Pipe and Lucerne Lakes
2005 Hydrilla Eradication Project

A n n u a l R e p o r t

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INTRODUCTION

Pipe and Lucerne Lakes are located within the cities of Maple Valley and Covington in south King County. In 1994 hydrilla (*Hydrilla verticillata*), a Class A noxious weed, was discovered in the lakes, becoming the only known infestation in King County and the Pacific Northwest. The Washington State Department of Ecology (State) required immediate action to eradicate the weed, and work began in 1995, continuing to the present. While different eradication methods have been used over the years, the extent of the infestation and the existence of a tuber bank have prevented total eradication to date.

In 2005, a small hydrilla population continued to exist in the lakes. This was the third year of using a method that combines the use of slow release herbicide, hand-pulling and frequent diver and snorkel assessment. This was the second year in which a tuber survey was done as well. Herbicide and hand-pulling directly affected the plant and its ability to thrive, whereas assessment helped King County and its contractors understand the infestation and how to best manage the project to insure success. This document summarizes the 2005 treatment season.

HISTORY OF TREATMENT

For several years in the early 1990s it was known that an unusual plant species inhabited Pipe and Lucerne Lakes, but at that time hydrilla (*Hydrilla verticillata*) was misidentified as *Egeria densa* (K. Hamel, pers. comm). In 1994, King County tentatively changed the plant identification to hydrilla, based on samples taken during the King County Aquatic Plant Mapping project done on over 36 area lakes.

In late May of 1995, the state confirmed that the plant was *Hydrilla verticillata*, considered to be one of the world's worst aquatic weeds. Steps were taken to have hydrilla listed as a Class A noxious weed in Washington State, which requires eradication measures. At that time the lakes were in unincorporated King County, so the County became the agency responsible for managing the eradication effort. In the summer of 1995, the County hired Resource Management Inc. (RMI) to apply the herbicide Sonar™ (active ingredient fluridone) to control the weed. RMI maintained herbicide levels from 10 to 20 ppb in the lakes over eight weeks in summer.

The hydrilla proved sensitive to the use of the herbicide, but based on advice from California, the County understood that the tubers were long-lived and did not necessarily germinate each year. This required a multi-year approach to eradication. Tubers have been known to be viable for up to ten years and are not necessarily affected by herbicides. Because of the tuber bank, one herbicide treatment was clearly not going to be sufficient for eradication, so the project was extended, and whole lake herbicide treatments were applied from 1995 to 2000. This action greatly reduced the weed throughout both lakes, although localized populations continued to exist.

In the late 1990s a lawsuit was filed in Oregon entitled 'Headwaters Inc. vs. Talent Irrigation District' that called into question whether aquatic herbicides were considered pollutants. In 2001 the Ninth Circuit Court of Appeals decided that in the Talent case aquatic herbicides should be considered pollutants and held to the standards of the National Pollution Discharge Elimination System (NPDES) permitting requirements under the Clean Water Act (CWA). Herbicide treatments were stopped during the summer, while the State put the appropriate permits in place.

During the 2001 season SCUBA divers surveyed the littoral zone of the two lakes for hydrilla, hand pulling plants as they were found. In 2002 the DOE set up an aquatic herbicide licensing system under NPDES, but diver hand-pulling was seen as an effective treatment in Pipe and Lucerne Lakes, so it was again the control method of choice in 2002. However, in October 2002 significant growth of hydrilla was found by State and spot treated by AquaTechnex with Aquathol Super K granular herbicide.

Initially, biological control in conjunction with herbicide was considered as a method of treatment in 2003. However, Kathy Hamel from the State learned of an eradication technique that was successful in California. California used low levels of slow release granular herbicide with the active ingredient fluridone in lakes during the growing season for several years until no hydrilla was found for three years. At the beginning of the 2003 treatment season, King County and the State decided to adopt the California strategy. To monitor the success of this new plan, King County internalized the project doing the herbicide treatments

and snorkel surveys using County staff, hiring a consultant only to perform the diver surveys. This allowed the County to create comprehensive maps and detailed reports about the patterns and locations of the hydrilla, as well as maintain control over the amount of herbicide used and the precise areas of coverage.

With the success of the 2003 and 2004 treatment season, King County followed the same procedures in 2005. The work was divided into assessment and treatment tasks; assessments were handled by county snorkelers and contracted SCUBA diving surveys, as well as a diver tuber survey. King County performed the snorkel survey in June and August in conjunction with the EnviroVision SCUBA divers who performed a third survey in October with county support.

King County continued to use herbicide applications and hand pulling as the treatment methods for hydrilla control. The County performed herbicide treatments three times during the summer, starting in May. During the survey assessment, both snorkelers and divers hand pulled plants when appropriate. In addition, an exploratory tuber survey was performed at the end of the season to assess the extent of the tuber bank.

Several King County staff members are involved in the hydrilla eradication project to insure its success. Sally Abella, King County Lake Stewardship Program Manager, acted as project manager: tracking the budget, assigning tasks, and providing technical expertise, as well as sieving mud during the tuber surveys. Beth Cullen, King County Water Quality Planner I with the Lake Stewardship Program, acted as field manager, project coordinator, and licensed applicator for the treatments. Michael Murphy, also of the King County Lake Stewardship Program, assisted with the snorkel and tuber surveys. Susan Raney, an intern with King County Water and Land Resource Division, assisted in herbicide treatments, herbicide sampling and snorkel surveys.

TREATMENT AND PUBLIC INPUT

Both hand-pulling and herbicide were used in treating hydrilla. The Sonar PR™ was the main control method covering the majority of the littoral zone in the lakes, and the hand-pulling was an excellent follow up to remove isolated, small areas of hydrilla. These treatment methods combined with frequent assessment are still proving to be effective in Pipe and Lucerne Lakes.

On May 8th, 2005 a public meeting was held to give citizens a chance to learn about the program, what the goals were, and the treatment process for 2005. Four people attended the spring meeting to learn about the 2005 treatment season. On December 8th 2005, another public meeting was held to pass on results and answer questions. Six citizens attended the meeting to learn about the 2005 findings.

Herbicide

Herbicide treatments can be complicated and time-consuming events. However, they are the most effective option against hydrilla because of the ability to target all areas of infestation and the continual inhibitory effect on the plants. Herbicide application is currently the most successful option when eradication is the goal.

As directed in the NPDES permit, a flyer went out to the community in the Pipe and Lucerne watershed three weeks prior to the first Sonar PR™ application, informing them of the treatment plan and the scheduled herbicide application dates. Within 24 hours before each herbicide application, every property on the lake was posted with signs stating that the herbicide treatment would be occurring.

Using the 2004 hydrilla location map and concentration levels from the herbicide monitoring data, application areas and herbicide amounts were calculated for the first treatment. All areas that were known to have hydrilla in 2003 were treated again in 2005. Even if hydrilla was not currently present, the areas were still treated. According to the prescribed treatment method, areas will continue to be treated for three years after the last hydrilla plant is found in that area. The goal of treatment was to make sure that all potential sites of hydrilla were covered, and if new infestations were found through the season, treatment areas could be adjusted to include the new locations. No new infestations were found this year, so treatment areas were the same as 2003 and 2004 (Figure 1).

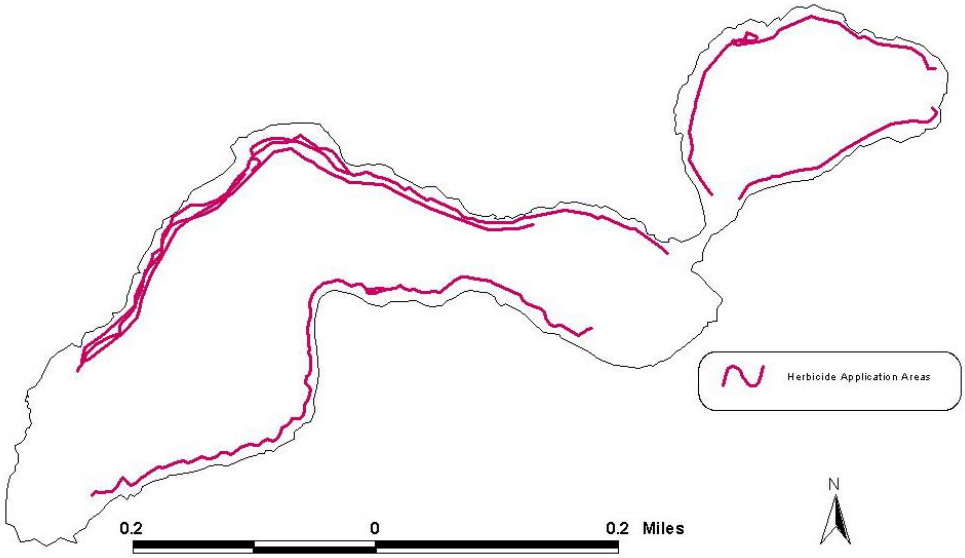

Figure 1: Herbicide Application 2005

Rates of application were calculated based on the acreage of hydrilla infestation, the amount of fluridone necessary to maintain a consistent concentration in the water column and the concentrations found during the 2003 and 2004 treatment seasons. The herbicide threshold for the treatment season was 5 ppb of fluridone present in the water column throughout the summer. In 2003 fluridone levels remained well above 5 ppb for the majority of the summer and into the fall in both lakes. In 2004 the total amount of herbicide was decreased to remain closer to the threshold herbicide level. This year the herbicide amount was decreased even further. Ten acres were treated in Pipe and four acres were treated in Lucerne. The first treatment on May 25th, 2005 spread 39 ppb (25.5 lbs/acre) in Pipe and 17 ppb (9 lbs/acre) in Lucerne; the second treatment in June was calculated at 50 ppb in Pipe (33 lbs/acre) and 22 ppb (12 lbs/acre) in Lucerne; the last treatment in August released 27 ppb (24 lbs/acre) in Pipe and 11 ppb (6 lbs/acre) in Lucerne. The total over the course of the summer was 116 ppb in Pipe and 50 ppb in Lucerne, less than the 150 ppb limit. Based on herbicide monitoring (FasTEST) results, the fourth treatment was cancelled in the lakes because fluridone levels remained well above the target.

To insure accuracy, each treatment was mapped using GPS, converted into an ArcView map, and used as a guide for future treatments. As seen in Figure 1 the treatments are following the perimeters of the lakes mostly over the littoral zone of the lakes. Hydrilla is spread along the perimeters of the lake at varying depths and the protocol states that hydrilla locations are to be treated for three years after the last plant is found at that spot.

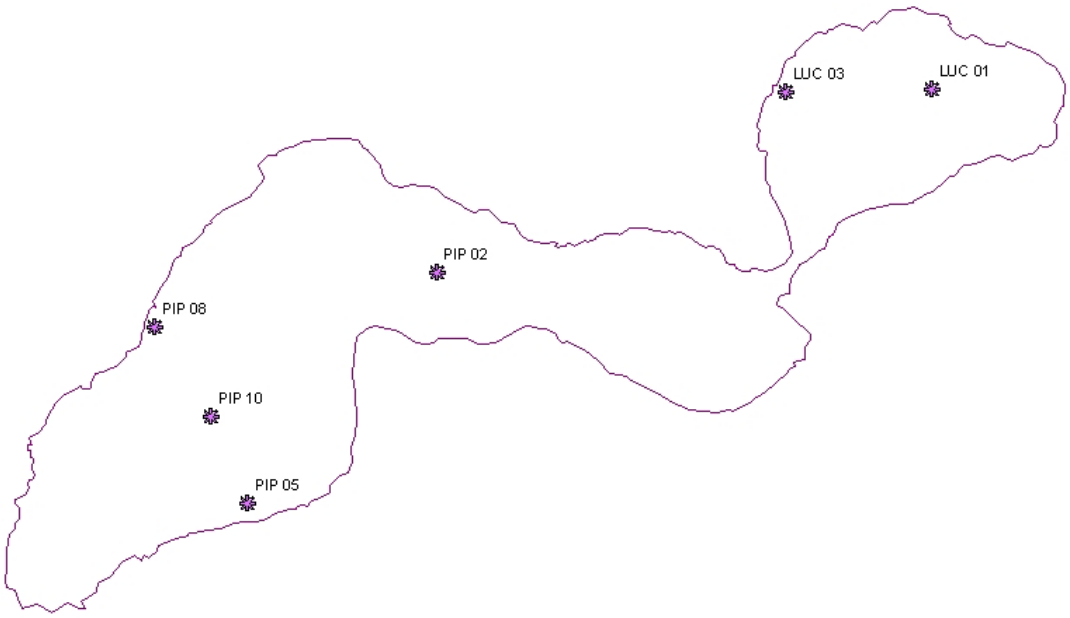

Figure 2: FasTest Locations

The NPDES permit requires monitoring of herbicide levels in the lake during the treatment. Water samples were collected prior to herbicide application and then at 14 day intervals after the first treatment. Samples were taken in treatment areas and the middle of the lakes (Appendix A). After each sampling event, the samples were shipped overnight to SePRO labs for analysis. Results from these tests allowed the County to track the herbicide levels and helped determine the locations and amounts of herbicide for subsequent applications.

In 2005 the first herbicide treatment occurred in late May to insure that when the hydrilla began to sprout it would come in immediate contact with target levels of fluridone. A small amount of fluridone was applied because residual levels were found in the lakes prior to the first treatment. However, the fluridone levels did not rise to the target level as expected and the second herbicide treatment was increased to the usual 50 ppb. To maintain the 5 ppb level throughout the remainder of the growing season, another Sonar PR™ application was done in early August. During most of the summer, levels stayed between 5 ppb and 10 ppb Pipe Lake and never exceeded 10 ppb (Figure 3). Fluridone was found in moderate levels throughout the lake, including areas that were not treated. This gave the County confidence that areas which were not treated directly, still came in contact with sufficient fluridone to kill plants.

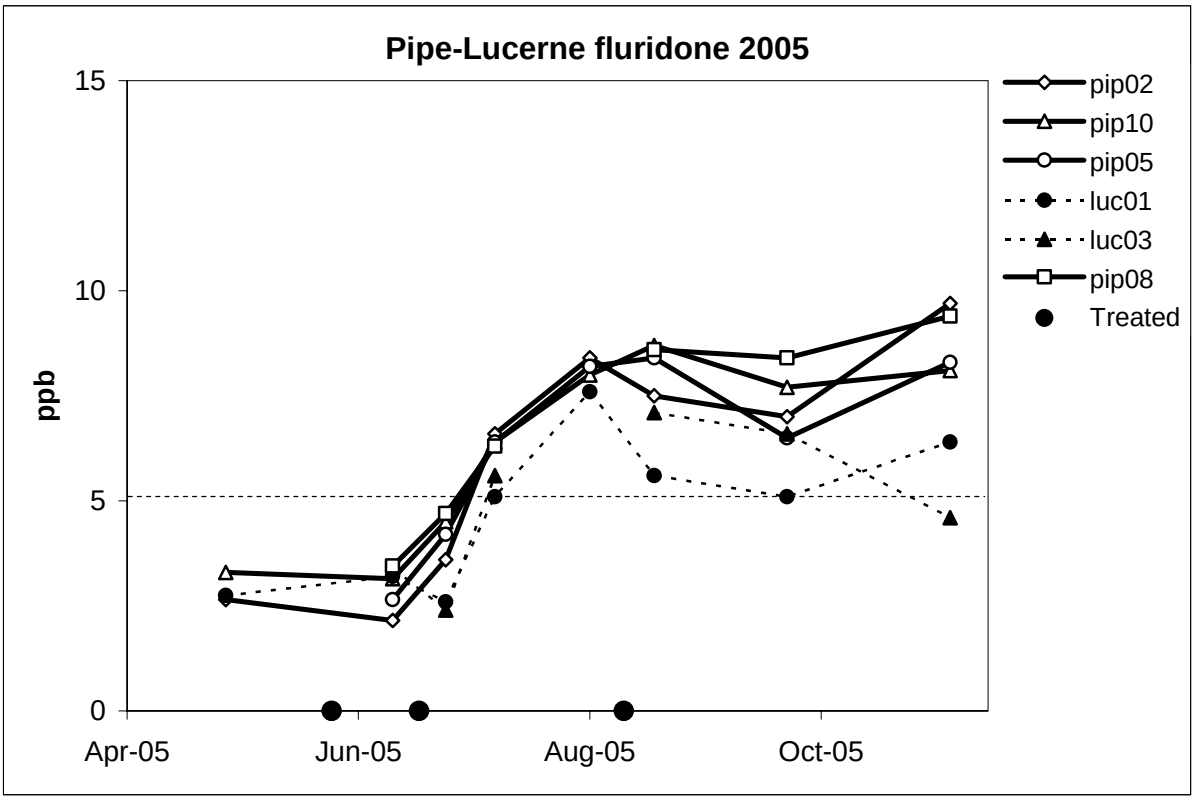

Figure 3: Herbicide Levels

Water quality testing included collecting temperature profiles and Secchi depths for both lakes. Temperature data illustrated where stratification occurred in both lakes and suggested how the herbicide might be distributed in the water column (see Appendix B). Data showed that the lakes were stratified by mid May, before the first treatment. This suggests that the fluridone did not mix between the epilimnion (top water) and the hypolimnion (bottom water). Since plants were found both in the epilimnion and hypolimnion, it was imperative that the granular herbicide was applied over both the shallow and deeper water to insure all plants came into contact with the fluridone.

Diver Hand-pulling

Hand-pulling of individual plants was done by snorkelers and SCUBA divers during assessments. Boat staff recorded the location with a GPS and then the divers/snorkelers hand-pulled the plants and place them in zip lock bags stored on the boat. Hand-pulling can be time consuming and the tubers are difficult to remove. Tubers are often rooted deep into the sediment and when plants are pulled, they can snap off at the stem, leaving the tubers behind. Divers pulled plants when they were found. There were few plants found in the lakes this year, and most of the plants were easy to pull although not all had tubers attached.

ASSESSMENT

Diver surveys are the most direct method to assess how herbicide treatments affect hydrilla and the other aquatic plants in the lakes. These assessments not only helped direct the treatments, but also collected important information for future treatment seasons. In addition to the regular diver and snorkel surveys, this year an informal tuber survey was done to assess the extent of the tuber bank.

Assessment throughout the growing season was a critical part of the project. The surveys were performed two ways: (1) snorkeling, and (2) SCUBA diving. SCUBA divers carried out three surveys this year in June, August, and October. Snorkel surveys were done in conjunction with the June and August SCUBA surveys. An exploratory survey to gauge the hydrilla tuber bank was conducted in conjunction with the August survey.

The assessment portion of the hydrilla project evaluated the success of eradication efforts. Without consistently checking the plants for herbicide damage and gauging the extent of populations, there is no way to measure the effects of treatments. This year, a similar hydrilla growth pattern to recent years emerged, but the plants were in much lower densities. No plants were found in the shallow waters this year; all plants were found at depths of nine to 13 feet. No plants were found in either lake in June. The August survey produced ten plants in nine to 13 feet in Pipe and by October, 13 plants were found in deeper water from 11 to 13 feet. Most of the plants were solitary, with one group of three plants found in August and one group of four plants in October.

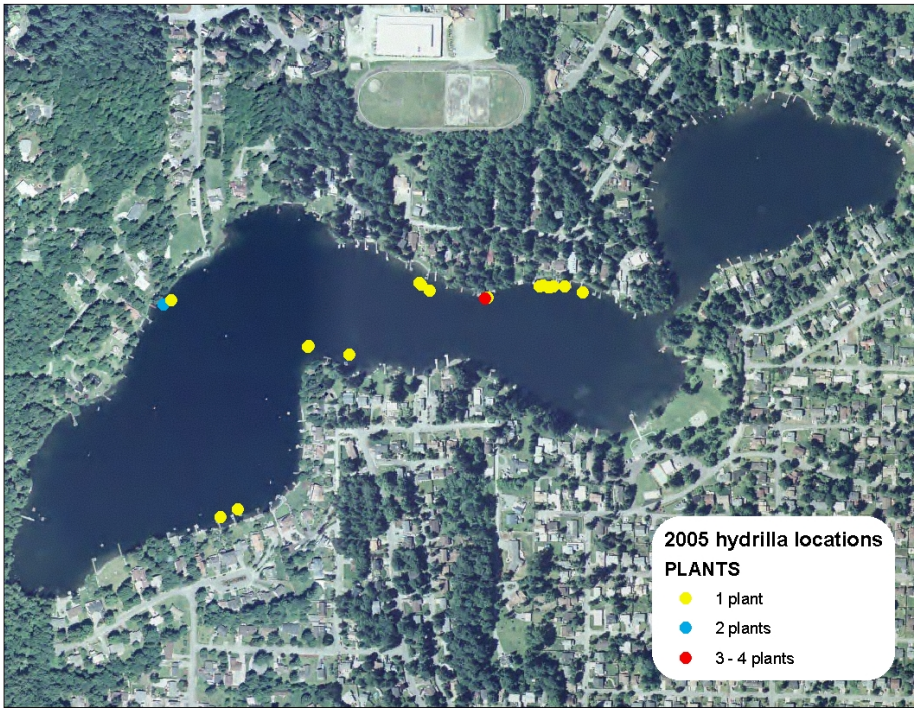

Figure 4: 2004 Hydrilla Locations

Only Pipe Lake had hydrilla in 2005. The areas of infestation were very similar to previous years. Areas in 2003 that were heavily infested continued to be the spots of infestation. However, areas that once had 20+ plants had only one or two plants. It is possible that the tuber bank is finally reaching exhaustion. GPS points and notes were taken of the exact plant locations, allowing for easy illustration of hydrilla dispersal in the lakes (Fig. 4).

Overall, hydrilla has decreased from 474 plants found in the lakes in 2003, 146 plants in 2004 and 23 plants found in 2005. In 2003 and 2004 each hydrilla plant was counted as an individual and sometimes where the densities of plants were high no hand-pulling occurred. It is possible this led to double counting which could have inflated the number of plants present in 2003 and 2004, but there is still a significant decrease in the amount of plants found in 2005.

Assessment results show that the treatment methods used over the last three years have been very effective. Based on the original 474 plants documented in 2003, there has been a 95% reduction of the population to date. No plants were found in Lucerne in 2005 and only one plant was found in 2004. The number of single plant locations has decreased measurably, with 74 single plants being found in 2003 and 17 being found in 2005.

The herbicide treatment also has had an effect on the native aquatic plant populations in the lake. The EnviroVision SCUBA team recorded other submerged aquatic plants observed during the hydrilla surveys. Table 1 is a list of all aquatic plants and macro algae that have been documented in the lakes in 2005.

Table 1: Aquatic plants and macro algae in the lakes

List of submersed and emergent aquatic plants and macroalgae observed at Pipe/Lucerne Lakes	
Scientific Name	Common Name
EMERGENT PLANTS	
Iris pseudacorus	Yellow-flag iris
Isoetes spp.	Quillworts
Juncus spp.	Rushes
Polygonum hydropiperodies	Waterpepper
Scirpus	Bulrushes
Solanum dulcamara	Bittersweet, nightshad
Typha spp.	Cattails
FLOATING-LEAVED PLANTS	
*Ludwigia palustrs**	Water pusland
Nymphaea odorata	Fragrant waterlily
SUBMERSED PLANTS	
Hydrilla verticillata	Hydrilla
Potamogeton robbinsii	Fern-leaf pondwwed
Potamogeton spp.	Thinleaf pnodwwed
Potamogeton zosteriformis	Flat-stem pondweed
Spirea spp.	Spirea
Utricularia spp.	Bladderworts
ALGAE	
Chara	Muskgrass, stonewort
Nitella spp.	Nitella

*Present in Lucerne Lake this year and not in previous years

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The divers observed that the native plant populations remain very low in both lakes and show signs of herbicide bleaching. There is no discernable difference between the level of damage observed in treated versus untreated areas. It was noted by the divers that the macroalgae appeared to have increased since 2004. Nitella (*Nitella spp*.) was found in shallower waters of six or seven foot depths. There were dense mats of macroalgae in several areas of the lakes, which obscure divers vision when searching for hydrilla.

In previous years a comprehensive plant survey was done along reference transects to survey what other plants were in the lake and the level of herbicide damage. That was not done in 2005, it is anticipated that comprehensive plant surveys will begin again when herbicide treatments have ceased.

After each assessment a complete report of the diver survey was submitted by the consultant. These summaries have been attached as an appendix to the report (Appendix C).

Tuber Survey

Hydrilla tubers can lay dormant for up to five years in the bottom sediments of lakes; referred to as the “tuber bank.” While the tubers are dormant it is likely that herbicide in the water column has no effect on them, and the tuber banks may be capable of re-infesting a lake even after the weed has been seemingly eradicated. On August 24, 2005 an exploratory tuber

survey was performed at Pipe and Lucerne Lakes to evaluate both tuber sampling methods and the extent of the tuber bank. This exercise better informed County staff how the tuber bank is behaving and confirmed findings from 2004.

The sampling team consisted of three personnel from Envirovision: two SCUBA divers and a field technician. Four County staff members also were present, with three lending boat support and one on the shore sieving bottom samples. Areas for the survey were chosen based on presence of plants. The day prior to the tuber survey, a general hydrilla survey was performed by the SCUBA divers and instead of pulling the plants, locations were staked to be found the next day for the tuber survey. This gave staff confidence that sediment samples were taken from likely areas for tuber banks.

To collect the sediment sample a square meter quadrat made of PVC pipe was placed over the plant. The plant was then removed and one diver would position a plastic bag placed in a crate over the area to be excavated and the other diver would use a trowel and dig as deep as it took to reach the hard pan and shovel it into the crate. The crate was then lifted by the boat support staff and excess water was drained off.

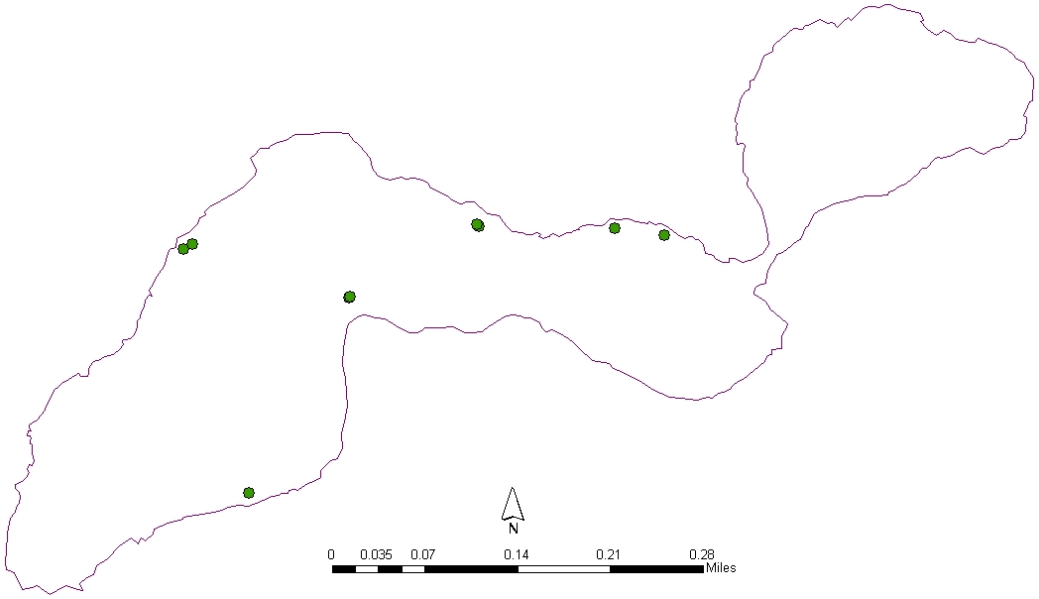

Figure 5: Locations of transects and points for the tuber survey

After the samples were bagged they were taken to shore by canoe and were washed through a fine sieve, which separated water and silt from larger objects. After sieving was complete, the residue was placed in zip lock bags and taken to King County for analysis.

Staff picked through all the residue but found only on tuber, which as known to be present because the hydrilla snapped off from the tuber prior to the excavation. However, this turned

into an excellent control for both the excavation and the sifting on land. Since that tuber was found, the divers were likely digging deep enough to reach the tuber bank, and the sifter was able to locate the tuber in the sediment. This increased our assurance that if there were other tubers in the sediment sample, they would be found.

CONCLUSIONS

The 2005 treatment season of the hydrilla eradication project proved to have very positive results. This was the third year King County was directly involved in control activities, and it was instructive to see how the three seasons compared. The over winter persistence of the fluridone was a surprise, as residual herbicide was not anticipated to linger in the system. This influenced the first treatment and the County decreased the amount of fluridone applied. The fluridone levels did not come up to the targeted 5 ppb in the anticipated two week time frame. The second treatment in June brought the fluridone levels up to the target level and then the treatment season followed much the same pattern as 2003 and 2004. A smaller amount of herbicide was used in 2005 and the level remained above target, which means the amount of herbicide may also be lower in 2006.

Fewer hydrilla plants were found this year than last year (146 in 2004 and 23 in 2005). All located plants were found in Pipe Lake during the August and October survey. No plants were found in Pipe in the June survey. The tubers apparently persist in the deeper waters, between nine to 13 feet deep. No hydrilla was found in shallow water this year. The highest infestation areas continue to be "hot spots" in Pipe Lake. However, each year the densities appear to be decreasing. No plants at all were found in Lucerne during the 2005 treatment season.

Throughout the summer, other plants such as *Typha* spp., *Nymphaea odorata,* and other submerged aquatic weeds also showed signs of herbicide damage. However, the bleaching of hydrilla was the most profound and easily spotted among the other plants. Divers noted the increase of macroalgae in the system. Dense mats can obscure divers' vision and mask hydrilla. While fluridone is in the water column this is not a major concern but when treatment stops, the marcoalgae may make it difficult to spot hydrilla if it recovers.

Although the tuber sampling event was exploratory only, the information gained from it was very useful. It is very encouraging that no unanticipated tubers were found during this small survey. This suggests that the treatment techniques are working, and the tuber bank maybe nearly exhausted. Based on these findings a tuber survey will likely not be done next year. The lack of an extensive tuber bank coincides with the drastic decrease in hydrilla plants.

BUDGET

Table 2: Hydrilla Eradication Project Budget

Hydrilla Eradication Budget (as of Novmber 2005)		
Task	**Cost: 2005**	**Est. 2006 Costs**
Task 1: Project Mangement	$12,158.58	$13,100.00
Task 2: Treatment	$36,856.42	$40,000.00
Task 3: Monitoring and Assessment	$29,154.78	$39,500.00
Total	**$78,169.78**	**$92,600.00**
Washington Department of Ecology	$71,447.18	TBD
Cities Match	$6,722.60	TBD

In 2005 the State awarded a grant to King County to perform the hydrilla eradication work (Table 2). The work was divided into three major tasks: project management, treatment and assessment. Project management included tasks such as report writing, financial tracking, public outreach, and project organization. Treatment included all aspects of herbicide treatment in the lake, such as purchasing equipment and herbicide, creating treatment maps, herbicide application and concentration assessments. The third task was snorkeling and diver assessment, which included staff time spent surveying the lake, writing reports and creating survey maps.

By the end of November 2005 a total of $78,169.77 was spent by King County, of which $71,447.18 was considered eligible for grant reimbursal, due to differing third burden rates between King County and Ecology. The cities of Maple Valley and Covington contributed the necessary matching funds to the grant for a total of $6,722.60. The table also includes the estimated costs for the 2006 treatment year.

FUTURE

The 2006 hydrilla eradication treatment methods will stay essentially the same as the past three years. Slow release granular Sonar PR™ will be the herbicide used and rates of application will most likely remain the same. The fluridone concentrations stayed well within target range in 2005 although the amount of herbicide was decreased slightly. Both SCUBA and snorkeling surveys will continue to make sure that the lakes are being surveyed as comprehensively as possible.

A tuber survey and a comprehensive plant survey will not be done in 2006. The results of the tuber survey were consistent with the idea that the tuber bank is being exhausted. The comprehensive plant survey will not be done until herbicide treatments are terminated and the regrowth of the native plants will be tracked.

Hydrilla has decreased from 474 plants found in 2003 to 146 plants in 2004 to only 23 plants in 2005. Lucerne was hydrilla free this year, but herbicide application will continue in the lake to ensure that all plants are eradicated. This is a significant decrease in two years and it is hoped that Pipe Lake is not far from being hydrilla free as well.

APPENDIX

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