# Department of Environmental Conservation
# Division of Environmental Health

## Long Island Trust Pesticide Permit Application
## for
## Aerial Use of Pesticides for Forestry Vegetation Management
## Long Island, Alaska

## Decision Document
## March 1, 2006

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## Acronyms and Abbreviations

| | |
|---|---|
| AAC | Alaska Administrative Code |
| ACMP | Alaska Coastal Management Program |
| ADF&G | Alaska Department of Fish and Game |
| AGDISP | Agricultural Dispersal Computer Model |
| cm | centimeters |
| DEC | Alaska Department of Environmental Conservation |
| DMLW | Division of Mining, Land, & Water |
| DNR | Alaska Department of Natural Resources |
| EEB | Ecological Effects Branch |
| EPA | Environmental Protection Agency |
| LD50 | lethal dose for 50% of a defined experimental animal population |
| MCL | Maximum Contaminant Level |
| MDL | Method Detection Limit |
| mg/L | milligrams per liter (equal to one ppm) |
| ng/L | nanograms per liter (equal to one ppt) |
| NHL | Non-Hodgkin's Lymphoma |
| NOAEL | No-Observed-Adverse-Effect-Level |
| NOEL | No-Observed-Effect Level |
| OHMP | Office of Habitat Management and Permitting |
| ppb | parts per billion (equal to one ug/L) |
| ppm | parts per million (equal to one mg/L) |
| ppt | parts per trillion (equal to one ng/L) |
| RfD | Reference Dose |
| SHPO | State Historic Preservation Office |
| SDTF | Spray Drift Task Force |
| ug/L | micrograms per liter (equal to one ppb) |
| USDA | United States Department of Agriculture |
| USFS | United States Forest Service |
| USFWS | United States Fish and Wildlife Service |

**Alaska Department of Environmental Conservation**
**Decision Document for Aerial Application of Pesticides for Forestry Vegetation Management, Long Island, Alaska**
**March 1, 2006**

# I. Department Decision – Summary and Conclusions

Long Island Trust has submitted a permit application to apply the pesticides Accord® EPA Reg. # 524-326 and Arsenal® EPA Reg. # 241-299, the surfactant Competitor®, and the drift inhibitor In-Place® by helicopter, to red alder sites on approximately 1,950 acres on Long Island property privately-owned by Klukwan Inc./Long Island Trust. The project is intended to allow an increase in conifer second growth by reducing salmonberry and red alder competition for water, nutrients, and sunlight in the treated areas.

The Alaska Department of Environmental Conservation (DEC) reviewed this permit application pursuant to Title 18, Chapter 90.525 of the Alaska Administrative Code (18 AAC 90.525). In considering whether to issue or deny the permit, DEC reviewed the information contained in the application, from the public record, from public hearings and from comments submitted. Based upon this information, DEC issues permit #06-0301-07-FORAIR-01 to Long Island Trust to aerially apply pesticides on areas of Long Island for forestry vegetation management purposes. In making this determination, DEC specifically finds as follows: that special precautions included in the permit stipulations are adequate to protect human health, safety, and welfare, animals and the environment; and that the activities allowed under the permit result in no unreasonable adverse effect. Finally, in addition to the special precautions contained in the permit application, DEC has, under its discretionary authority, instituted additional conditions which are included in the permit stipulations to ensure that the permit protects human health, safety, or welfare, animals, or the environment.

DEC finds that existing scientific evidence indicates that:

1. Imazapyr and glyphosate are biosynthesis inhibitors. Imazapyr kills target plants by inhibiting the production of the branched-chain aliphatic amino acids required for plant DNA synthesis and growth. Similar to imazapyr, glyphosate is a biosynthesis inhibitor of aromatic amino acids in plants.

2. Glyphosate is strongly adsorbed to soils and relatively immobile, preventing excessive leaching or uptake by non-target plants. The half-life averages two months. Glyphosate is also degraded by rapid microbial action.

3. Of the herbicides commonly used in forest applications, imazapyr is one of the more persistent, depending on the soil type. Studies indicate the persistence of imazapyr in soil is highly variable and reported soil half lives range from about 5 days to 17 months, depending on factors such as temperature, pH, aeration, organic matter, and soil depth. The most influential factor in the persistence of imazapyr in

soil, however, appears to be microbial activity. The half-lives of most other forest herbicides are generally 2 to 5 weeks (Spence, 1996).

4. The Agricultural Dispersal (AGDISP) model results indicate that if aerial spraying were conducted at a wind speed of 7 miles per hour, no pesticides would be detected at a distance of 50 feet from the spray area.

5. Persistence and mobility data indicate that neither glyphosate nor imazapyr persist in aquatic environments. Imazapyr has a half-life of only 2 days in aqueous solution, and glyphosate quickly binds with sediments.

6. Regarding karst topography, it is highly unlikely the herbicide will reach the groundwater system. The herbicides have a very strong affinity for adsorption to organic and inorganic material in soils. The soils on Long Island will sequester the herbicide long enough for the herbicide to degrade naturally.

7. With respect to wildlife, comprehensive toxicity studies have been conducted with respect to both imazapyr and glyphosate. These studies indicate that both chemicals are excreted from mammalian species relatively quickly, and there is a high lethal dose for 50% of a defined experimental animal population.

8. Similar to wildlife, toxicity studies regarding both imazapyr and glyphosate are relatively complete for aquatic species. These studies find a low persistence of both chemicals in an aquatic environment.

9. Safety reviews of glyphosate conducted by regulatory agencies and scientific institutions worldwide have concluded that there is no indication of any human health concern. The oral absorption rate of glyphosate is low, and the chemical is eliminated essentially unmetabolized. Additional study results shows glyphosate does not bioaccumulate in animal tissue. No statistically significant toxicity occurred in acute, subchronic, or chronic studies. There is no scientifically reliable evidence of direct DNA damage in vitro or in vivo. Multiple life time feeding studies failed to demonstrate any tumorigenic potential from glyphosate, resulting in the chemical being classified as noncarcinogenic. In addition, there were no effects on fertility or reproductive parameters in two multigeneration studies with glyphosate.

10. A collection of scientific studies regarding imazapyr was presented by the EPA in the *Federal Register*, dated September 26, 2003 (EPA, 2003). This collection of studies summarized the risk assessment and statutory findings to establish the legal limit for pesticide residue in or on a food. The collection of studies included the following information/conclusions: imazapyr showed no evidence of carcinogenicity in at least two animal tests in different species and therefore, a quantitative cancer risk assessment was not necessary to support the tolerance evaluation; imazapyr was not shown to produce a toxic metabolite(s); there is no scientific evidence of developmental neurotoxicity resulting from exposure to

imazapyr; and no acute risk from exposure to imazapyr is expected based on acute single dose exposure studies.

DEC's decision is based upon its analysis of information referenced in this Decision Document, including the information summarized above.

A copy of the permit is available from DEC upon request.

## II. Background Information

The Department of Environmental Conservation (DEC) received a permit application from Long Island Trust to aerially spray pesticides on 1,950 acres of its Long Island (map in Appendix A) property for forestry vegetation management purposes. Specifically, Long Island Trust proposes to apply the pesticides Accord® and Arsenal®, the surfactant Competitor®, and the drift inhibitor In-Place® by helicopter, to red alder sites on approximately 1,950 acres on Long Island, property privately owned by Klukwan Inc./Long Island Trust. The project is intended to allow an increase in conifer second growth by reducing salmonberry and red alder competition for water, nutrients, and sunlight in the treated areas. The pesticide Accord®, EPA Registration Number 524-326, active ingredient glyphosate, is registered for forestry conifer and hardwood release. The label contains directions for aerial treatment, including mixing instructions if used with the herbicide, Arsenal®. Arsenal®, EPA Registration Number 241-299, active ingredient imazapyr, also has label directions for conifer release treatment. A surfactant adjuvant is recommended on the Accord® label to enhance its effect and reduce the amount of product needed.

## III. Regulatory Background

Under 18 AAC 90.505, a person or government entity may not, without first obtaining a permit issued by the Department, direct, conduct, participate in, or allow the use of a pesticide (1) to waters of the state; or (2) by aircraft or helicopter. To meet this requirement, Long Island Trust submitted a permit application under 18 AAC 90.515 on August 1, 2005 to conduct aerial spraying of pesticides, as discussed above. Because the application is part of a Forestry Vegetation Management Project, in addition to the requirements of 18 AAC 90.600-620, the requirements of 18 AAC 90.800 must also be met by the permit holder.

## IV. Evidence Supporting Department Decision

In addition to interviews conducted with subject matter experts, over 120 studies were reviewed and evaluated in support of this decision document. All studies were given equal consideration for inclusion. However, only unbiased, scientifically-based, peer-reviewed (or validated) data were utilized in the decision to issue this permit. Section VII includes the list of references used. It is understood that large doses of glyphosate and imazapyr will cause adverse effects on internal organs and physiological systems in humans, animals, and aquatic species. When reviewing these studies in support of a permit decision, the dose-response relationships between specific biological effects and potential exposure scenarios were examined. Based on the predicted, anticipated exposure during and after the application the Department finds that there will no unreasonable adverse effects posed as a result of the herbicide application.

## *A. Chemical Properties and Application Information*

The herbicides proposed for use in the permit are imazapyr and glyphosate. Both chemicals are biosynthesis inhibitors. Imazapyr kills target plants by inhibiting the production of the branched-chain aliphatic amino acids required for plant DNA synthesis and growth (Washington, 2004). Similar to imazapyr, glyphosate is a biosynthesis inhibitor of aromatic amino acids in plants (Boutin, 2003). Glyphosate is a systemic non-selective soluble concentrate herbicide that is taken up by the leaves of the target plant and translocated through the plant by cell to cell diffusion and vascular transport to the chloroplasts. Once there, the chemical targets the enzyme 5-enolpyruvylskikimate-3-phosphate synthase. Glyphosate inhibits the shikimic acid pathway, which is responsible for the production of the aromatic amino acids phenylalanine, tyrosine, and tryptophan (Boutin, 2003).

### Persistence and Mobility

Persistence is defined as the amount of time a chemical will be detected, or "persist" in the environment after pesticide application. Mobility is defined as the ability of the chemical to migrate through the soils. Several factors contribute to chemical migration through soils, including the soil partitioning factor of the chemical (or ability to bind with soil particles), the type of soils, precipitation, and others. This phenomenon is also described as fate and transport of the chemical.

#### Glyphosate

Glyphosate mobility in soil is very limited. Once applied, the chemical is bound to the soil through phosphonic acid moiety. In a study conducted at the University of Helsinki, glyphosate was applied to different soil types. Immediately after application, 92% of the chemical was detected in the soil. Approximately 76% remained after 28 days, and after wintering over, only 10% of the initial concentration was detected in the soil, confirming the strong soil-binding nature of the chemical (Muller, 1979). This characteristic was confirmed by Tu (2001) and Schuette (1998), in that glyphosate is strongly absorbed to soils and relatively immobile, preventing excessive leaching or uptake by non-target plants. The half-life averages two months.

Glyphosate is also degraded by rapid microbial action. Other chemical properties show that it is non-volatile and does not degrade photochemically. Although it has a high water solubility, it strongly binds with soil particles and becomes immobile in soils (Boutin, 2003).

Monitoring results from The Danish Pesticide Leaching Assessment Programme showed that glyphosate, when applied in late autumn, can leach through the root zone in loamy soils at concentrations exceeding 1 microgram per liter (ug/L). The leaching risk was negligible in coarse, sandy soils (Kjaer, 2002). However, the concentrations were well below the EPA maximum contaminant level (MCL) of 700 ug/L.

Persistence in water has also been discussed in several studies. In a USGS study of 51 streams in nine Midwestern states, glyphosate was detected in 36% of the samples; however, the highest measured concentration was only 8.8 ug/L or parts per billion (ppb), well below the EPA MCL. In this study, the samples were collected to coincide with runoff events following the herbicide application. Median concentrations detected for each runoff period were <0.10 ug/L (USGS, 2004).

Regarding the aquatic environment, given its rapid dissipation in forest stream ecosystems, its susceptibility to biodegradation, and its tendency to sorb strongly to organic substrates, significant biological impact to aquatic organisms as the result of silvicultural applications at recommended rates would be highly unlikely (Feng, 1989).

#### Imazapyr

The persistence and mobility of imazapyr was evaluated in a 2004 study, conducted in Sweden. Imazapyr was sprayed on a railway embankment. The study showed that apart from the top 10 centimeters (cm) of soil, the microbial amount and activity of the chemical were small. The main proportion of imazapyr was found in the upper 30 cm of soils, and degraded with a half-life in the range of 67-144 days. Minute amounts were transported to lower soil layers and to groundwater only in proportion to the amounts applied (Borjesson, 2004). Of the herbicides commonly used in forest applications, imazapyr is one of the more persistent, depending on the soil type. Studies show the persistence of imazapyr in soil is highly variable and reported soil half lives range from about 5 days to 17 months, depending on factors such as temperature, pH, aeration, organic matter, and soil depth. The most influential factor in the persistence of imazapyr in soil, however, appears to be microbial activity (USDA, 1999). The half-lives of most other forest herbicides are generally 2 to 5 weeks (Spence, 1996).

In soils, imazapyr is degraded primarily by microbial metabolism. It does not degrade significantly by photolysis or other chemical reactions. However, it will quickly undergo photodegradation in aqueous solutions with a half-life of only two days. Despite its potential mobility in soils, imazapyr has not been reported in water runoff, and there have been no reports of imazapyr contamination in water. Like glyphosate, imazapyr does not volatilize readily when applied in the field (Tu, 2004).

### Adjuvants

The permit application proposed the use of Competitor® and In-Place® as adjuvants. The state of Washington, which reviews and registers adjuvants, approves the use of both Competitor® and In-Place® (Johansen 2004, 2005). Before allowing registration as an adjuvant, both products, and specific constituents of each product, were reviewed for potential toxicity to ensure their safety. In addition to terrestrial and forestry use, Competitor® is also approved for aquatic use. Competitor® is a modified vegetable oil containing a non-ionic emulsifier. It was found to be practically non-toxic to Daphnia in research studies (Johansen, 2004). This adjuvant is not toxic or irritating to the skin and there are no known chronic effects. In addition, there are no known preexisting medical conditions that would be aggravated by exposure to Competitor® (Wilbur-Ellis, 2004). In-Place® is a petroleum distillate that acts as an inverse emulsifier. As the herbicide mixture is sprayed from each nozzle, this adjuvant encapsulates the herbicide/water droplet inside the oil-based substance, inhibiting drift of the herbicide outside the spray area (Wilbur-Ellis, 2005).

### Pesticide Drift

To evaluate pesticide drift, the Spray Drift Task Force (SDTF), a consortium of 38 agricultural chemical companies established in 1990 in response to EPA spray drift data requirements, conducted studies to quantify primary drift from aerial, ground hydraulic, air blast, and chemigation applications. Over 300 applications were made in 10 field studies, covering a range of application practices for each type of application. Prior to initiating the studies, the SDTF compiled 2,500 drift-related studies from the scientific literature, utilizing the information to develop test protocols. Results showed that droplet size is the most important factor in drift, while the active ingredient does not significantly affect spray drift. A cutoff point of 141 microns or 150 microns has been established as a guide to indicate which droplet sizes are most prone to drift. Droplet size can be increased by reducing spray pressure, increasing nozzle orifice size, using special drift reduction nozzles, and additives that increase spray viscosity, and rearward nozzle orientation on aircraft (Petroff, 2004). The field studies showed drift can be kept very low using good application procedures. With current technology, there are many ways to minimize drift to levels approaching zero. When drift cannot be reduced to low enough levels through altering equipment set up and application techniques, buffer zones may be imposed to protect areas downwind of applications (SDTF, 1997). Drift minimization techniques that will be utilized during aerial application on Long Island include utilizing a drift inhibitor to encapsulate the active ingredient inside the spray droplets (ranging from 200 to 600 microns in size), using properly positioned drift reduction nozzles, flying at a reduced air speed, placing nozzles on only 60 % of the total boom length, and using only the inside half of the spray boom on the perimeter of the spray area.

To evaluate the potential for pesticide drift in this permit, the permit applicant modeled pesticide drift utilizing AGDISP, software developed by the U.S. Forest Service. AGDISP predicts or "models" what will happen to a pesticide after it is sprayed from an aircraft, including deposition, evaporation, and drift from the target area (USDA, 2002). The algorithms utilized in the model were evaluated and validated by the SDTF, comparing 161 separate trials of typical agriculture aerial applications under a wide range of application and meteorological conditions. The model response was similar to the field observations for many application variables (e.g. droplet size, application height, wind speed). Overall, the model algorithms are in good agreement with field results for estimating near-field buffer zones needed to manage human and ecological exposure (Bird, 2002). Based on the extensive experience and data review conducted by the SDTF, and their evaluation of the AGDISP model compared to actual field tests, this model is acceptable for use in predicting potential drift during the Long Island herbicide application.

The AGDISP model results, submitted by the applicant, were evaluated by DEC. The applicant's results were based on a wind speed of 4 miles per hour. During DEC's analysis, wind speeds as low as 4 and as high as 7 miles per hour were evaluated, in conjunction with the wind speed limitations in 18 AAC 90.610(2)(B), and wind speed limitations of 5 miles per hour included on the Accord® label. DEC analysis indicates that if aerial spraying were conducted at a wind speed of up to 7 miles per hour, no pesticides would be detected at a distance of 50 feet from the spray area. This conclusion is based on a Method Detection Limit (MDL) of 50 ppb for glyphosate and 5.0 ppb for imazapyr (EPA, 2005). The MDL is the minimum concentration of a chemical substance present in a sample that can be measured with a 99 percent probability that the measured concentration is above zero (Stevenson, 1991). Other model input and application information that was evaluated included nozzle type and size, orientation, type of helicopter, boom length, number of nozzles, application height, minimum droplet size, droplet size variation, and terrain. It should be noted that the AGDISP model is asymptotic. As a result, any graphic presentation of model results, while approaching zero, will not reach zero at any distance. ADEC interprets the pesticide free zone to mean no amount of pesticide would be detected by laboratory analysis as a result of drift.

In addition to running the AGDISP model, DEC staff attended the International Conference on Pesticide Application for Drift Management October 27 through 29, 2004. Specific to this permit, DEC staff conducted a site visit to Oregon to meet the certified applicator who will be conducting the aerial spraying. Staff inspected the proposed equipment and rode in the helicopter during an actual application to ensure all facets of the application were conducted properly.

### Buffer Zones and Monitoring

A buffer zone of 50 feet is proposed in the amended permit application. This distance is in addition to a 35-foot "no pesticide zone" stipulated in the regulations. The results of AGDISP modeling support the establishment of minimum 50-foot buffer zone around adjacent lands. DEC will require a 100-foot buffer zone around water bodies and wetlands in addition to the 35-foot "no pesticide zone," which is also supported by the model results and herbicide labels. Pesticides shall not be applied within 1/2 mile (2,640 feet) of the historic Howkan Village site or the Koianglas site, within 1,000 feet of any eagle nest between March 1 and May 31, or within 330 feet of any bald eagle nest at other times, as recommended by DNR.

Pre-application and post-application environmental monitoring will be conducted by a qualified, third party consultant. The consultant will develop and submit sampling protocols to DEC for approval before pesticide application occurs. Sampling and laboratory analysis will be required prior to pesticide application to confirm baseline conditions; just after the application to confirm buffer zones; and several days after the application to characterize herbicide fate and transport. The media to be sampled will include vegetation, water, soils, and sediment upstream from near shore aquatic species (shellfish). All sampling will be conducted in the presence of DEC staff. Validated analytical results will be submitted to DEC for review.

## *B. Environmental Issues*

### Surface Water and Groundwater

According to a *Reconnaissance Survey of Groundwater Conditions on Northern Long Island, Alaska*, "the likelihood that herbicides will enter the groundwater system on Long Island and cause adverse impacts to wildlife is essentially negligible as long as the procedures proposed for aerial spray application are followed. Based on previous published accounts of the fate of Accord® in similar application scenarios, the limited area of application, dilute solution concentrations, and dense vegetative growth, less than 1% of applied herbicide is expected to reach the soil surface of Long Island. The concentration of herbicides that actually infiltrates soils and reaches groundwater to become part of the flow system is therefore expected to be below detection levels." (O'Donnell, 2004).

Current knowledge and scientific evidence shows the following: First, a 135-foot distance will be required around all water bodies and wetlands; second, persistence and mobility data show that both glyphosate and imazapyr do not persist in aquatic environments. Imazapyr has a half-life of no more than 2 days in water, and glyphosate quickly binds with sediments. Lastly, AGDISP model results show no pesticides would be detected at the 135-foot distance.

### Topography, Geology, and Hydrogeology

Geologic settings which are dominated by carbonate lithologies such as those found on Long Island require special consideration to protect groundwater because of the complex groundwater flow paths which can develop. The complexities of groundwater flow and the ready dissolution of carbonate material often result in the development of "karst topography," which can be found over a large area of Long Island. Because the carbonate material dissolves so readily, groundwater can move within preferential "flowpaths." The concern with aerial spraying is that the herbicides will enter the groundwater system, migrate some lateral distance within the groundwater system over a short period of time (hours to days), and re-emerge at some other location. This re-emergence could occur quickly enough to prevent the herbicides from degrading naturally.

It is possible that the above scenario could occur following the application of the herbicide on Long Island. However, based on the information considered, the Department finds the following:

1. It is highly unlikely the herbicide will reach the groundwater system. The herbicides have a very strong affinity for adsorption to organic and inorganic material in soils. The soils on Long Island will sequester the vast majority of the herbicide long enough for the herbicide to degrade naturally.

2. It is possible that some of the herbicide might reach the groundwater system. If this occurs, and even if the herbicide does travel through a preferential "fast path," these groundwater systems do not tend to concentrate transported materials in a particular location. The herbicide will re-emerge at a concentration no greater than it was when it entered the groundwater system. At the proposed application rate, concentrations are lower than established water quality standards, even with no degradation in the groundwater system.

3. The herbicide will be applied in a very diluted form (the rate instructions on the label are 41.5% at 1.5 quarts per acre for Accord® and 53.1% at 2 ounces per acre Arsenal® and will result as a non-point source of herbicide to the environment. Groundwater quality degradation that results from preferential or "fast flow" in karst groundwater systems typically results from point-sources of pollution. In these situations, very concentrated contaminated waters are transported by highly preferential flow processes and re-emerge at some distant location.

4. Even though groundwater in karst systems travels in so called "fast pathways," typically this groundwater flow is much slower than in surface water systems. Where surface water in streams may have a residence time of a few hours or days, typical groundwater residence times (even in karst systems) are usually much longer than a month or two, which would provide enough time for herbicide degradation before re-emergence.

### Wildlife and Threatened and Endangered Species

Glyphosate and imazapyr effectively kill target plant species by inhibiting the production of amino acids in plants which are not present in animals. One of the impacts an herbicide may have on wildlife is to reduce potential food sources or modify flora (Boutin, 2003). Since the herbicide application is on only 1,950 acres, less than 10 percent of available land on Long Island, this should not eliminate a large amount of potential food sources. The resulting forest growth enhancement from the vegetation management project may benefit wildlife by allowing plants more commonly consumed to grow more easily.

#### Glyphosate

Based on the current, available data, EPA determined that the effects of glyphosate on birds, mammals, fish, and invertebrates are minimal (EPA, 1993). While several studies indicate there could be an impact to wildlife/birds of herbicide application due to reduced habitat (e.g. lodging and food), there are no significant effects of glyphosate, itself. Regarding loss of habitat, a 1993 study conducted in Nova Scotia suggested that there are relatively small and short-term effects of silvicultural use of glyphosate on the prominent bird species of regenerating clear cuts (MacKinnon, 1993). Additional data regarding the results of glyphosate studies on mammals is included in later sections of the document.

#### Imazapyr

Studies indicate the chemical is excreted by mammalian systems rapidly with no bioaccumulation. The LD50, or calculated concentration to cause death in 50% of a defined experimental animal population over a specified observation period, for rats is >5,000 milligrams per kilograms (mg/kg), and for bobwhite quail and mallard ducks >2,150 mg/kg. Reports indicate that in rats, imazapyr was excreted rapidly in the urine and feces with no residues accumulating in the liver, kidney, muscle, fat, or blood (Tu, 2004). In addition, chronic studies in three mammalian species and several reproductive studies in two mammalian species indicate that imazapyr is not likely to be associated with adverse effects at relatively high doses (USDA, 1999). Finally, a 1987 EPA Ecological Effects Branch (EEB) review of Arsenal® for forestry use stated that, "[t]he toxicity data available suggest that Imazapyr is practically nontoxic to mammals based on an acute oral LD50 of >5,000 mg/kg (both sexes)" (EPA, 1987).

#### Conclusion

Available toxicity studies are relatively complete, regarding both imazapyr and glyphosate. Based on these studies, the fact that both chemicals are excreted from mammalian species relatively quickly, and the high LD50, no effects on wildlife are expected from herbicide application on Long Island.

### Aquatic Species

According to *An Ecosystem Approach to Salmonid Conservation, 1996,* the risk of toxicological effects of herbicides on salmonids is greatest when herbicides are directly applied to surface waters or reach surface waters by wind drift. There is substantial literature regarding the toxicity of various herbicides to salmonids; most of the available information comes from laboratory studies, rather than the field. In addition, these studies focus on acute lethal doses. Research has shown that herbicides used in conifer release applications may actually benefit the habitat by accelerating the long-term recovery of upland and riparian areas. Applying herbicides in upland areas slows the recovery of vegetation, prolonging disruption to hydrologic and sediment delivery processes. Within the riparian zone, removing deciduous vegetation increases solar radiation reaching streams, which stimulates algal production, potentially increasing the food base for invertebrates and fish. Delayed production of deciduous trees and accelerated growth of conifers reduces the delivery of leaves and intermediate-sized wood to streams over the short term, but increases the potential for recruiting large coniferous wood over longer periods (Spence, 1996).

In addition to general herbicide data, there are an abundant number of studies regarding the potential effects of glyphosate and imazapyr on a variety of aquatic species, discussed in the following paragraphs.

#### Glyphosate

The U.S. Fish and Wildlife Service conducted a study at the Columbia National Fishery Research Laboratory to determine the acute toxicity of technical grade glyphosate on four aquatic invertebrates and four fish. Study results showed the chemical degrades quickly in water and is not active against submersed aquatic vegetation. In addition, study results showed that when applied at recommended label application rates along ditchbank areas of irrigation canals, it did not adversely affect resident populations of fish or invertebrates. The study did suggest reapplications of the pesticide should be avoided for at least seven days to prevent accumulation (Folmar, 1979).

Another study conducted in Thailand indicated that long-term exposure to glyphosate at sublethal concentrations did have adverse effects on the histopathological and biochemical alterations of the Oerochromis Niloticus (Nile Tilapia), a tropical, plant eating fish from Africa. In the studies, this species was exposed to glyphosate for three months, at concentrations of 5 and 15 parts per million (ppm), orders of magnitude over the predicted, worst-case scenario, exposure of $<7.5$ parts per trillion (ppt) (Jirungkoorskul, 2003).

In another study, the acute and sub-acute toxicities of glyphosate were investigated on carp. The intent of the study was to establish the lethal dose of glyphosate and the dose required to cause changes in fish enzyme activity. The results indicated an acute toxicity of 645 milligrams per liter (mg/L) at 48 hours of exposure and 620 mg/L at 96 hours of exposure. However, the study included a caveat that acute toxicity levels ranged up to 1,000 mg/L in other studies, depending on the fish species and exposure times. The study concluded that, based on these levels, glyphosate was practically non-toxic to carp (Neskovic, 1996).

Another study, conducted to show the potential effect of glyphosate in a direct aquatic application, indicated a decline of the concentration of glyphosate by 73% between the first high tide immediately following application and the second high tide one day later. Based on this decline, comparing the maximum concentrations for glyphosate in seawater with acute toxicity values in the literature indicates that under worst-case conditions, direct effects to aquatic organisms would not be likely (Simenstad, 1995). Similarly, the concentration of glyphosate formulation required to cause acute toxicity to aquatic animals was found to be >2 mg/L in a study conducted by Freedman, a dose that is considerably larger than the aqueous residues observed even after deliberate oversprays of streams and ponds (Freedman, 1991).

Several recent studies, conducted by Rick Relyea of the Department of Biological Sciences at the University of Pittsburgh, regarding the impact of another glyphosate product, Roundup®, on aquatic and terrestrial amphibians were reviewed. The results of these studies suggested that applying Roundup® formulations containing the surfactant polyethoxylated tallow amine (POEA) did have the potential to cause mortality to amphibians. However, laboratory studies showed that glyphosate alone has a low toxicity while the POEA surfactant was toxic to a variety of taxa, including amphibians. This study did not isolate the impacts of glyphosate and the surfactant, so it could not be determined which component of Roundup® caused the mortality, but it appeared likely that the surfactant was the cause (Relyea, 2005). Finally, a study conducted by the EPA on several species of California and Pacific Northwest salmon and steelhead showed that application rates of up to 5 pounds of active ingredient (lbs a.i.) per acre (glyphosate) had no effect to salmonids, including steelhead, Chinook salmon, or Coho salmon (EPA, 2004).

**Imazapyr**

The bioaccumulation of imazapyr in aquatic species is low. Imazapyr is considered non-toxic to fish by EPA standards, or insignificant, based on tests conducted utilizing standard EPA protocols (Washington, 2004). Imazapyr has a low toxicity to algae, and submersed vegetation is not affected (Tu, 2004).

A 1987 EPA Ecological Effects Branch (EEB) review of Arsenal® for forestry use indicated that, "[i]mazapyr is practically nontoxic to freshwater fish and aquatic invertebrates with LC50 [LD50] values >100 ppm. Assuming a direct application to water with 1.5 pounds of active ingredient (lb/ai), the level is substantially below that necessary to adversely affect aquatic organisms" (EPA, 1987).

In a separate study, Fowlkes, et al, conducted a field study to determine the effects of imazapyr on macroinvertebrates in logged pond cypress domes. The study site was a managed pine plantation, consisting of pine flatwoods interspersed with pond cypress domes, which are natural wetlands. To conduct the study, imazapyr was stirred into water columns (constructed of polyvinyl chloride, or PVC, piping pushed into the sediment) at 1-times, 10-times, and 100-times the expected environmental concentration that would appear in the pond if the area were to be sprayed directly with the operational treatment rate for the surrounding forest site. Study results indicated that imazapyr had little effect on the macroinvertebrate community, specifically total taxa richness and abundance. In addition, imazapyr appeared to have little effect on chironomic biomass via direct growth inhibition or secondary means. In the study, imazapyr did not have acute or toxic effects on macroinvertebrate composition, chironomid deformity, or biomass at concentrations up to 100 times the expected environmental concentration and has low toxicity compared with many other herbicides used in forestry and agriculture. The study concluded that imazapyr is unlikely to pose a risk of harm to aquatic invertebrates when used in forest vegetation management at prescribed rates and at the normal frequency of one to three times in a rotation of 20 to 80 years (Fowlkes, 2003).

#### Conclusion

Available toxicity studies are relatively complete for both imazapyr and glyphosate. Based on these studies, the low persistence of both chemicals in an aquatic environment, and the required 135-foot distance between the spray area and water bodies (which includes the 35-foot pesticide free zone), no unreasonable adverse effects on fish or other aquatic species are expected from herbicide application on Long Island.

## *C. Human Health Issues*

The use of imazapyr or glyphosate does not pose any identifiable hazard to workers or the general public in U. S. Forest Service (USFS) programs when applied according to the EPA approved product labels and in compliance with Federal and State regulations regarding the safe handling and use of pesticides (USDA, 1999).

### Cancer, Hormonal and Genetic Alterations, Reproductive and Other System Effects

The USFS calculated the cancer risk to the general public from herbicide use on Forest Service lands in the Southeast United States to be 1 in 10 million. These estimates were based on a conservative approach, assuming the herbicides used were carcinogenic and exposure levels were high over long periods of time, 70 years. The fundamental assumption of carcinogenicity is subject to much debate and, to date, no forestry herbicide has been conclusively shown to be carcinogenic (McNabb, 2002). Specific study results are discussed in the following paragraphs.

#### Cancer, Hormonal and Genetic Alterations

Reviews of the safety of glyphosate conducted by several regulatory agencies and scientific institutions worldwide have concluded that there is no indication of any human health concern. The oral absorption of glyphosate is low, and the chemical is eliminated essentially unmetabolized. Additional experimental evidence shows glyphosate does not bioaccumulate in any animal tissue. No statistically significant toxicity occurred in acute, subchronic, or chronic studies. There is no scientifically reliable evidence for direct DNA damage in vitro or in vivo. Multiple life time feeding studies failed to demonstrate any tumorigenic potential for glyphosate, resulting in the chemical being classified as noncarcinogenic. In addition, there were no effects on fertility or reproductive parameters in two multigeneration studies with glyphosate. No statistically significant toxicity occurred in acute, subchronic, and chronic studies (Williams, 2000).

A team representing the Ontario College of Family Physicians conducted a pesticides literature review to research the relationship of pesticides to human health. In this report, the only reference to glyphosate was a Swedish case-control study, relating the herbicide to Non-Hodgkin's Lymphoma (NHL). The study showed that there were dose-response effects in the pesticide group including glyphosate (Sanborn, 2004). However, according to Dr. Allan Felsot, environmental toxicologist at Washington State University, the Swedish study was flawed for several reasons. First, the study was based on self-reporting of pesticide use among the study population. Second, the Swedish study ignored the fact that the association between glyphosate use and incidence of NHL was not statistically significant. Finally, the study ignored the very low potential of glyphosate to penetrate the skin even if a worker was exposed. Dr. Felsot concluded that the study made faulty conclusions that were not supported by the available data (Felsot, 2000).

In a separate study conducted in 1991, the Health Effects Division Carcinogenicity Peer Review Committee convened to evaluate the carcinogenic potential of glyphosate. A review of previous studies was completed and the committee concluded that glyphosate should be classified as a Group E (evidence of non-carcinogenicity for humans), based on the lack of convincing carcinogenicity evidence in adequate studies in two animal species (Dykstra, 1991).

Finally, EPA's last comprehensive review of scientific studies on glyphosate (pre 2001) concluded that proper use of glyphosate would not cause adverse effects in humans. Based on adequate scientific studies, glyphosate does not cause risks of concern for birth defects, mutagenic effects, neurotoxic effects, reproductive problems, or cancer (State, 2001).

Imazapyr has not been found to cause mutations or birth defects in animals, and is classified by the EPA as a Group E compound, indicating that imazapyr shows no evidence of carcinogenicity. The chemical also shows no mutagenic or teratogenic potential (Tu, 2004). This correlates with tests of carcinogenic and mutagenic activity conducted on imazapyr, which are consistently negative (USDA, 1999).

### Reproductive System Effects

A 2000 study, conducted by the Department of Cell Biology and Biochemistry at Texas Tech University, examined the potential effect of pesticides on the reproductive system. One of the pesticides in the study was Roundup® (active ingredient – glyphosate). The study showed Roundup® decreased progesterone production in a dosage-dependent manner without inducing a parallel decrease in total protein synthesis, indicating this herbicide did not cause acute cellular toxicity. However, glyphosate did not alter steroid production or total protein synthesis at any dose tested (Walsh, 2000).

Studies conducted for the Department of Health and Human Services to determine the toxicity of glyphosate demonstrated that the chemical was excreted in urine and feces after oral administration. There was no evidence of genetic or reproductive toxicity (USDHHS, 1992).

Several studies on the reproductive effects of imazapyr in rats and rabbits have been conducted and submitted to the EPA in support of registration. All of the studies were negative, showing that imazapyr does not cause adverse reproductive or development effects (USDA, 1999).

### Dermal, Inhalation Exposure

A study of forestry ground pesticide applicators found indications of significant dermal exposure of glyphosate. However, based on biomonitoring, there was no indication of an absorbed dose. Potential exposure of glyphosate is almost exclusively through dermal contact. There is minimal opportunity for inhalation exposure due to the chemical's low vapor pressure (Acquavella, 1999).

In another study of 346 volunteers, a 41% solution of glyphosate was applied to skin. The study showed the chemical applied to unabraded skin did not show irritation greater than either all-purpose cleaner, dishwashing detergent, or baby shampoo. After a 21-day irritancy assay, glyphosate and baby shampoo were less irritating than the cleaner. No evidence of skin sensitization was observed and glyphosate demonstrated no potential for photo-irritation or photosensitization (Hayes, 1991).

## Acute and Chronic Toxicity

The following paragraphs discuss the acute and chronic toxicity of glyphosate and imazapyr. In this section, the terms reference dose (RfD), and No-Observed-Effect-Level (NOEL) are used several times. These terms are defined as follows: The reference dose represents the level at or below which daily aggregate dietary exposure over a lifetime will not pose appreciable risks to human health. It is determined by using the toxicological endpoint or the NOEL for the most sensitive mammalian toxicological study (EPA, 1997). The NOEL is the dose of a chemical at which no treatment-related effects were observed (USDA, 1999). Finally, the No-Observed-Adverse-Effect-Level (NOAEL) is the dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse (USDA, 1999).

### Glyphosate

The EPA conducted an assessment for re-registration of glyphosate in 1993. Findings showed glyphosate is of relatively low oral and dermal acute toxicity. It was placed in Toxicity Category III for these effects (I being the highest and IV being the lowest). An acute inhalation toxicity assessment was not conducted because glyphosate is non-volatile. Additionally, adequate inhalation studies exist with end-use products showing low inhalation toxicity. EPA's worst-case risk assessment of glyphosate's many registered food uses concluded that human dietary exposure and risk are minimal. Existing and proposed tolerances were reassessed, and the EPA determined that no significant changes to the proposed tolerances were needed to protect the public (EPA, 1993).

A culmination of studies regarding glyphosate was presented in the Federal Register, dated October 8, 1998 (EPA, 1998). This document summarized the risk assessment and statutory findings to establish the legal limit for pesticide residue in or on a food. The study included the following information/conclusions:

1. Acute toxicity and irritation potential of glyphosate is low (based on dermal studies).

2. Regarding genotoxicity, negative results (i.e. no effects) were obtained when glyphosate was tested in a dominant-lethal mutation assay.

3. Regarding reproductive toxicity, there was no indication of increased sensitivity of rats or rabbits to in utero and postnatal exposure to glyphosate. The conclusion was that there are no extra sensitivities with respect to pre- and post-natal toxicity between adult and infant animals.

4. Regarding developmental toxicity, the systemic NOEL was 1,000 mg/kg/day and the lowest-observed effect level was 3,500 mg/kg/day in Sprague-Dawley rats. Developmental toxicity was not observed at any dose in a similar study conducted on rabbits. The conclusion was that prenatally exposed fetuses were not more sensitive than maternal animals.

5. Regarding a determination of safety, the agency concluded that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to glyphosate residues.

6. Glyphosate does not appear to produce a toxic metabolite produced by other substances. Therefore, EPA did not assume glyphosate has a common mechanism of toxicity with other substances.

7. The agency concluded that no harm to the public would result due to acute risk for the proposed uses of glyphosate.

Effects of long-term, chronic exposures of mammals to glyphosate are small, especially considering doses that humans or other animals might receive during an operational treatment in forestry. The NOEL for exposure to glyphosate has been reported at 2,000 mg/kg for rats and dogs fed for 90 days. In comparison, the acute toxicity, indexed by the LD50, is 12.5 mg/kg for nicotine, 13.7 mg/kg for alcohol, and 150 mg/kg for gasoline 192 mg/kg for caffeine, 3000 mg/kg for salt and 5,600 mg/kg for glyphosate (Freedman, 1991).

A 1996 risk assessment, prepared for the USDA Forest Service, quantified the risk to the general public from the commercial use of glyphosate at an application rate of 1 pound of active ingredient per acre (lb a.i./acre). The assessment used several “worst-case” scenarios to calculate potential risk. Results are presented in Table 1.

Table 1 – Quantitative Summary of Risks for the General Public – Glyphosate

| Activity | Scenario | Dose (mg/kg/day) | Hazard Quotient* |
|---|---|---|---|
| Direct spray | Naked child, entire body surface, wash after 1 hour | 0.031 – 0.061 | 0.02 – 0.03 |
| | Young woman, feet and legs, wash after 1 hour | 0.0026 – 0.0053 | 0.001 – 0.003 |
| Walking through treated area | Dermal absorption, contaminated vegetation | 0.0005 - 0.0009 | 0.0002 – 0.0005 |
| Contaminated water | 10 kg child consuming 1 liter immediately after spraying | 0.0093 | 0.005 |
| | 0.1 – 1.0 ug/L in ambient water | 0.0001 - -0.0001 | 0.0001 – 0.001** |
| Consumption of contaminated fish | Shortly after spraying | 0.002 | 0.001 |
| | Over prolonged periods | 0.00009 | 0.0009** |
| Consumption of contaminated vegetation | Berries shortly after spraying | 0.032 | 0.02 |
| | Berries, time 0 to day 20 | 0.006 | 0.06** |

Notes: *based on an EPA 10-day health advisory of 2 mg/kg/day
**based on the verified EPA Reference Dose (RfD) for lifetime exposures = 0.1 mg/kg/day
ug/L – micrograms per liter in water
Source: (USDA, 1996)

As shown in Table 1, based on an assumed application rate of 1 lb a.i./acre, the worst-case risk scenarios result in a dose significantly lower than the EPA reference dose of 2 mg/kg/day. The hazard quotient is the ratio of the estimated level of exposure to the reference dose. Based on the results of these scenarios, no hazards are apparent for the general public. It should be noted that the proposed rate of application of glyphosate in the permit is 0.5 lb a.i./day, or half of the rate assumed in the risk scenarios (USDA, 1996).

**Imazapyr**

A current collection of studies regarding imazapyr was presented in the EPA *Federal Register*, dated April 9, 1997 (EPA, 1997). This document summarized the risk assessment and statutory findings to establish the legal limit for pesticide residue applied on field corn. The study included the following information/conclusions:

1. Regarding acute toxicity, or LD50, imazapyr is placed in Category I for eye irritation, Category III for dermal and inhalation, and Category IV for oral.

2. A metabolism study in rats indicated that imazapyr was rapidly absorbed and excreted by 7 days post-dosing, with 90% of the dose eliminated in urine within 48 hours. Metabolite characterization studies showed essentially all the test material was excreted unchanged.

3. Imazapyr has an established RfD of 2.5 mg/kg/day, based on a NOEL of 250 mg/kg/day, from a 1-year dog feeding study.

4. Imazapyr is classified as Group E (evidence of non-carcinogenicity for humans).

5. Exposure analysis showed that exposure from residues on corn for the U.S. population and all subgroups would be less than 1% of the RfD.

As a follow up to the 1997 *Federal Register* entry, a culmination of studies regarding imazapyr was presented in the *Federal Register*, dated September 26, 2003 (EPA, 2003). This document summarized the risk assessment and statutory findings to establish the legal limit for pesticide residue in or on a food. The study included the following information/conclusions:

1. The acute oral toxicity of imazapyr, or LD50, is >5,000 mg/kg, placing it in Category IV. The acute dermal toxicity, or LD50 is >2,000 mg/kg, placing it in Category III.

2. Imazapyr showed no evidence of carcinogenicity in at least two adequate animal tests in different species. Therefore, a quantitative cancer risk assessment was not performed to support the tolerance evaluation.

3. Imazapyr does not appear to produce a toxic metabolite produced by other substances.

4. There is no concern for developmental neurotoxicity resulting from exposure to imazapyr.

5. No acute risk from exposure to imazapyr is expected because there were no toxic effects of concern attributable to a single dose identified in the available data.

The oral LD50 of imazapyr, according *The Herbicide Handbook*, is a dose of >5,000 mg/kg in a rat. The oral LD50 for caffeine in mice is 127 mg/kg. The oral LD50 for aspirin in mice is 1100 mg/kg. The LD50 for glyphosate in rats is 5600 mg/kg (Rose, 2002).

Based on the estimated levels of exposure and the RfD derived by the EPA Office of Pesticides Programs, exposures that can be anticipated both in the typical use of imazapyr or in a number of accidental exposure scenarios do not lead to dose levels that exceed the RfD. In other words, all of the anticipated exposures – most of which involve highly conservative or protective assumptions – are below the RfD by at least a factor of 2 (USDA, 1999).

Imazapyr can cause irritation to the eyes and skin. Based on the available reported side effects information, eye and/or skin irritation are the reported overt effects that can be associated with the mishandling of imazapyr. These effects can be minimized or avoided by prudent hygiene practices during the handling of the chemical, and with the proper personal protective equipment (USDA, 1999).

A 1999 risk assessment, prepared for the USDA Forest Service, quantified the risk to the general public from the commercial use of imazapyr at an application rate of 0.15 lb a.i./acre, with results shown in Table 2. The exposure scenarios utilized in this study are similar to the ones conducted in the glyphosate assessment. Both show a series of “worst-case” exposure scenarios.

Table 2 – Quantitative Summary of Risks for the General Public – Imazapyr

| Activity | Scenario | Dose (mg/kg/day) | Hazard Quotient |
|---|---|---|---|
| Direct spray | Naked child, entire body surface, wash after 1 hour | 0.000383 – 0.158 | 0.0002 – 0.1 |
| | Young woman, feet and legs, wash after 1 hour | 0.0000385 – 0.0159 | 0.00002 – 0.01 |
| Walking through treated area | Dermal absorption, contaminated vegetation | 0.000870 – 0.2447 | 0.0003 – 0.1 |
| Contaminated water | 13.3 kg child consuming 1 liter shortly after an accidental spill of 200 gallons of a field solution into a pond 1 m deep. | 0.0083 – 1.28 | 0.003 – 0.5 |
| | 70 kg adult consumes contaminated water for a lifetime. 0.011 mg/L – 0.43 mg/L concentration in water. | 0.0000176 – 0.0369 | 0.000007 – 0.01 |
| Consumption of contaminated fish | 70 kg adult angler consuming fish shortly after an accidental spill of 200 gallons of a field solution into a pond 1 m deep. | 0.00041 – 0.0256 | 0.0002 – 0.01 |
| | 70 kg adult Native American subsistence user consuming fish shortly after an accidental spill of 200 gallons of a field solution into a pond 1 m deep | 0.00198 – 0.125 | 0.0008 – 0.05 |
| | 70 kg adult angler consuming fish from contaminated water over a lifetime. 0.011 mg/L – 0.43 mg/L concentration in water. | 0.000000126 – 0.00243 | 0.00000005 – 0.001 |
| | 70 kg adult Native American subsistence user consuming fish from contaminated water over a lifetime. 0.011 mg/L – 0.43 mg/L concentration in water. | 0.00000102 – 0.01183 | 0.0000004 – 0.005 |
| Consumption of contaminated vegetation | Berries shortly after spraying | 0.00085 – 0.124 | 0.0003 – 0.05 |
| | Berries, time 0 to day 90 | 0.00036 – 0.075 | 0.00014 – 0.03 |

Notes: mg/L – milligrams per liter in water
Source: (USDA, 1999)

As shown in the table, based on an assumed application rate of 0.08 lb a.i./acre for the low and 2.5 lb a.i./acre for the high, the worst-case risk scenarios result in a dose significantly lower than the EPA reference dose of 2.5 mg/kg/day, using a dog NOAEL of 250 mg/kg/day and an uncertainty factor of 100. This NOAEL appears to be the most appropriate and is supported by additional NOAELs in rats and mice as well as a number of studies on potential reproduction and developmental effects. The hazard quotient is the ratio of the estimated level of exposure to the reference dose or some other index of acceptable exposure. Based on the results of these scenarios, no hazards are apparent for the general public (USDA, 1999). It should be noted that the proposed rate of application of imazapyr in the permit application is 2 ounces/acre, or 0.125 lb a.i./day, less than the application rates assumed in the risk scenarios.

All of the anticipated exposures, most of which involve highly protective assumptions, are below the RfD by at least a factor of 2. The use of the RfD, which is designed to be protective of chronic or lifetime exposures, is itself a very conservative component of the risk characterization because the duration of any plausible and substantial exposures is far less than lifetime. For longer-term exposure, the consumption of contaminated vegetation is below the level of USDA concern by a factor of 10 (USDA, 1999).

#### Effects on Subsistence Resources

Several studies, including acute and chronic toxicity studies on a variety of mammalian species, show that imazapyr and glyphosate do not bioaccumulate in animals. Study results are discussed in previous sections of this document. In addition, risk assessments have been conducted, assuming a worst-case scenario of human exposure through the consumption of subsistence foods. The results of these assessments indicate no risk to the general public from the use of subsistence resources.

### *D. Economic Issues*

#### Alaska's Image Regarding Wild Salmon Fisheries

As discussed in previous sections of this document, available toxicity studies are relatively complete regarding the potential effect of both imazapyr and glyphosate on aquatic species. Based on these studies, the low persistence of both chemicals in an aquatic environment, and the required 135-foot buffer zone between the spray area and water bodies, no effects on fish or other aquatic species are expected from herbicide application on Long Island.

In addition, it has been legal to aerially apply pesticides in Alaska for 30 years. In the last fifteen years, DEC has issued three permits for this type of application. DEC also has an active fish monitoring program looking for pesticides in salmon and other fish species and so far finding none. Ground application of herbicides, including glyphosate and imazapyr, has been conducted on Long Island for forestry management, having no effect on Alaska's image regarding wild salmon. Indeed, both imazapyr and glyphosate are routinely applied in many parts of the state during the summer months; the Long Island application will not represent a marked increase in the total volume of these chemicals being used in the state.

## V. Comments and Coordination

### *A. Agency Coordination*

Staff within DEC, including experts in geology, contaminant fate and transport, and pesticides, evaluated the permit application. In addition, DEC coordinated the permit application review with the Office of Habitat Management and Permitting (OHMP), the Division of Mining, Land & Water (DMLW), Division of Forestry, the Alaska Department of Fish and Game (ADF&G), and the Alaska Coastal Management Program (ACMP), all under the Department of Natural Resources (DNR), as well as the U.S. Environmental Protection Agency (USEPA). No comments were received on the original permit application from the State Historic Preservation Office (SHPO), the U.S. Fish and Wildlife Service (USFWS), or the U.S. Forest Service (USFS). Therefore, no follow-up coordination was conducted with these agencies. In a letter dated August 30, 2005, DNR stated, “According to the amended permit application, the only changes being proposed by Klukwan, Inc. are the use of Competitor in place of R-11 as the surfactant and the addition of In-Place as a drift inhibitor. Since we have already recommended the use of Competitor as a surfactant, DNR does not have any additional comments to offer on the amended aerial pesticide spraying permit.” During the public comment period, comments were received from the USFWS on the amended permit application regarding proximity of spraying to eagle nests, which were considered.

### *B. Public Coordination*

Formal public notice for the permit application began on September, 19, 2005. In addition, DEC posted the notice online (http://www.state.ak.us/dec/eh/pest/klukwan.htm) in accordance with state requirements and published the notice in both the Ketchikan Daily News and The Island News on September 19, 2005 and September 26, 2005. This formal comment period ended October 31, 2005. We received approximately 918 comments, including oral testimony provided during two DEC-sponsored public hearings held in Hydaburg and Craig on October 14, 2005. Comments related to specific topics are addressed in the previous sections. It should be noted that of the comments received, over 745 were a standardized wording, chain e-mail expressing general opposition. In addition, DEC received some comments supporting issuance of the permit.

## VI. Permit Stipulations

The following standard conditions and permit-specific stipulations are required as part of Permit #06-0301-07-FORAIR-01:

1. The pesticide label will be followed at all times;
2. Pesticides shall not be applied directly to the waters of the State;
3. Pesticides shall not be applied within 135 feet of waterbodies or wetlands;
4. Records shall be maintained and available to DEC upon request. These records shall contain the reasons for spraying, method and time of application, duration of treatment, and the quantity of pesticide used;
5. All pesticide containers will be triple rinsed, punctured and disposed in an approved landfill. Do not contaminate water by cleaning of equipment or disposal of equipment washwater;
6. All safety requirements specified on the pesticide label will be strictly adhered to;
7. The permittee shall report any spill or accident, alleged accident or complaint to the DEC Pesticide Program immediately after its occurrence;
8. Pesticides shall be applied using properly calibrated equipment in strict compliance with general safety precautions;

Permit-Specific Conditions –

1. The permittee shall submit a written “Summary of Treatment Results” (18 AAC 90.535) within 90 days after the permit expires, including dates of treatments, total amount of each pesticide used, assessment of success or failure of the treatment, and any observed effect on human health, safety, or welfare to animals or the environment;

2. The pilot(s) shall be certified as a commercial Alaskan applicator in Category 11, Air Application, and at least one person in the ground crew shall be certified in the commercial applicator Category 12, Forest Pest Control. For the latter certification, Category 2, Demonstration and Research Pest control, may be substituted;
3. The aircraft and pilot shall be properly licensed to operate under FAA regulations, Part 137;
4. Updated/current documentation of insurance shall be provided to DEC prior to any spray activity;
5. The aircraft spray equipment shall be certified as appropriate for the application by a representative approved by the Alaska Department of Environmental Conservation, Pesticide Program. In addition, there must be a method of radio communication between the aircraft and ground supplied by the permittee to all DEC representatives;
6. The operation may be halted at any time by a representative of DEC;
7. The plots shall be laid out in such a manner that the borders are at least 135 ft. from the nearest shoreline, standing water, or stream. Plots shall be marked in a conspicuous manner visible to the pilot, DEC observers and operations director;
8. Spray operations shall not be conducted when the wind velocity exceeds 5 miles per hour. The operations director shall have available a device for measuring the wind velocity. The wind speed will be recorded every half hour during the application;
9. It shall be demonstrated to the DEC representative that the spray system, pump pressures and nozzles have been selected to provide a droplet spectrum whose volume median diameter (vmd) is no less than 400 microns and no droplets are smaller than 150 microns;
10. The spray apparatus shall be equipped with a pilot-operated, reverse suction cut-off system;
11. Pesticide containers shall be stored as per label and 18 AAC 90 requirements;
12. Persons shall not be transported in the hopper of the spray aircraft and pesticides shall not be transported in the hopper unless in unopened containers except from the operating airstrip to the spray area when operations are in progress;
13. The applicator will contact and advise DEC of the spray dates and application procedure prior to application;
14. Pre and post application (just prior to application time and 1 hour post application) environmental sampling will be conducted, in accordance with a DEC-approved sampling plan;
15. This permit authorizes a single application event. It is anticipated that this application event could last up to three days, depending on weather conditions. Multiple seasons of application are not authorized;
16. Pesticides shall not be applied within 1/2 mile (2,640 feet) of the historic Howkan Village site or the Koianglas site, within 1,000 feet of any eagle nest between March 1 and May 31, or within 330 feet of any bald eagle nest at other times; and

17. The permittee will reimburse the department for all travel expenses associated with the permit.

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# IX.  Appendix

Appendix A		Map of Long Island

# Long Island Spray Project