the upper estuary, and the locations of shoals continually shift. Sediment transport is influenced by the complex dynamics of fluvial sediment and water inputs from tributaries entering the harbor and mixing with marine sediment and water inputs from the Pacific Ocean. Historic changes to the estuary, as a result of factors including the presence of the navigation channel, jetties, and the Point Chehalis Revetment, have altered the natural geomorphology of Grays Harbor.

11. Tidal dispersivity or other estimates of dispersivity or diffusion in the water column.

Estimates of tidal diffusion are not available for Grays Harbor.

12. General description of sediment characteristics.

Ecology conducted sediment sampling throughout Grays Harbor in 2002 (WDOE 2007). The total organic content (TOC) of sediments in Grays Harbor was found to be less than 1.5 percent. The sediments were comprised mostly of fine sand, with this fraction comprising 64 percent of the sediment, whereas the silt fraction was approximately 14 percent (WDOE 2007).

13. Dispersivity or diffusion rate of sediment porewater.

Diffusion rates of sediment porewater in Grays Harbor were not available.

General SIZ Information

14. Results of field trials.

Experimental trials using imidacloprid have been conducted in Willapa Bay since 2007, with the most comprehensive work occurring between 2010 and 2014. 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); 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 tetany (paralysis), or were dead by any cause, directly or indirectly related to treatment (e.g. bird predation of crabs exhibiting tetany) 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 tetany has ceased (Patten 2011).

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 4 or 5 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 were not similar to one another at the time of imidacloprid application. This makes

interpretation of subsequent differences between treated and control sites more difficult (i.e., are differences due to imidacloprid, or to unequal starting conditions?). 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.

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 all the data from this area consistently failed to find a treatment effect. That is, the invertebrates on the treatment and control sites were similar enough to one another that the data showed no statistical differences after 14 and 28 days, demonstrating there was either no effect, or no effect with recovery and recolonization.

Before imidacloprid application, invertebrates on the control and treatment plots at the Cedar River site were statistically different for 5 of the 9 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. However, the data also show that the abundances of some species increased 28 days after treatment. 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 3 endpoints for molluscs (abundance, taxonomic richness, and Shannon diversity), or for richness and diversity in polychaetes or crustaceans.

Given the poor initial match between the treatment and control sites in Cedar River in 2011, and the mixed results with respect to a treatment effect in data from that trial, 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.

In 2012, experimental trials aimed at determining efficacy, environmental fate and transport, and the biological effects of imidacloprid were performed 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); 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 7 to 10 acres in size. Both the granular (Mallet) and flowable (Nuprid) formulations of imidacloprid were used in these trials.

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 No Observable Effects Concentration (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 upslope and downslope side of the plot. Pre- and post-treatment samples were also collected from the control plots. 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 having areas with 0.5 to 3 feet of water on them during an outgoing tide. Sample bottles were buried upright in the sediment with the mouth of the bottle 5 cm above the sediment surface. As the tide rose the sample bottles filled, beginning with the sampling points of lowest elevation. As soon as each individual bottle was filled, the bottle was

sealed and removed from the sediment. Samples were collected prior to and approximately 2 hours following application of imidacloprid.

Water column samples were analyzed on an iterative basis, meaning that all water samples collected pre-treatment, those collected on the sample plot, and those collected 60 m off the plot were analyzed immediately. When imidacloprid concentrations within water samples collected 60 m from the treated plot were less than the screening value of 3.7 µg/L, samples collected at further distances along the corresponding transects were not analyzed. When concentrations were greater than or equal to 3.7 µg/L, the next sample further along the respective transect was analyzed. This iterative procedure was repeated in a stepwise fashion until either the screening level was not exceeded or all samples along the respective transects were analyzed.

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 2 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.

Sediment and Sediment Porewater Sampling and Analyses. 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.

Whole sediment and sediment porewater samples were collected using a modified semi-transparent, Nalgene 500 mL HDPE bottle with the bottom removed and a vent hole drilled into the top shoulder of the bottle. All coring devices were new, chemically cleaned at point of manufacture, and not re-used. The sample sizes were 7 cm in diameter by 10 cm in depth. Two sediment cores were collected at each sampling point to ensure sufficient sediment porewater could be extracted from whole sediments. Each sediment core was approximately 750 g, and the sum weight of both cores was approximately 1500 g. From this quantity of sediment, a whole sediment and sediment porewater imidacloprid and olefin analysis could be performed where necessary. When both measures were desired, the sample was first homogenized for about five minutes, and then split into two identical aliquots for the respective analyses. Approximately 400 g of sediment were removed and placed in a disposable, sterile 500-mL Millipore Steritop® 0.22 micron filtration unit. Vacuum was applied and the porewater extracted and collected into individual, clean 125-mL amber glass bottles. Samples were placed on wet ice or refrigerated (< 4 °C) until being shipped to the laboratory for analysis.

As with the water column samples, sediment porewater samples were analyzed on an iterative basis using a time, distance, and concentration-based process. If imidacloprid concentrations were less than the 0.6 µg/L screening value in sediment porewater samples collected from within the treatment areas, porewater samples collected at later dates were not analyzed. Similarly, if imidacloprid concentrations

were less than the practical quantitation limit of 6.7 µg/kg in whole sediment, sediment samples collected at later dates were not analyzed.

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. The analyses 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).

Eelgrass Sampling and Analyses. 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 in overlying surface waters would be absorbed into the solid and liquid fractions of the sediment, 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 binding 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 10 percent 56 days after treatment. At the other two sites with lower TOC, imidacloprid concentrations had declined to less than 5 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 tetany (temporary 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 tetany-affected crab 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.

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.

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, tetany) 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.

In general, non-target effects on the epibenthic and benthic invertebrates from imidacloprid were absent to minimal 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 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).

15. The locations of spawning areas; nursery areas; waterfowl feeding areas; shellfish harvesting areas; areas used by species of economic importance; tribal fishing grounds or other tribal areas; ecologically unique habitats; water supply intake areas; public recreation areas; areas protected by federal, state, or local laws; or pristine areas (with respect to sediment quality) in the vicinity of the discharge.

Spawning Areas, Nursery Areas, and Areas Used by Species of Economic Importance. Spawning by Pacific herring is documented near the mouth of Grays Harbor, along Damon Point State Park, near the Westport marina, and in the South Bay sloughs south of the State Route 105 bridge. Surf smelt spawning has only been documented on the ocean shore side of Westport, and sand lance spawning has been found in only one small area just east of the Johns River mouth.

The closest bull trout spawning area is the Quinault core area, more than 50 miles up the coast from the Willapa Bay. Green sturgeon do not spawn in Washington waters. Eulachon are known to spawn in

the Chehalis River, but are not long-term residents in the Grays Harbor nearshore during out-migration, and are found only infrequently (USACE 2013).

Juvenile salmonids and English sole feed over lower intertidal and shallow subtidal areas, which may include Pacific oyster beds. Young salmonids and sole fed mostly on small crustaceans, including harpacticoid copepods, cumaceans, and amphipods.

Harbor seals feed on bottom fish over subtidal and intertidal areas, and occasionally on salmon. Grays Harbor was thought to have the largest breeding colony of harbor seals in Washington and Oregon in 1983. No more recent information was found. The harbor seal pupping season occurs in May, June and July when seals disperse to areas throughout Grays Harbor. Ecology designated five areas in North Bay, six in Central Bay, and one in South Bay as harbor seal haul-out grounds (Gardner 1981 as cited in WDF and WDOE 1987). Northern sea lions, harbor porpoises and gray whales have also been occasionally observed in Grays Harbor.

No information was found to describe use of Grays Harbor high intertidal mudflats by mammals. It is assumed that, similar to Willapa Bay, river otters may venture into channels on the mudflats in search of fish, and raccoons may forage on the tide flats when these areas are exposed at low tide.

Herring, smelt, sand lance, and anchovy feed on phytoplankton and zooplankton in Grays Harbor. Juvenile lingcod and flatfish feed in the shallow water near shellfish beds.

Waterfowl Feeding Areas. Waterfowl tend to feed mostly in the high intertidal mudflats, which are the first areas available as the tides recede, and the last ones covered by incoming tides (USDI/USFWS 1997). Waterfowl feed primarily on aquatic plants including eelgrass, salt marsh plant seeds, and invertebrates such as amphipods, worms, and insect larvae. Shorebirds probe the mud with elongated bills and extract the small invertebrates that constitute their food. Amphipods are the most important food for dunlin and western sandpipers wintering in western Washington. Caspian terns take a wide variety of fish while feeding over shallow intertidal areas. The wetlands and waterways of Grays Harbor may be particularly important to raptors, most of which prey on shorebirds (WDF and WDOE 1985).

Shorebirds like rhinoceros auklet, common murre, marbled murrelet, pigeon guillemot, and parasitic jaeger use deeper water areas of the bay as feeding sites. Other waterbirds observed in the outer bay and deeper waters of both the North and South channels of Grays Harbor included loons, grebes, shearwaters, petrels, and cormorants. Gulls and terns are abundant during the summer months and often nest in the same areas. East Sand, Whitcomb, Rice, and Goose Islands are important nesting colonies, especially for the Caspian tern. The largest identified Caspian tern colonies on the West Coast occur along the lower Columbia River (WDOE 1983 as cited in WDF and WDOE 1985). Double-breasted cormorants had relatively small nesting colonies on Sand Island and Ned Rock at the time of investigations conducted by sources cited here.

Species observed in the fall, winter, or spring include mallard, pintail, American wigeon, canvasback, Canada goose, red knot, least sandpiper, dunlin, black turnstone, and rhinoceros auklet (Jordan 1981, as cited in WDF and WDOE 1985). Goose Island summertime residents include glaucous-winged gull, western gull, and rhinoceros auklet.

Limited information is available regarding murrelet use of the marine environment within Grays Harbor and Willapa Bay. WDFW conducts surveys for murrelets in nearshore environments along the coast where the birds forage. They feed primarily on fish and invertebrates in marine waters, although they have also been detected on rivers and inland lakes (Carter and Sealey 1986). In general, small schooling fish and large pelagic crustaceans are the main prey items. Pacific sand lance, northern

anchovy, immature Pacific hearing, capelin, Pacific sardine, juvenile rockfishes, and surf smelt are the most common fish species taken. Squid, euphausiids, mysid shrimp, and large pelagic amphipods are the main invertebrate prey.

Red knot feed on Macoma clams in particular, which benefit from stable sediments after burrowing shrimp control. Red knot do not feed on commensal clams associated with burrowing shrimp because their bill limits foraging depth.

Tribal Fishing Grounds. Most of Grays Harbor's beaches are privately owned. Shellfish and seaweed may not be taken from private beaches without the owner's or lessee's permission. The only public beach within Grays Harbor is adjacent to the Westport Boat Basin. At the Westhaven Cove Marina, crabbing is allowed off any of the floats in this area as well as off of the walkway along the top of the breakwater. The entire outer coastal shoreline from the north jetty at the mouth of Grays Harbor to the Copalis River is also public beach.

The Quinault Tribe has usual and accustomed fishing areas at Grays Harbor and its watersheds, including the Humptulips River. As such, they are entitled to all shoreline areas, including privately owned lands, but must have permits in place to harvest shellfish on privately owned lands.

The Chehalis Tribe also has a presence in Grays Harbor. It is unclear at this time if they have usual and accustomed fishing areas at Grays Harbor, however they do own an aquatic land parcel in Grays Harbor that is likely a shellfish bed.

Water Intake Supply Areas. There are three brackish water supply intakes known to be present in Grays Harbor. One is located at the Westport Marina, and two are located near Nythus and Paterson Streets, and are associated with Ocean Gold and D&M Crab. Further inquiries have produced no additional information on the presence of water intake supply areas in Grays Harbor.

Public Recreation Areas. Grays Harbor recreational areas include State and local parks and designated wildlife areas. Most of these occur in the western half of the harbor within and near the north (Ocean Shores) and south (Westport) peninsulas. Recreational activities include fishing, bird watching, wildlife viewing, hiking and boating (USACE 2014), clamming and crabbing (Corps of Engineers, Seattle District 2011). Recreational fishermen are present during annual salmon runs, and people dig for clams in season during low tides. The Westport Boat Basin is considered a public recreation area and crabbing is permitted off any of the floats in this area, as well as off the walkway along the top of the breakwater. There are several state and local shoreline parks in the vicinity of North Bay and South Bay where commercial shellfish beds are located, including Damon Point State Park; Bottle Beach State Park; Oyhut Wildlife Recreation Area; Ocean Shores Bay Wildlife Area; Olympic-Willapa Hills Wildlife Area; Johns River Wildlife Area; and Bowerman Basin. In addition, the Ocean Shores Marina, Johns River Wildlife Recreation Area, and the Westport Marine provide boat launches and moorage for public use.

Recreational clam digging and crabbing are also popular activities in the Grays Harbor area. Razor clams can be found near the north and south jetty at the mouth of the harbor. Crabbing in the harbor commonly consists of using crab pots to catch Dungeness and red rock crabs; however, crabs are also caught using ring nets and dip nets and by wading in shallow water during spring and early summer.

Areas Protected By Federal, State, or Local Laws. In Grays Harbor, these areas include the Grays Harbor National Wildlife Refuge located near the Bowerman Basin, Damon Point State Park, Bottle Beach State Park, Oyhut Wildlife Recreation Area, Ocean Shores Bay Wildlife Area, Olympic-Willapa Hills Wildlife Area, and Johns River Wildlife Area.

Pristine Areas. Chemical concentrations in the sediments of Grays Harbor are generally low; however, localized sites of chemical contamination have been found; therefore the sediments of Grays Harbor are not considered 'pristine'.

16. The legal location of aquatic lands proposed for use as or potentially affected by (or adjacent to) the proposed SIZ.

The legal location of aquatic lands proposed for use as or potentially affected by (or adjacent to) the proposed SIZ will be provided each year in the Annual Operations Plan.

17. The names and addresses of landowners of aquatic lands proposed for use as (or adjacent to) the proposed SIZ.

The names and addresses of WGHOGA members who have participated in the burrowing shrimp Integrated Pest Management program since 2005 are listed in Table 1. This is the most current list available at this time. Participants may change during any given year and this would be reflected in the appropriate Annual Operations Plan for that year.

Table 1. Current Participants in the Burrowing Shrimp Integrated Pest Management Program.

Company	Contact Person	Address	Phone #
Bay Center Mariculture Co.	Richard Wilson	PO Box 356 Bay Center, WA 98527	360-875-6172
Coast Seafoods Co.	Tim Morris	PO Box 166 South Bend, WA 98586	360-875-5557
G.A. & Lila L. Wiegardt	Dobby Wiegardt	PO Box 305 Ocean Park, WA 98640	360-665-4966
Heckes Clams, Inc.	John Heckes	PO Box 1657 Ocean Park, WA 98640	360-665-4371
Jambor Oyster LLC.	Nick Jambor	29 Holtz Rd. South Bend, WA 98586	360-875-5494
Markham Oyster Inc.	Dave Hollingsworth	20 Old Westport Rd. Aberdeen, WA 98520	360-648-0047
Nisbet Oyster Co. Inc.	David Nisbet	PO Box 338 Bay Center, WA 98527	360-875-6629
Northern Oyster Co.	Brian Sheldon	PO Box 1039 Ocean Park, WA 98640	360-665-2804
Olsen & Son Oyster Co.	Phil Olsen	PO Box 905 South Bend, WA 98586	360-875-5821
R & B Oyster Co.	Leonard Bennett	PO Box 309 Bay Center, WA 98527	360-875-5324
Stony Point Oyster Co.	Don Gillies	6931 US Hwy 101 South Bend, WA 98586	360-875-9964
Taylor Shellfish Co.	Eric Hall	PO Box 76 Nahcotta, WA 98637	360-665-5625
Wiegardt & Sons	Ken Wiegardt	PO Box 309	360-665-4111

		Ocean Park, WA 98640	
Willapa Fish and Oyster Co.	Eric Petit	PO Box 524 South Bend, WA 98586	360- 875-6549
Willapa Bay Shellfish	Warren Cowell	PO Box 43 Ocean Park, WA 98640	360-665-4212

Table 2 includes a list of all current WGHOGA members. Not all members are currently part of the Burrowing Shrimp Integrated Pest Management Program.

Table 2. Current WGHOGA members.

Company	Address		
Bay Center Mariculture	P.O. Box 356	Bay Center, WA	98527
Belly Acres Clams/Oysters	2515 Bay Ave	Ocean Park, WA	98640
Brady's Oysters, Inc.	3714 Oyster Pl. Rd.	Aberdeen, WA	98520
Carol Wiegardt	P.O. Box 336	Nahcotta, WA	98586
Coast Seafood's Co.	POB 166	South Bend, WA	98586
Ekone Oyster Co.	29 Holtz Rd.	South Bend, WA	98586
Heckes Clams	P.O. Box 1657	Ocean Park, WA	98640
Heckes Oyster Co.	P.O. Box 27	Oysterville, WA	98641
Herrold Fish & Oyster Co.	4109 St. Hwy 101	Ilwaco, WA	98624
Kemmer Oyster co. Inc	P.O. Box 33	Ocean Park, WA	98640
Long Island Oyster Co.	P.O. Box 1054	Long Beach, WA	98631
Lytle Seafoods Oyster Shack	1 Rock View Ln.	Hoquiam, WA	98550
Markham Enterprises	20 Old Westport Rd.	Aberdeen, WA	98520
Nisbet Oyster Co.	P.O. Box 338	Bay Center, WA	98527
Northern Oyster Co. Inc.	P.O. Box 1039	Ocean Park, WA	98640
Olsen and Son	P.O. Box 905	South Bend, WA	98586
R&B Oyster Co.	P.O. Box 309	Bay Center, WA	98527
Station House Oyster Co.	P.O. Box 6	Chinook, WA	98614
Stony Point Oyster, Co.	6931 US Hwy 101	South Bend, WA	98586
Taylor Shellfish	P.O. Box 76	Nahcotta, WA	98586
Wiegardt & Son	P.O. Box 309	Ocean Park, WA	98640
Willapa Bay Fish and Oyster	P.O. Box 524	South Bend, WA	98586
Willapa Bay Shellfish	27718 Sandridge Rd.	Ocean Park, WA	98640
Willapa Resources	P.O. Box 365	Ocean Park, WA	98640
Wilson Oyster Co.	P.O. Box 236	Ocean Park, WA	98640
Dobby Wiegardt	P.O. Box 305	Ocean Park, WA	98640

Appendix B includes two tables of names and addresses. Table B-1 is a list of names and addresses of aquatic landowners with property immediately adjacent to shellfish beds that may be treated with imidacloprid. Table B-2 is a list of names and addresses of landowners with upland property that is adjacent to shellfish beds that may be treated with imidacloprid.

18. Demonstrate that the discharge meets all known, available and reasonable methods of prevention, control and treatment (AKART).

Extensive work has been done on potential alternatives to use of chemical insecticides to control burrowing shrimp. These include various mechanical measures, shellfish culture practices, non-insecticide chemical use, and biological controls. None of these methods, except the use of carbaryl and imidacloprid, has been shown to effectively control burrowing shrimp on commercial shellfish beds in a manner that could reasonably be implemented on the large scale of commercial shellfish grounds in Grays Harbor. Despite this, efforts will continue to find alternatives to chemical control of burrowing shrimp, and an updated Integrated Pest Management Plan will be developed to serve this purpose. The Integrated Pest Management plan, as discussed in the Draft EIS will serve as AKART for this permit. This plan, along with the restrictions in place in the NPDES permit and FIFRA registrations, will help determine appropriate pest management methods, set action thresholds, incorporate principles of IPM, and help reduce pesticide use. These restrictions and best management practices (BMPs) include limitations such as the frequency with which a shellfish bed may be sprayed, environmental conditions during spraying, human health and safety measures, monitoring requirements, and public notification of spray events. An Environmental Impact Statement (EIS) was required by Ecology as part of the SEPA documentation for the issuance of a NPDES permit. This EIS outlines the restrictions and BMPs in more detail.

19. Describe best management practices (BMPs) that will be implemented to minimize impacts.

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

- 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 10 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.

20. Describe how the treatment acreage being proposed is the minimum practicable considering environmental effects, technical feasibility, and cost

Growers use an array of information to decide if and when they should treat a commercial shellfish bed. Before applying for treatment, they consider crop cycles, whether the bed can sustain the crop without loss, whether the bed needs to be treated to sustain the crop for the period of time it will occupy a bed, the life stage and infestation level of burrowing shrimp in the shellfish bed of concern, and other physical and biological conditions at each site. The assessment correlates directly to shrimp density and the activity of the burrowing shrimp that are present. If a few shrimp are causing lots of sediment perturbation, the crop will begin to be lost immediately after planting. If a grower determines that a bed needs to be treated to protect their crop investment, they identify the bed on an application for treatment. The bed will then be assessed by Ecology based on the inspection method specified in the permit.

The treatment acreage being proposed differs from the carbaryl 2006 permit (WA 0040975) in total tideland acreage that could be treated each year, and includes treatment of areas primarily grown with commercial clams as well as areas primarily grown with commercial oysters. Growers report that the 800-acre total allowance (Willapa Bay and Grays Harbor combined) under the carbaryl permit was not sufficient in years when there was significant recruitment of burrowing shrimp. Some beds that met the treatment threshold of 10 burrows per square meter went untreated. Growers had to adjust their treatment plans to focus only on areas primarily grown for oysters and most in need of treatment. Burrowing shrimp populations are cyclic and are currently beginning to greatly increase in numbers. The purpose for the larger acreage requested under the imidacloprid permit is to address this current trend of high recruitment, the inclusion of areas primarily grown with commercial clams to the tidelands authorized for treatment, and what currently appears to be the reduced effectiveness of imidacloprid compared to carbaryl. Growers anticipate that, at least initially, it may be necessary to treat beds more frequently with imidacloprid to protect the same areas (personal communication with a WGHOGA member, May 28, 2014).

Growers seek flexibility through the larger annual treatment area in Grays Harbor under the imidacloprid permit (up to 500 acres in Grays Harbor) compared to the carbaryl permit (up to 200 acres) in order to evaluate the need for treatment on selected beds. The larger acreage would allow them to defer some treatments to subsequent years with the knowledge that the overall allotment should be sufficient to cover varying annual needs throughout the actively-farmed tidelands. Some portion of the actively-farmed tidelands would likely never be treated, and portions of some beds included in the estimate of actively-farmed tidelands are not useable. For lands that are treated, the treatment timing and frequency will be determined on a site-specific basis depending on shrimp infestation levels, efficacy of imidacloprid treatments, and physical and biological characteristics of the commercial shellfish beds

Some areas commercially grown with clams have either functioned directly as areas primarily grown for oysters in the past, or have oysters as a secondary crop. With low burrowing shrimp recruitment over the past 10 years or so, it has been possible to farm some of these beds without shrimp control. However, due to the large recent recruitments of burrowing shrimp in Grays Harbor, growers are now also seeing high shrimp densities in areas primarily cultivated with clams. The threshold for treatment in areas commercially grown with clams is reportedly the same as in areas commercially grown with oysters. Growers report that they begin to lose areas primarily or exclusively grown with clams at the same shrimp density as the threshold within areas where oysters are grown; i.e., at 10 adult burrows per square meter (personal communications with WGHOGA members, May 28, 2014, July 30, 2014, and July 31, 2014). Efficacy on areas commercially grown with clams would be monitored and assessed the same as areas commercially grown with oysters, based on burrowing shrimp density following treatment.

21. Propose a SIZ closure plan.

WGHOGA will put in place a SIZ closure plan to demonstrate that the Grays Harbor SIZ has demonstrated recovery from using imidacloprid to control burrowing shrimp populations in commercial shellfish beds. The regulations outlined in WAC 173-204-415(5) and WAC 173-204-415(6)(b) explain the regulations that allow Ecology to close a SIZ and trigger the SIZ closure plan. The regulations state that Ecology may require closure of the SIZ if the SIZ maintenance standards are being violated, or if Ecology determines that the SIZ is no longer needed in order to meet State Sediment Management Standards. This closure plan will be based on natural recovery and monitoring of the SIZ and will ultimately be similar to the ongoing monitoring required by the proposed NPDES permit. It will include sampling location(s) in Grays Harbor to determine if there have been ongoing effects of imidacloprid on the invertebrate communities. This will entail sampling and analysis of benthic invertebrates, surface water quality sampling, and sediment sampling to determine the level of persistence of imidacloprid in the sediment. Details regarding methods to be used and length of time to monitor will be consistent with the requirements of the NPDES permit.

References

Bowers, L. 1996a. Acute Toxicity of (carbon 14)-NTN 33823 to Chironomus tentans Under Static Conditions: Lab Project Number: 107316: N3823302. Unpublished study prepared by Bayer Corp. 30 p. MRID 43946602 cited in SERA 2005.

Bowers, L. and C. Lam. 1998. Acute Toxicity of 6-chloronicotinic acid (a metabolite of Imidacloprid) to Chironomus tentans Under Static Renewal Conditions: Lab Project Number: 96-B-123: 108127. Unpublished study prepared by Bayer Corporation. 24 p. MRID 44558901 cited in SERA 2005.

Booth, S.R., K. Rassmussen, and A. Suhrbier. 2014. Impact of imidacloprid on epibenthic and benthic invertebrates: 2011 studies to describe the Sediment Impact Zone (SIZ) related to imidacloprid treatments to manage burrowing shrimp.

Booth, S.R., K. Rassmussen, and A. Suhrbier. 2013. Impact of imidacloprid on epibenthic and benthic invertebrates: 2012 studies to describe the Sediment Impact Zone (SIZ) related to imidacloprid treatments to manage burrowing shrimp.

Carter, H.R. and S.G. Sealy. 1986. Year-round use of coastal lakes by marbled murrelets. Condor 88(4):473–477. In: USFWS, March 24, 2009.

Cialone, M.A. and N.C. Kraus. 2001. Engineering Study of Inlet Entrance Hydrodynamics: Grays Harbor, Washington, UA. Proceedings of Coastal Dynamics 01, ASCE, Reston, VA, 413-422.

Dobbs, M. and J. Frank. 1996. Acute Toxicity of (carbon 14)-NTN 33519 to Chironomus tentans Under Static Conditions: Lab Project Number: 107311: N3823301. Unpublished study prepared by Bayer Corp. 35 p. MRID 43946604 cited in SERA 2005.

European Food Safety Authority (EFSA). 2006. Draft Assessment Report – Imidacloprid. Initial risk assessment provided by the rapporteur Member State Germany for the existing active substance IMIDACLOPRID of the third stage (part A) of the review programme referred to in Article 8(2) of Council Directive 91/414/EEC

Gardner, F. 1981. (Editor) Washington Coastal Areas of Major Significance. Washington Department of Ecology.

Grue, C.E. 2012. Fate, persistence, and potential for non-target impacts associated with the use of imidacloprid to control burrowing shrimp on oyster beds in Willapa Bay and Grays Harbor, Washington – A compilation of reports prepared for the Willapa Grays Harbor Oyster Growers Association. Report submitted to the Willapa Grays Harbor Oyster Growers Association. Washington Cooperative Fish and Wildlife Research Unit, School of Aquatic and Fishery Sciences, University of Washington. Seattle, WA. 92 pp.

Grue, C.E. and J.M. Grassley. 2013. Environmental Fate and Persistence of Imidacloprid Following Experimental Applications to Control Burrowing Shrimp in Willapa Bay, Washington. Washington Cooperative Fish and Wildlife Research Unit, University of Washington. Seattle, WA. 91 pp.

Hart Crowser, Inc. 2012. Sampling and Analysis Plan: Experimental Trials for Imidacloprid Use in Willapa Bay, Washington. Hart Crowser, Inc. Edmonds, WA. 72 pp.

Hart Crowser, Inc. 2013. Draft Field Investigation 2012 Experimental Trials for Imidacloprid Use in Willapa Bay, Washington. Prepared for Willapa Grays Harbor Oyster Growers Association, May 15, 2013. Report No. 12733-02. Hart Crowser Inc. Edmonds, WA. 192 pp.

Kagabu, S., C. Kato, and K. Nichimura. 2004. Insecticidal and Neuroblocking Activities towards American Cockroach (Periplaneta Americana L.) of Imidacloprid Metabolites, 5-hydroxy-, 4,5-dihydroxy- and 4,5-dehydroimidacloprid. Journal of Pesticide Science. 29(4):376–379.

Nauen R., K. Tietjen, K. Wagner, and A. Elbert. 1998. Efficacy of plant metabolites of imidacloprid against Myzus persicae and Apis gossypii. Pesticide Science. 52:53–57.

Patten, K. 2011. Field Assessments of Non-Target Effects of Imidacloprid on Dungeness Crab in Willapa Bay, Washington 2008 to 2011. Final Report to the Willapa and Gray Harbor Oyster Growers Association.

Patten, K. 2013. Efficacy and Non-Target Impacts of Imidacloprid Following Applications to Control Burrowing Shrimp in Willapa Bay, Washington in 2012. Washington State University Long Beach Research and Extension Unit. http://longbeach.wsu.edu/shellfish/documents/efficacyandnon-targetimpactsofimidaclopridtocontrolburrowingshrimpinwillapabay2012.pdf

Rooney, D. and L. Bowers 1996. Acute Toxicity of (carbon 14)-NTN 33823 to Hyalella azteca Under Static Conditions: Lab Project Number: 107315: N3823202. Unpublished study prepared by Bayer Corp. 34 p. MRID 43946601 cited in SERA 2005.

SERA, 2005. Imidacloprid – Human Health and Ecological Risk Assessment, Final Report. Prepared for USDA Forest Service by Syracuse Environmental Research Associates, Inc. December 8, 2005.

Suchail, S., D. Guez, and L. Belzunces. 2001. Discrepancy between acute and chronic toxicity induced by imidacloprid and its metabolites in Apis mellifera. Environmental Toxicology and Chemistry. 20(11): 2482–2486.

Tomizawa, M. and J.E. Casida. 1999. Minor structural changes in nicotinoid insecticides confer differential subtype selectivity for mammalian nicotinic acetylcholine receptors. British Journal of Pharmacology. 127:115–122.

Tomalski M., W. Leimkuehler, C. Schal, and E. Vargo. 2010. Metabolism of Imidacloprid in Workers of Reticulitermes flavipes (Isoptera: Rhinotermitidae). Annals of the Entomological Society of America. 103(1):84–95.

U.S. Army Corps of Engineers (USACE). 2011. Environmental Assessment Fiscal Years 2012 through 2018 Maintenance Dredging and Disposal, Grays Harbor and Chehalis River Navigation Project. Prepared by the U.S. Army Corps of Engineers, Seattle District, Environmental and Cultural Resources Branch, September 2011.

U.S. Army Corps of Engineers (USACE). 2013. Environmental Assessment, FY 2013 through 2020, Point Chehalis Revetment Maintenance Project, Westport, Grays Harbor County, Washington. February 2013. Seattle District, Seattle, WA.

U.S. Department of the Interior, U.S. Fish and Wildlife Service (USDI/USFWS). 1997. Environmental Assessment: Control of smooth cordgrass (*Spartina alterniflora*) on Willapa National Wildlife Refuge. Ilwaco, WA.

U.S. Environmental Protection Agency (USEPA). 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses. Publication PB85-227049. Office of Research and Development Environmental Research Laboratories - Duluth, Minnesota, Narragansett, Rhode Island and Corvallis, Oregon.

U.S. Environmental Protection Agency (USEPA) 2014. Interim Reregistration Eligibility Decision for Carbaryl. Case 0080. http://www.epa.gov/oppsrrd1/REDs/carbaryl_ired.pdf (accessed February 2014).

Ward, G. 1991. NTN 33893 Technical: Chronic Toxicity to the Mysid, Mysidopsis bahia, Under Flow-Through Test Conditions: Lab Project Number: 9008023G/H: 101347. Unpublished study prepared by Toxikon Environmental Sciences. 87 p. MRID 42055322 cited in SERA 2005.

Washington Department of Ecology (WDOE). 1983. Grays Harbor Estuary Management Plan. Programmatic Draft Environmental Impact Statement. Washington State Coastal Zone Management Program, Amendment No. 3. In: WDF and WDOE 1985.

Washington Department of Ecology (Ecology). 2007a. Condition of Outer Coastal Estuaries of Washington State, 1999. A Statistical Summary. Publication No. 07-03-012.

Washington Department of Fisheries (WDF) and Washington Department of Ecology (WDOE). 1985. Final Environmental Impact Statement: Use of the Insecticide Sevin to Control Ghost and Mud Shrimp in Oyster Beds of Willapa Bay and Grays Harbor. Olympia, WA. June 1985.

Appendix A

Material Safety Data Sheets (MSDS) – Imidacloprid

Nufarm

For Chemical Emergency, Spill, Leak, Fire, Exposure, or Accident,
Call CHEMTREC Day or Night: 1-800-424-9300.
For Medical Emergencies Only, Call 1-877-325-1840.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: Nuprid™ 2F Insecticide
Synonyms: Insecticide: Imidacloprid; 1-[(6-chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine
EPA Reg. No.: 228-484

Company Name: Nufarm Americas Inc.
150 Harvester Drive, Suite 200
Burr Ridge, IL 60527

Date of Issue: April 17, 2007 **Supersedes:** July 7, 2006
Sections Revised: 2, 11 and 14

2. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance and Odor: White aqueous suspension with a sweet odor.
Warning Statements: Keep out of reach of children. CAUTION. Harmful if absorbed through skin. Harmful if inhaled. Avoid contact with skin, eyes or clothing. Avoid breathing spray mist.

Potential Health Effects:
Likely Routes of Exposure: Inhalation, eye and skin contact.
Eye Contact: Minimally irritating based on toxicity studies.
Skin Contact: Mildly toxic and non-irritating irritating based on toxicity studies.
Ingestion: No more than slightly toxic if ingested based on toxicity studies.
Inhalation: Low inhalation toxicity. Inhalation of glycerin mists may cause irritation of respiratory tract.
Medical Conditions Aggravated by Exposure: None known.

See Section 11: TOXICOLOGICAL INFORMATION for more information.

Potential Environmental Effects:
This product is highly toxic to bees exposed to direct treatment or residues on blooming crops or weeds. This product is toxic to wildlife and highly toxic to aquatic invertebrates.

See Section 12: ECOLOGICAL INFORMATION for more information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS NO.	% BY WEIGHT
Imidacloprid	138261-41-3	21.4
Inert Ingredients Including		78.6
Glycerin	56-81-5	

4. FIRST AID MEASURES

If Swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.
If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.
If on Skin: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice.
If in Eyes: Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
Note to Physician: No specific antidote is available. Treat the patient symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point: >210°F (>98.9°C) Pensky-Martens
Autoignition Temperature: Not determined **Flammability Limits:** Not determined

Extinguishing Media: Water, carbon dioxide, dry chemical or foam.
Special Fire Fighting Procedures: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full fire-fighting turn out gear. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.
Unusual Fire and Explosion Hazards: If water is used to fight fire, contain runoff, using dikes to prevent contamination of water supplies. Dispose of fire control water later.
Hazardous Decomposition Materials (Under Fire Conditions): May produce gases such as hydrogen chloride, hydrogen cyanide, and oxides of carbon and nitrogen.

National Fire Protection Association (NFPA) Hazard Rating:
Rating for this product: Health: 1 **Flammability:** 1 **Reactivity:** 1
Hazards Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.
Environmental Precautions: Prevent material from entering public sewer systems or any waterways. Do not flush to drain. Large spills to soil or similar surfaces may necessitate removal of topsoil. The affected area should be removed and placed in an appropriate container for disposal.
Methods for Containment: Dike spill using absorbent or impervious materials such as earth, sand or clay. Collect and contain contaminated absorbent and dike material for disposal.
Methods for Cleanup and Disposal: Pump any free liquid into an appropriate closed container. Wash entire spill area with soap and water. Absorb and place into container for disposal. Decontaminate tools and equipment following cleanup. See Section 13: DISPOSAL CONSIDERATIONS for more information.
Other Information: Large spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

7. HANDLING AND STORAGE

Handling:
Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Users should wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Remove Personal Protective Equipment

(PPE) immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Storage:
Store in a cool, dry place and in such a manner as to prevent cross contamination with other pesticides, fertilizers, food and feed. Store in original container and out of the reach of children, preferably in a locked storage area. Handle and open container in a manner as to prevent spillage. Do not contaminate water, food or feed by storage or disposal.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:
Where engineering controls are indicated by specific use conditions or a potential for excessive exposure, use local exhaust ventilation at the point of generation.

Personal Protective Equipment:
Eye/Face Protection: To avoid contact with eyes, wear chemical goggles or shielded safety glasses. An emergency eyewash or water supply should be readily accessible to the work area.
Skin Protection: To avoid contact with skin, wear long pants, long-sleeved shirt, socks, shoes and chemical-resistant gloves made of any waterproof material. An emergency shower or water supply should be readily accessible to the work area.
Respiratory Protection: Not normally required. If vapors or mists exceed acceptable levels, wear NIOSH approved air-purifying respirator with cartridges/canisters approved for use against pesticides.
General Hygiene Considerations: Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material: 1) do not store, use and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored; 2) wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics or using the toilet.

Exposure Guidelines:

	OSHA		ACGIH		
Component	TWA	STEL	TWA	STEL	Unit
Imidacloprid	NE	NE	NE	NE	NE
Glycerin Mist	15 (T) 5 (R)	NE	10	NE	mg/m^3

T = Total Dust
R = Respirable Fraction

NE = Not Established

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: White aqueous suspension with a sweet odor.

Boiling Point:	Not determined	**Solubility in Water:**	Dispersible
Density:	9.35 pounds/gallon	**Specific Gravity:**	1.121 @ 20°C
Evaporation Rate:	Not determined	**Vapor Density:**	Not determined
Freezing Point:	Not determined	**Vapor Pressure:**	Not determined
pH:	6 – 7 (1% solution)	**Viscosity:**	634.6 mPa s @ 20°C

Note: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

10. STABILITY AND REACTIVITY

Chemical Stability: This material is stable under normal handling and storage conditions.
Conditions to Avoid: Excessive heat. For imidacloprid, strong exothermal reaction above 200°C.
Incompatible Materials: Not known
Hazardous Decomposition Products: Under fire conditions, may produce gases such as hydrogen chloride, hydrogen cyanide, and oxides of carbon and nitrogen.
Hazardous Reactions: Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:
Except as noted, data from laboratory studies conducted on this product:
Oral: Rat LD_{50}: >2,000 mg/kg (female)
Dermal: Rat LD_{50}: >2,000 mg/kg
Inhalation: Rat 4-hr LC_{50}: >5.33 mg/l (similar product)
Eye Irritation: Rabbit: Minimally irritating
Skin Irritation: Rabbit: Non-irritating
Skin Sensitization: Not a contact sensitizer in guinea pigs following repeated skin exposure.

Subchronic (Target Organ) Effects: Repeated overexposure to imidacloprid may effect heart, thyroid, blood chemistry, and liver.
Carcinogenicity / Chronic Health Effects: Prolonged overexposure to imidacloprid can cause effects to the thyroid. Imidacloprid did not cause cancer in laboratory animal studies. The U.S. EPA has given imidacloprid a Group E classification (evidence of non-carcinogenicity in humans).
Reproductive Toxicity: In a two-generation reproduction study in rats, imidacloprid produced reduced mean body weights and body weight gains. No other reproductive effects were observed.
Developmental Toxicity: Rat and rabbit studies on imidacloprid resulted in skeletal abnormalities, increased resorptions (rabbits) and reduced body weight gains at doses that were also toxic to mother animals.
Genotoxicity: The imidacloprid mutagenicity studies, taken collectively, demonstrate that imidacloprid is not genotoxic or mutagenic.

Assessment Carcinogenicity: None listed with ACGIH, IARC, NTP or OSHA.

See Section 2: HAZARDS IDENTIFICATION for more information.

12. ECOLOGICAL INFORMATION

Ecotoxicity:
Data on Imidacloprid Technical:

96-hour LC_{50} Rainbow Trout:	211 mg/l	Japanese Quail Oral LD_{50}:	31 mg/kg
48-hour EC_{50} Daphnia:	85 mg/l	Bobwhite Quail Oral LD_{50}:	152 mg/kg
96-hour LC_{50} Mysid:	0.038 ppm	House Sparrow Oral LD_{50}:	41 mg/kg
48-hour Honey Bee Contact LD_{50}:	0.078 µg/bee	48-hour Honey Bee Oral LD_{50}:	0.0039 µg/bee

Environmental Fate:
Hydrolysis half-life of imidacloprid is greater than 30 days at pH 7 and 25°C. The aqueous photolysis half-life is less than 3 hours. The soil surface photolysis of imidacloprid has a half-life of 39 days, and in soil, the half-life ranged from 26 to 229 days.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:
Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Handling and Disposal:
Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill or by incineration, or, if allowed by State and local authorities, by burning. If burned, stay out of smoke.

14. TRANSPORTATION INFORMATION

Follow the precautions indicated in Section 7: HANDLING AND STORAGE of this MSDS.

DOT
Non Regulated – See 49 CFR 173.132(b)(3)

IMDG
Non Regulated – See IMDG 2.6.2.1.3

IATA
Non Regulated – See IATA 3.6.1.5.3

15. REGULATORY INFORMATION

U.S. Federal Regulations:

TSCA Inventory: This product is exempted from TSCA because it is solely for FIFRA regulated use.

SARA Hazard Notification/Reporting:
Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370): Immediate

Section 313 Toxic Chemical(s): None

Reportable Quantity (RQ) under U.S. CERCLA: None

RCRA Waste Code: None

State Information:
Other state regulations may apply. Check individual state requirements.

California Proposition 65: Not Listed.

16. OTHER INFORMATION

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of Federal law to use a pesticide product in any manner not prescribed on the EPA-accepted label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Nufarm Americas Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Nufarm Americas Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon Information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Nuprid is a trademark of Nufarm Americas Inc.

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name:	**Mallet® 0.5G Insecticide**
EPA Reg. No.:	228-501
Synonyms:	Imidacloprid; 1-[(6-chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine
Product Type:	Insecticide
Company Name:	Nufarm Americas Inc. 150 Harvester Drive, Suite 200 Burr Ridge, IL 60527
Telephone Numbers:	For Chemical Emergency, Spill, Leak, Fire, Exposure, or Accident, Call CHEMTREC Day or Night: 1-800-424-9300 For Medical Emergencies Only, Call 1-877-325-1840
Date of Issue:	May 17, 2012 Supersedes: February 23, 2007
Sections Revised:	3, 4, 7, 8, 11, 12, 13, 14, 15

2. HAZARDS IDENTIFICATION

Emergency Overview:
Appearance and Odor: Brown colored granules with slight odor.
Warning Statements: Keep out of reach of children. CAUTION. Causes moderate eye irritation. Avoid contact with eyes or clothing.

Potential Health Effects:
Likely Routes of Exposure: Inhalation, skin and eye contact.
Eye Contact: Moderately irritating based on toxicity studies. Dusts may cause irritation.
Skin Contact: Slightly toxic and minimally irritating based on toxicity studies.
Ingestion: Slightly toxic if ingested based on toxicity studies.
Inhalation: Low inhalation toxicity.
Medical Conditions Aggravated by Exposure: Inhalation of product may aggravate existing chronic respiratory problems such as asthma, emphysema or bronchitis. Skin contact may aggravate existing skin disease.

See Section 11: TOXICOLOGICAL INFORMATION for more information.

Potential Environmental Effects:
This product is highly toxic to aquatic invertebrates.

See Section 12: ECOLOGICAL INFORMATION for more information.

3. COMPOSITION / INFORMATION ON INGREDIENTS

COMPONENT	CAS NO.	% BY WEIGHT
Imidacloprid	138261-41-3	0.5
Other Ingredients Including		99.5
N-methyl pyrrolidone	872-50-4	

4. FIRST AID MEASURES

If on Skin or Clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes. Call a poison control center or doctor for treatment advice.
If in Eyes: Hold eye open and rinse slowly and gently with water for 15 to 20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. Call a poison control center or doctor for treatment advice.
If Swallowed: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by the poison control center or doctor. Do not give anything by mouth to an unconscious person.
If Inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.
Note to Physician: No specific antidote is available. Treat the patient symptomatically.

5. FIRE FIGHTING MEASURES

Flash Point: Not applicable
Autoignition Temperature: Not applicable **Flammability Limits:** Not applicable

Extinguishing Media: Use extinguishing media suitable for surrounding materials. Dry chemical, carbon dioxide, foam, water spray or fog.
Special Fire Fighting Procedures: Firefighters should wear NIOSH/MSHA approved self-contained breathing apparatus and full fire-fighting turn out gear. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later.
Unusual Fire and Explosion Hazards: If water is used to fight fire, contain runoff, using dikes to prevent contamination of water supplies. Dispose of fire control water later
Hazardous Decomposition Materials (Under Fire Conditions): May produce gases such as oxides of carbon and nitrogen.

National Fire Protection Association (NFPA) Hazard Rating:
Rating for this product: Health: 1 Flammability: 1 Reactivity: 0
Hazards Scale: 0 = Minimal 1 = Slight 2 = Moderate 3 = Serious 4 = Severe

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions: Wear appropriate protective gear for the situation. See Personal Protection information in Section 8.
Environmental Precautions: Prevent material from entering public sewer systems or any waterways. Do not flush to drain. Large spills to soil or similar surfaces may necessitate removal of topsoil. The affected area should be removed and placed in an appropriate container for disposal.
Methods for Containment: Dike spill using absorbent or impervious materials such as earth, sand or clay. Collect and contain contaminated absorbent and dike material for disposal.
Methods for Cleanup and Disposal: Wash entire spill area with a detergent slurry, absorb and sweep into container for disposal. Decontaminate tools and equipment following cleanup. See Section 13: DISPOSAL CONSIDERATIONS for more information.
Other Information: Large spills may be reportable to the National Response Center (800-424-8802) and to state and/or local agencies.

7. HANDLING AND STORAGE

Handling:
Avoid contact with eyes or clothing. Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove clothing/Personal Protective Equipment (PPE) if pesticide gets inside. Then wash thoroughly and put on clean clothing. Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

Storage:
Store in a cool, dry place and in such a manner as to prevent cross-contamination with other pesticides, fertilizers, food and feed. Store in original container and out of reach of children, preferably in a locked storage area. Do not contaminate water, food or feed by storage or disposal.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Controls:
Where engineering controls are indicated by specific use conditions or a potential for excessive exposure, use local exhaust ventilation at the point of generation.

Personal Protective Equipment:
Eye/Face Protection: To avoid contact with eyes, wear chemical goggles or shielded safety glasses. An emergency eyewash or water supply should be readily accessible to the work area.
Skin Protection: To avoid contact with skin, wear long pants, long-sleeved shirt, shoes plus socks, and chemical-resistant gloves made of waterproof material such as barrier laminate, butyl rubber, nitrile rubber, neoprene rubber, natural rubber, polyethylene, ppolyvinylchloride (PVC) or viton. An emergency shower or water supply should be readily accessible to the work area.
Respiratory Protection: Not normally required. If vapors or mists exceed acceptable levels, wear NIOSH approved air-purifying respirator with cartridges/canisters approved for use against pesticides.
General Hygiene Considerations: Personal hygiene is an important work practice exposure control measure and the following general measures should be taken when working with or handling this material: 1) do not store, use and/or consume foods, beverages, tobacco products, or cosmetics in areas where this material is stored; 2) wash hands and face carefully before eating, drinking, using tobacco, applying cosmetics or using the toilet.

Exposure Guidelines:

	OSHA		ACGIH		
Component	TWA	STEL	TWA	STEL	Unit
Imidacloprid	NE	NE	NE	NE	

NE = Not Established

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance and Odor: Brown colored granules with slight odor.

Boiling Point:	Not applicable	**Solubility in Water:**	Relatively insoluble
Density:	46 pounds/cubic foot	**Specific Gravity:**	Not applicable
Evaporation Rate:	Not applicable	**Vapor Density:**	Not applicable
Freezing Point:	Not applicable	**Vapor Pressure:**	Not applicable
pH:	6.4	**Viscosity:**	Not applicable

Note: Physical data are typical values, but may vary from sample to sample. A typical value should not be construed as a guaranteed analysis or as a specification.

10. STABILITY AND REACTIVITY

Chemical Stability: This material is stable under normal handling and storage conditions.
Conditions to Avoid: Excessive heat. Do not store near heat or flame.
Incompatible Materials: Strong oxidizing agents: bases and acids.
Hazardous Decomposition Products: Under fire conditions may produce gases such as oxides of carbon and nitrogen.
Hazardous Reactions: Hazardous polymerization will not occur.

11. TOXICOLOGICAL INFORMATION

Toxicological Data:
Data from laboratory studies conducted on a similar, but not identical, formulation:
Oral: Rat LD_{50}: > 5,000 mg/kg (female)
Dermal: Rat LD_{50}: > 5,000 mg/kg
Inhalation: Rat 4-hr LC_{50}: >2.06 mg/l
Eye Irritation: Rabbit: Moderately irritating
Skin Irritation: Rabbit: Minimally irritating
Skin Sensitization: Not a contact sensitizer in guinea pigs following repeated skin exposure.

Subchronic (Target Organ) Effects: Repeated overexposure to imidacloprid, may affect heart, thyroid, blood chemistry, and liver. Repeated overexposure to N-Methyl 2-pyrrolidinone (NMP) may cause effects to eyes, skin, respiratory system, central nervous system, liver and kidneys. The solvent component of this product is reported to cause irritation to the eyes and skin and may contribute to the irritation potential reported for this product.
Carcinogenicity / Chronic Health Effects: Prolonged overexposure to imidacloprid can cause effects to the thyroid. Imidacloprid did not cause cancer in laboratory animal studies. The U.S. EPA has given imidacloprid a Group E classification (evidence of non-carcinogenicity in humans). No increase in tumors was seen in rats via dietary or inhalation exposure to NMP for two years; however, an increase in liver tumors was noted in mice receiving high dietary doses over a similar period. Liver tumors are not uncommon when non-genotoxic chemicals such as NMP are tested in the mouse bioassay.
Reproductive Toxicity: In a two-generation reproduction study in rats, imidacloprid produced reduced mean body weights and body weight gains. No other reproductive effects were observed. NMP may adversely affect reproduction in rats after ingestion, although fertility is unaltered.
Developmental Toxicity: Rat and rabbit studies on imidacloprid resulted in skeletal abnormalities, increased resorptions (rabbits) and reduced body weight gains at doses that were also toxic to mother animals. Fetal developmental effects were observed following ingestion, inhalation and dermal exposures to NMP in pregnant animals, and occurred both in the presence and absence of maternal toxicity.
Genotoxicity: The imidacloprid mutagenicity studies, taken collectively, demonstrate that imidacloprid is not genotoxic or mutagenic. Neither *in vitro* nor *in vivo* tests on NMP demonstrated mutagenic effects.

Assessment Carcinogenicity: None listed with ACGIH, IARC, NTP or OSHA.

See Section 2: HAZARDS IDENTIFICATION for more information.

12. ECOLOGICAL INFORMATION

Ecotoxicity:
Data on Imidacloprid Technical:
Data on Imidacloprid Technical:

96-hour LC_{50} Rainbow Trout:	211 mg/l	Japanese Quail Oral LD_{50}:	31 mg/kg
48-hour EC_{50} Daphnia:	85 mg/l	Bobwhite Quail Oral LD_{50}:	152 mg/kg
96-hour LC_{50} Mysid:	0.038 ppm	House Sparrow Oral LD_{50}:	41 mg/kg
96-hour LC_{50} Bluegill:	>105 mg/l	Bobwhite Quail 8-day Dietary LC_{50}:	1535 ppm
48-hour Honey Bee Contact LD_{50}:	0.078 µg/bee	Mallard Duck 8-day Dietary LC_{50}:	>4797 ppm
48-hour Honey Bee Oral LD_{50}:	0.0039 µg/bee		

Environmental Fate:
Hydrolysis half-life of imidacloprid is greater than 30 days at pH 7 and 25°C. The aqueous photolysis half-life is less than 3 hours. The soil surface photolysis of imidacloprid has a half-life of 39 days, and in soil, the half-life ranged from 26 to 229 days.

13. DISPOSAL CONSIDERATIONS

Waste Disposal Method:
Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility. Improper disposal of excess pesticide is a violation of Federal law.

Container Handling and Disposal:
Nonrefillable bags: Nonrefillable container. Do not reuse or refill this container. Completely empty bag into application equipment, then offer for recycling if available, or dispose of empty bag in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinance. If burned stay out of smoke.

14. TRANSPORTATION INFORMATION

Follow the precautions indicated in Section 7: HANDLING AND STORAGE of this MSDS.

DOT
Not regulated by DOT unless shipped by water. See IMO / IMDG description.

IMDG
UN3077, Environmentally hazardous substance, solid, n.o.s.,
(Imidacloprid), 9, III, Marine Pollutant

IATA
UN3077, Environmentally hazardous substance, solid, n.o.s.,
(Imidacloprid), 9, III, Marine Pollutant

15. REGULATORY INFORMATION

U.S. Federal Regulations:

TSCA Inventory: This product is exempted from TSCA because it is solely for FIFRA regulated use.

SARA Hazard Notification/Reporting:
Hazard Categories Under Criteria of SARA Title III Rules (40 CFR Part 370): Immediate

Section 313 Toxic Chemical(s):
N-Methyl-2-pyrrolidinone (CAS No 872-50-4), < 2% by weight in product

Reportable Quantity (RQ) under U.S. CERCLA: None

RCRA Waste Code: None

State Information:
Other state regulations may apply. Check individual state requirements.

California Proposition 65: WARNING. This product contains chemicals known to the State of California to cause cancer or birth defects or other reproductive harm

16. OTHER INFORMATION

This Material Safety Data Sheet (MSDS) serves different purposes than and DOES NOT REPLACE OR MODIFY THE EPA-ACCEPTED PRODUCT LABELING (attached to and accompanying the product container). This MSDS provides important health, safety and environmental information for employers, employees, emergency responders and others handling large quantities of the product in activities generally other than product use, while the labeling provides that information specifically for product use in the ordinary course.

Use, storage and disposal of pesticide products are regulated by the EPA under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) through the product labeling, and all necessary and appropriate precautionary, use, storage, and disposal information is set forth on that labeling. It is a violation of Federal law to use a pesticide product in any manner not prescribed on the EPA-accepted label.

Although the information and recommendations set forth herein (hereinafter "Information") are presented in good faith and believed to be correct as of the date hereof, Nufarm Americas Inc. makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Nufarm Americas Inc. be responsible for damages of any nature whatsoever resulting from the use of or reliance upon Information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

Mallet is a registered trademark of Nufarm Americas Inc.

Appendix B

Table B-1. Names and addresses of aquatic landowners with property adjacent to shellfish beds.

Current Owner	Mailing Address		Zip Code
Confederated Chehalis Tribes	PO Box 536	Oakville, WA	98568
Wild Life Marsh Land LLC	PO Box 1691	McCleary, WA	98557
Ronald J Young	131 Beacon Hill Dr.	Hoquiam, WA	98550
Cedar River Seafoods LLC	20 Old Westport Road	Aberdeen, WA	98520
Middleton Fam LLC & Tuohy	8107 Trimble Lane SE	Olympia, WA	98501

Table B-2. Names and addresses of landowners with upland property adjacent to shellfish beds.

Current Owner	Mailing Address		Zip Code
State of Washington Dept of Game	600 N Capitol Way	Olympia, WA	98504
Arthur D Rathjen and Mary Bos	1415 52nd St SE	Everett, WA	98203
Mark Rydman et al	1904 Overhulse Rd NW	Olympia, WA	98502
Joel and Anne V Adamson	771 Beacon Place NE Unit 101	Bremerton, WA	98311