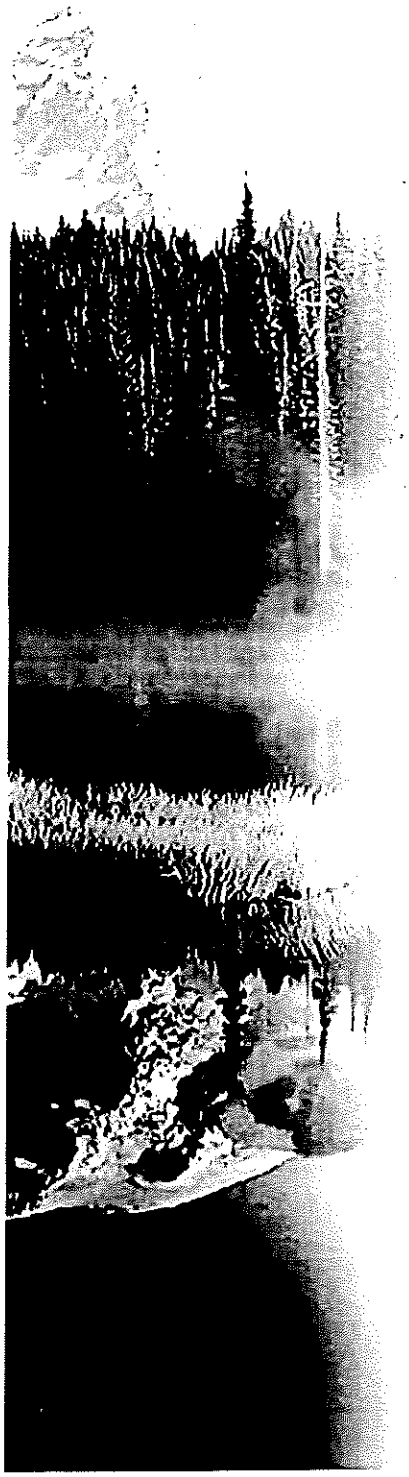

Sacheen Lake Integrated Aquatic Vegetation Management Plan

August, 2002

Prepared for:

Sacheen Lake Water and Sewer District

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INTRODUCTION

Sacheen Lake supports a variety of beneficial uses including fishing, wildlife observation, swimming, water skiing and boating. This lake is heavily used by lakeshore residents and the lake is regarded as an amenity by the local community, with property values around the lake being influenced by this condition. There is one public boat launch on the lake which is open April through November and non-resident use of lake is moderate. Unfortunately, the lake has for many years exhibited growth in aquatic plants and algae which has hindered the beneficial uses to some extent. A lake restoration project performed between 1990 and 1998 appears to have controlled the growth of algae and temporarily controlled a serious infestation of Eurasian watermilfoil (*Myriophyllum spicatum*, referred to as 'Milfoil' herein). The Milfoil is believed to have been introduced into the lake around 1970. In recent years (since the completion of the restoration project) the continued growth of Milfoil has presented a considerable challenge to the lake residents which prompted this search into additional control or eradication techniques as well as a reassessment of the lake users goals and objectives for aquatic vegetation management.

This Integrated Aquatic Vegetation Management Plan (IAPMP) has been prepared as an effort to develop a holistic, integrated approach to controlling and managing the aquatic plants and algae in Sacheen Lake and thus protecting the beneficial uses, wildlife habitat and water quality. The process followed in the preparation of this Plan is outlined in the Washington Department of Ecology (WDOE) Aquatic Weeds Management Fund Program Guidelines (**WDOE 2001a**), the publication titled "A Citizen's Manual for Developing Integrated Aquatic Vegetation Management Plans" (**WDOE 1994**) and recent WDOE vegetation management plan guidance (**WDOE 2001b**).

LAKE MANAGEMENT HISTORY

The Sacheen Lake residents were aware of the need for lake protection as early as 1970 when they organized themselves to form the Sacheen Lake Betterment Association (SLBA). The residents further prepared for managing the lake with the formation of the Sacheen Lake Sewer and Water District (SLSWD) in 1982. Even though the Sewer District was not voted funds to proceed with the construction of a sewer treatment system at the time it was formed, the fact that the District existed allowed the residents to carry their concern into action when lake problems became apparent. The problems that manifested themselves during the late 1970's were rising lake levels, rapidly expanding infestation of Milfoil and declining water clarity.

Following consultation with the WDOE the lake residents became aware that grants were available for water quality investigation and restoration through the State Centennial Clean

Water Fund. These grants could help them understand and address their lake problems. So, a grant application was prepared, the Sewer District was reactivated and a full lake restoration process was started in 1989.

Phase I Water Quality Assessment

The Phase I water quality assessment was conducted in 1990/91 by the Biology Department at Eastern Washington University (EWU-Biology). This study indicated that phosphorus was the major nutrient which was limiting algal growth. Further, phosphorus loading to the lake, from both external and internal sources, placed the lake in a eutrophic state where water clarity would continue to decline, algal growth would continue to increase and dissolved oxygen would continue to be depleted in deeper waters. The tributaries were identified as the primary source of phosphorus to the lake and the existing on-site wastewater systems serving lakeshore homes were estimated to be the second largest contributor of phosphorus.

The lake's Milfoil infestation was mapped during the Phase I effort and this was felt to have started around 1970 although it was not identified until the mid 1980s. The rapidly expanding Milfoil beds were also estimated to be contributing to the nutrient enrichment problem by pulling nutrients from the sediments and releasing them into the lake water (**Soltero et al. 1991**).

The recommendations formulated from the Phase I project were to work towards a level of phosphorus loading more consistent with a mesotrophic state. This was felt to be possible if a 20% reduction in loading from the tributaries was achieved along with a 50% reduction in internal loading through installation of a sewer system. To achieve the tributary reduction, further study of the watershed was recommended so that non-point sources of phosphorus could be identified and controlled. Because of the expected expense of sewer system construction and also the uncertainty of the effectiveness of this (in the short term) a whole-lake herbicide treatment was recommended to eliminate the Milfoil infestation and directly reduce the release of phosphorus from this plant mass and from the sediments. This effort would also serve to improve the recreational and wildlife uses of the lake.

Part of the Phase I project was to survey and inventory all aquatic plant populations in the lake. A total of 12 different aquatic plant species were found in the lake, the predominant species being Robinson's pondweed (*Potamogeton robinnsii*) which comprised 68% of the total estimated biomass. *Myriophyllum spicatum* was the second most abundant at 22.1 % of the biomass (**Soltero et al 1991**). Following a snorkeling effort of the entire littoral area, it was determined that there were approximately 70 acres with some Milfoil and many areas were completely choked with topped-out Milfoil growth.

Phase II Restoration Implementation

The Phase II project was conducted between 1991 and 1998 and included elements or tasks which focused attention on the existing problems, both in-lake and in the watershed, and also looked at guiding development and other human activities which could degrade the lake in the future.

The watershed study component of the Phase II project was performed in 1993-94 and provided documentation of non-point sources of pollution (primarily nutrients) in the lake tributaries. This work led to subsequent efforts applying for a Best Management Practice (BMP) implementation grant and preparing guidelines for new development within the lake watershed.
The whole-lake herbicide treatment for Milfoil control was performed in 1995 by lake treatment specialists with Resource Management, Inc. using the product Sonar (active ingredient fluridone) with good success. The target dose of fluridone was 10 to 20 parts per billion (ppb) and this dosage was maintained for over eight weeks with five applications at roughly two week intervals. The treatment was delayed one year waiting for a label change which would allow this product to be used without restriction around water intakes. Otherwise, all treatment design, application and monitoring efforts were accomplished as planned. Follow-up control efforts using benthic barriers and hand removal were necessary, however, following the reintroduction of Milfoil to the lake. This reintroduction most likely came from plants which survived the treatment in the lake's primary inlet which could not be treated with Sonar due to label restrictions. Thus the goal of complete eradication was not achieved, although there was virtually a 100% reduction of Milfoil in the lake proper, and the restoration of full beneficial uses, in the short term.

Monitoring of aquatic plant populations showed that total biomass and the dominance of Milfoil was increasing rapidly prior to the Sonar treatment. One month after the last application of herbicide, however, total plant biomass had decreased approximately 65% and a year later nearly a 100% decrease was seen (with the "plants" found being essentially lifeless stems). This resulted in a reduction of calculated phosphorus release from almost 18 kg/yr in 1994 to 0.5 kg/yr in 1996 (**Soltero et al 1997**).

Phase II project water quality monitoring showed that there was a reduction of phosphorus levels and algal populations following the Sonar treatment, along with a slight improvement in water clarity. The continued presence of Milfoil in the lake, even at very low levels, was a concern, however. The final report for the Phase II restoration stated that continued surveillance and hand removal of returning plants was absolutely necessary. Annual inspections conducted by qualified divers and continued public and land owner education of Milfoil presence and the risks it poses were also recommended (**Resource Management, Inc. 1998**).

Post-Phase II Work

With the completion of the grant funded Phase II project work, the complete financial responsibility for continued Milfoil control fell on the lake residents. With the taxing

capability of the SLSWD, however, it was decided that a Maintenance and Operation measure would be placed on the local ballot to cover additional Milfoil controls as well as ongoing operating expenses. These M & O levies have been approved by the residents and have allowed both inspections and various treatments to be performed since 1998.

Milfoil control work conducted in 1999 and 2000 included an annual diver survey, three to five days per year of diver hand pulling and 2,4-D herbicide applications. The diver hand pulling was performed in areas where sparse growth was found and herbicide was used in spot treatments where it was felt that the growth was too extensive or dense for hand work to be effective. The total area "treated" by divers was typically less than one acre each year and the chemical treatments totaled 14 acres in 1999 and 19 acres in 2000. Note that the 2,4-D was used following the provisions of Enhanced Substitute Senate Bill 5424 which limited applications to twenty percent or less of the littoral zone of the lake. This bill also required that all residents be notified of the proposed treatment 21 days in advance and that buoys marking the treated areas be placed in the lake during the time that water use restrictions were in place. Water rights and water use issues were addressed through the 21-day notice which stated that water should not be used for "irrigation, agricultural sprays, watering dairy animals or domestic uses" (see example notice in the Spring 2000 Sacheen Scope newsletter in Appendix D). The notice further stated that shoreline notices and buoys would be removed to indicate the end of water use restrictions. The 2,4-D applications and diver removal were performed by or under the supervision of experienced aquatic biologists with Resource Management, Inc. The results of these treatments were that Milfoil plant densities were kept low but that the infestation steadily expanded from fragmentation of remaining plants. While targeted monitoring was not performed, information collected during subsequent surveys has indicated that the 2,4-D treatments had an overall efficacy (effectiveness) of 50% to 80%. The overall effectiveness of the diver hand removal was probably lower due to limited visibility and the difficulty of removing all plant parts (especially all roots in gravelly bottom areas and all fragments in large, mature plants).

No herbicide was used in 2001 due to uncertainty about potential liability following the Talent Irrigation court decision. The 2,4-D applications that were made at Sacheen under Senate Bill 5424 were performed without the normal State permit (a Temporary Modification of State Water Quality Standards) provided the treatment was for a pioneering infestation or followed previous treatments. This State legislation was superceded in 2001 by the Talent Irrigation decision.

In spite of the 1999 and 2001 treatments, Milfoil growth in Sacheen Lake has expanded and it has become apparent that a greater level of effort or different approach is needed. This is compounded by the low level of treatment (no chemical application) performed in 2001. It is also felt by the SLSWD Board that a re-assessment of available Milfoil control techniques and of the lake community's aquatic plant management goals and objectives would help direct future efforts.

PROBLEM STATEMENT

Lake User Groups

The primary lake "user group" active in the determination of the problem statement and management goals was the Sacheen Lake Betterment Association (SLBA). The SLBA represents the diverse interests of the lake residents, and has shown an active concern for protecting the lake. The Sacheen Lake Sewer and Water District (SLSWD) is a special purpose district which is administered by members of the SLBA who are elected by the residents. The SLSWD is primarily responsible for work performed using grants and involving hired contractors or consultants.

It is primarily through the SLBA's annual meetings, SLSWD's monthly meetings, and the SLBA newsletter and telephone tree that information exchange was accomplished. Through these avenues Milfoil and lake quality management information is provided to the residents. General feedback obtained at both formal and informal meetings, and also from voting on M & O levies indicated that the SLSWD had wide support for the lake management efforts. In order to provide a more formal opportunity for residents, other lake users and management agencies to provide specific input into the development of this IAVMP and on-going aquatic plant controls, a public meeting was held on September 30, 2001. A special notice about this meeting was mailed to all SLBA members and residents within the SLSWD boundaries and a Public Notice was published in the local newspaper, the Newport Miner. During this meeting a summary of the Phase I and II restoration efforts was given by Mr. Dave Lamb, the SLSWD's lake management consultant. Mr. Lamb also described the post-restoration treatments and the results of aquatic plant surveys that were conducted in August 2001. A questionnaire and IAVMP project summary were provided to the attendees and questions about the lake were answered. The meeting notices, Agenda, IAVMP Project Summary, Sign-in sheet and Questionnaire are presented in **Appendix A**.

The key result of the public meeting was that the attendees reaffirmed their interest in continuing to work to control Milfoil growth to avoid the loss of the "environmental quality" and beneficial uses that Sacheen Lake provides. Further, it was acknowledged that Milfoil is the only plant that presents a significant threat to the lake although other plants do present some hindrance to the lake residents (see **Citizen and Agency Input** section below). While the goal of the restoration Sonar treatment was to completely eliminate Milfoil from the lake, the complete eradication of Milfoil was now seen as an unrealistic goal.

Citizen and Agency Input

The following is a summary of the questionnaires that were completed at or following the September 30 public meeting as shown in **Table 1 in Appendix A**. There were 24 questionnaires completed and submitted either at the public meeting or mailed in afterwards. Of these 22 were lake residents and two were managers or agency representatives. Of those

responding 15 indicated that the water quality in the lake was good, or fair to good, six indicated it was fair and two indicated it was poor. Comments provided on the most important factor about good water quality were that it was clean and/or clear (10 responses), that it was usable (eight responses). Five comments indicated that Milfoil or other aquatic plants were the most important factor about water quality. Occasional other comments indicated a concern for the lake to be free flowing, free of odors, not "polluted", that a sewer system was needed and pesticide use was a concern.

Regarding the rating of the effect of aquatic plants on the usability of the lake, two responses indicated little effect, nine indicated moderate effect and 13 indicated significant effect. Comments on the most important factor about aquatic plants centered on the control of aquatic plants in general (seven comments), control of Milfoil in specific (five comments) and the elimination of Milfoil (four comments). There were also five comments that indicated that the benefits of aquatic plants were the most important factor.

As to the overall usability of the lake, 16 questionnaires indicated that this was good or fair to good and six indicated fair. No responses indicated a poor usability. Comments on usability included recreation (five comments), "weeds" (five comments), clarity (two), water quality (two), water level (one) and overuse by boats (two). Two comments indicated that there were no problems at Sacheen Lake or that problems were under control.

Problem Categories

Informal discussions about the ongoing aquatic plant growth and its control have been held by the SLSWD Board and the SLBA membership over the past three years. The recent public meeting was held for the purpose of discussing the current levels of growth and to solicit input from the residents about aquatic plant management. From these it can be seen that Sacheen Lake is currently experiencing some level of growth that could be considered as a problem. However, based on the relatively recent experience (pre-Sonar treatment) with Milfoil in the lake, most residents are aware of the potential of this plant to create significant impacts to the lake environment. The current and potential problem categories which do or could result from these impacts are listed below. All of the residents who spoke at the public meeting and the majority of those who completed questionnaires were united in their desire to prevent these problems.

- current and potential hindrance to swimming because of excessive plant growth
- potential hindrance to boating and water skiing
- current and potential degradation of fishing and fish habitat
- potential reduction in aesthetic appeal of the lake
- potential decrease in property values

Problem Statement

The Problem Statement developed for this Plan is that Sacheen Lake is experiencing an increase in the growth of Milfoil which if not controlled has the potential to significantly impact (degrade) the human and wildlife uses of the lake.

WATERSHED and LAKE CHARACTERISTICS

The overall quality of lakes is closely related to the quality of the water flowing into them, including the quality of surface streams, overland runoff and groundwater. The quality of the inflows is a function of the quality of the watershed, both near shore and distant. There are human factors involved in lake and watershed quality, as well as other factors, such as the introduction of invasive, non-native aquatic plants.

In order to fully understand the lake system, with its uses and problems, and the opportunities for its protection and management, the watershed and waterbody must be described. The following discussion summarizes the available on Sacheen Lake.

Watershed

Watershed Physical Features. The Sacheen Lake watershed is located entirely within Pend Oreille County, WA, in Water Resource Inventory Area #62. The discussion below is summarized from the Phase I report (**Soltero et. al. 1991**).

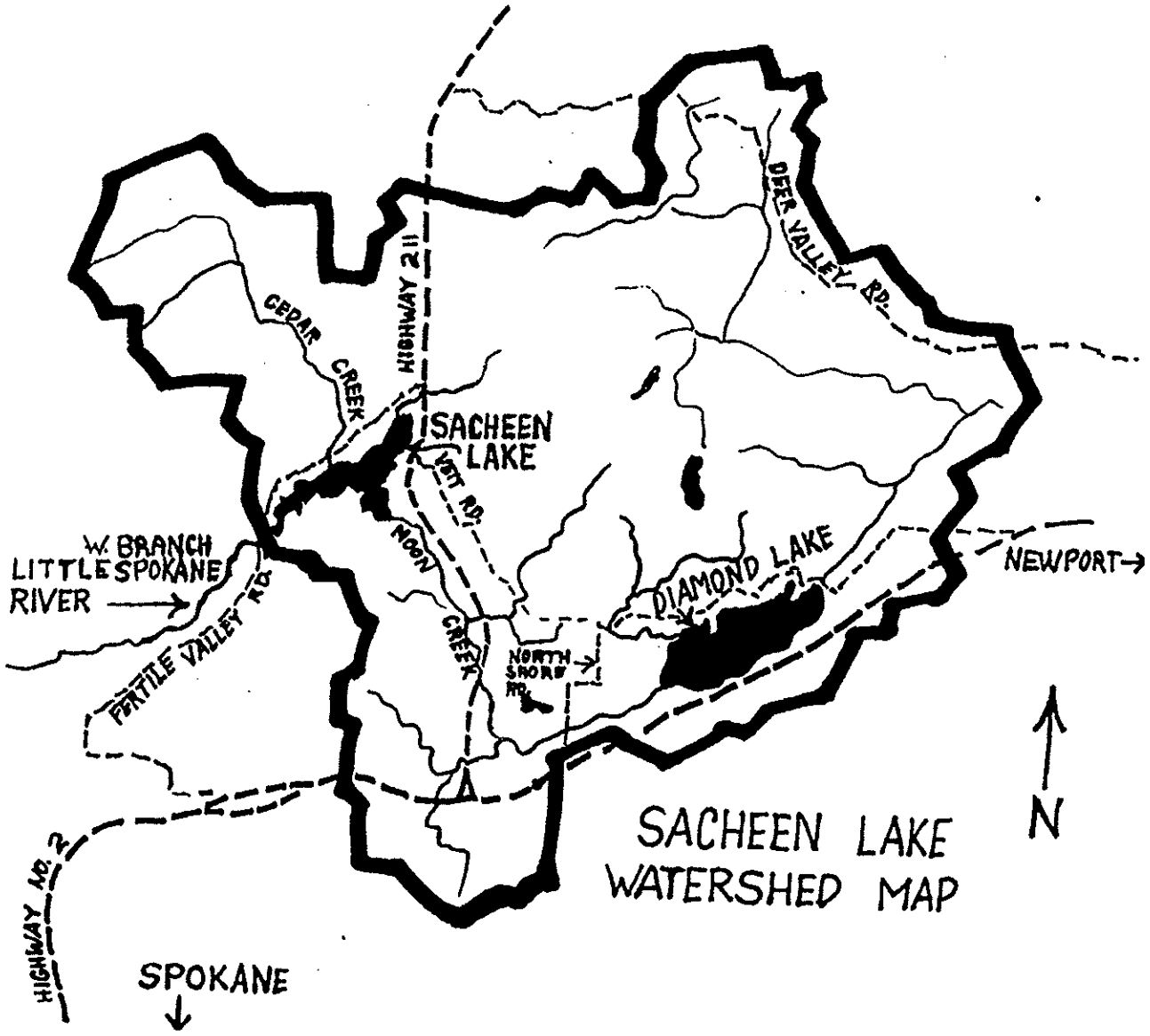

Figure 1. Sacheen Lake watershed, Pend Oreille County, WA (from Sacheen Lake Sewer and Water District 1995).

This watershed is part of the West Branch of the Little Spokane River drainage basin that starts at Diamond Lake (see **Figure 1**) and ends at the confluence with the East Branch south of Eloika Lake. The watershed upstream of the outlet channel encompasses 46 square miles and includes Diamond Lake.

The Sacheen Lake area, considered by Conners (1976) as part of the Okanogan Highlands is part of a larger physiographic province known as the Northern Rocky Mountains. The total relief of the watershed is 1996 feet with the highest point being Little Blue Grouse Mountain at 4,230 feet and the lowest point being the lake's outlet at approximately 2,230 feet.

The watershed can be divided into three major basins. The largest is the Moon Creek drainage which enters the southeastern arm of the lake and drains approximately 38 square miles (see **Figure 1**). The Cedar Creek sub-basin drains 3.4 square miles north of the lake including most of the east side of Little Blue Grouse Mountain. An unnamed creek enters the lake at the northern arm and this drain 2.9 square miles. This area encompasses a small basin underlain by glacial outwash that lies just east of the lake. Approximately two square miles of land around the lake are drained by numerous small, ephemeral streams. This land probably serves as seasonal runoff channels for melt and rain waters.

Land use in the watershed is approximately 80% forest or unproductive, 13% agricultural and 1% residential suburban (Dion et al. 1976). The forested areas are primarily located north and south of the lake and the agricultural areas are primarily along the Moon Creek corridor East of the lake, and in the Unnamed Creek drainage northeast of the lake, to a lesser extent. Agricultural areas are primarily used for livestock grazing and hay growing. The lake's shoreline is approximately six miles long and about 70% of this is developed. There are about 320 homes on or near the lakeshore, almost 290 of which have direct lake access and most of the rest have indirect access through neighborhood-owner beaches. The developed shorelines are primarily along the north and east sides of the lake as indicated on the Beneficial Use Map, **Figure 2.** Much of the south shore of the lake is undeveloped due to poor road access to this area, large landholdings and wetlands.

There are a number of wetlands located around Sacheen Lake as indicated in **Figure 2**. For the most part, these wetlands are classed as "Scrub-shrub" wetlands, following Cowardin et al (1979), although there are numerous small areas that are dominated with emergent species. While the wetland areas along the north side of the lake are fairly small (less than 0.1 acre), the Moon Creek wetland and the West Branch wetland (at the east and west ends of the lake, respectively) are significant in terms of size and habitat. The smaller wetland areas support a variety of emergent plant and shrub species, primarily Cattails (*Typha latifolia*) and Douglas spirea (*Spirea douglasii*)(Lambert Group, Inc. 1997). The Moon Creek wetland supports primarily emergent plant species, including Cattails and Reeds Canary Grass (*Phalaris arundinacea*), and occupies perhaps several hundred acres, all of which is upstream of the lake. Much of this area has been degraded due to livestock grazing in the past.

The West Branch wetland is an extremely large area that runs from the Sacheen lake outlet to Trout Lake, a distance of approximately three miles. This system is primarily a scrub-shrub system. The presence of beaver in this area has apparently enlarged the wetland area considerably over the years and dam building eventually hindered the outflow from Sacheen

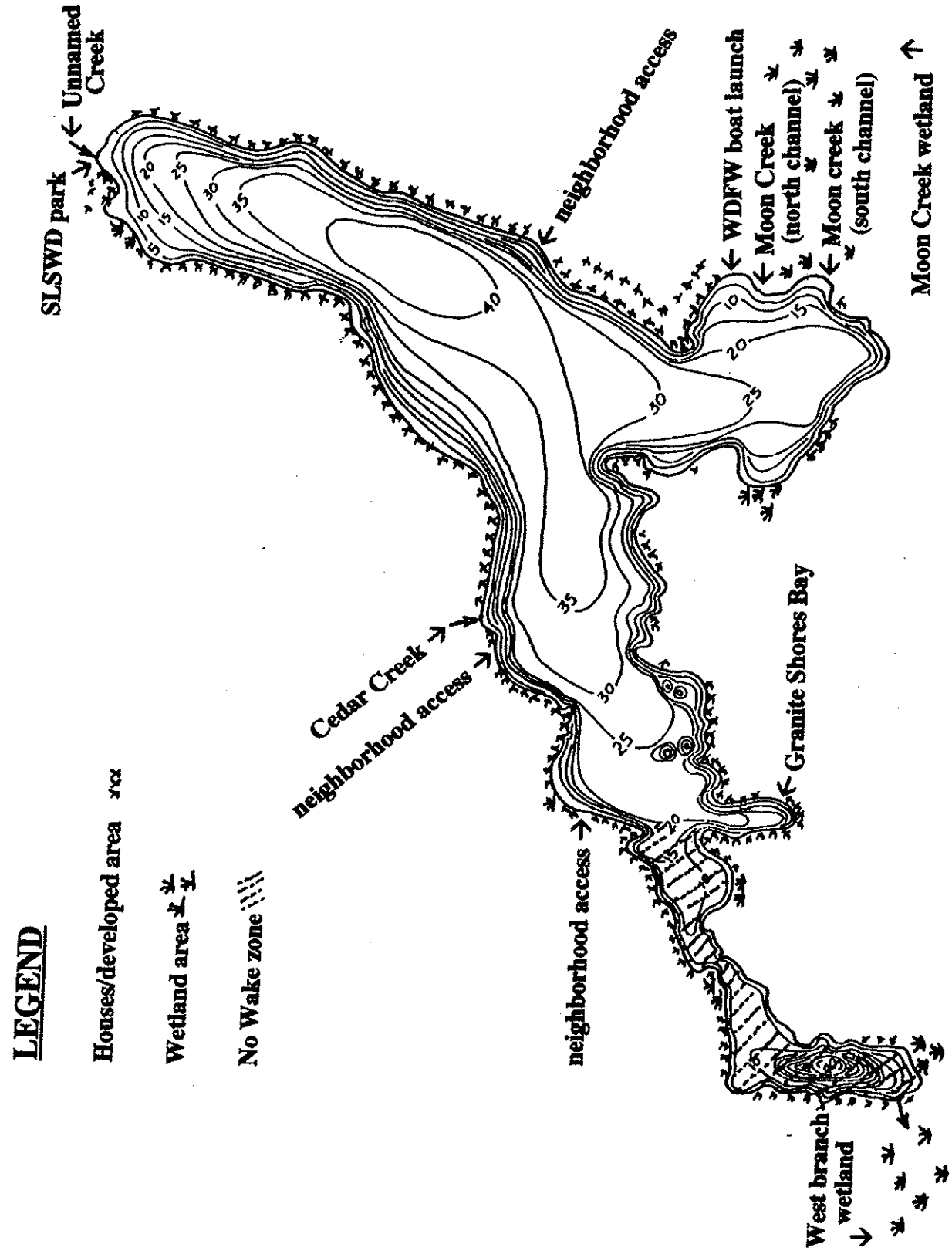

Figure 2. Sacheen Lake showing beneficial use areas and wetlands.

Lake to the point that the dams were controlling the water level in the lake. This prompted a water level study to be performed as part of the Phase I project (see Soltero et al. 1991). The results of this study were that a target lake level was chosen and "beaver pipe" drains were installed through the two upper dams to maintain the target lake surface level.

Most of the wetland areas around and downstream of the lake were monitored before and after the 1995 whole-lake herbicide treatment to assess impacts from that treatment. The findings of this monitoring were that no permanent adverse impacts occurred and only minor temporary impacts. The temporary impacts were the whitening (chlorosis) of cattail, yellow iris and Reeds canary grass leaves which is a direct result of absorption of fluridone by the roots of these plants. This effect disappeared within approximately 60 days of the completion of the Sonar treatment with no toxicity observed. The only permanent effect that the Sonar treatment had on wetland plants was the removal of limited areas which were dominated by Yellow pond lily (*Nuphar polysepalum*). This effect was only seen in *Nuphar* which was in permanently flooded areas (and therefore in the lake proper and not actually in "wetlands"). This effect was anticipated prior to the treatment and was considered to be a benefit because growth of this plant had been hindering recreation to some extent in some shoreline areas (particularly the Moon Creek inlets areas and west of the "narrows".

Inlet Water Quality & Non-Point Sources. The quality of the water flowing into Sacheen Lake was measured during each of the Phase I and II study years as a means of determining the lake's nutrient budget. In addition, as part of the Phase II Restoration project, a watershed non-point source study was performed. Since the Phase I study had found that Sacheen Lake was on the verge of eutrophy and that phosphorus was the element which limited algae and submersed plant growth, the objectives of the non-point study were to identify sources of non-point phosphorus loading and to recommend means of controlling this. While numerous other chemical and physical water quality parameters were investigated for the non-point source study, the phosphorus is considered most pertinent to this IAVMP.

Following review of the data collected from the watershed, and consideration of observations made during the sampling trips, four areas of concern were identified. All four of these were located within the Moon Creek drainage (Soltero et al 1996). The elevated phosphorus levels found in the identified reaches were believed to be due primarily to increased soil erosion and animal waste deposition resulting from grazing activities.

The Unnamed Creek drainage was sampled at only one location for the Non-Point study and total phosphorus levels there were the second lowest of all tributaries measured.

Phosphorus loads were also relatively low from this drainage. This stream flows underground for a portion of its length and also passes through a wetland area near the lake. These factors may tend to filter some contaminants from the stream flows.

The Cedar Creek drainage is the second largest in the lake watershed but it provides the least of the measured flows. However, this predominantly forested area consistently provided some of the highest concentrations of phosphorus seen during this study. The most likely suspect source of this phosphorus is soil erosion and/or vegetative cover disturbance due to logging activities.

Lake

Physical Features. The surface area of Sacheen Lake is 320 acres, its' mean depth is 24 feet, its' maximum depth is about 40 feet and its' volume is 7,600 acre-feet (Dion et al. 1976). The littoral zone of the lake is typically from the shoreline to a depth of 15 feet. The lake bottom sediments are predominantly organic muck with course decomposed granite sands along most shoreline areas.

Inflow and Water Budget. The water budget for Sacheen Lake was determined for each of the restoration monitoring efforts (1990/91, 1994/95, 1995/96 and 1996/97) by EWU-Biology. Typically, 80% to 90% of the inflow was found to come from the surface inlets, 7% to 18.5% from precipitation and 1% to 2.5 % from groundwater inputs (Soltero et al. 1991, 1995, 1997). As indicated above, Moon Creek is the primary inlet carrying approximately 77% to 94% of the surface inflow (between its two channels); with Unnamed Creek carrying 4% to 17%, and Cedar Creek 0.2% to 8%. The Sacheen Lake Restoration studies showed that there can be a considerable variation in surface flows from year to year as shown in **Table 2** (below).

During the 1990/91 Phase I study approximately 4,952 acre feet (ac-ft) of water was calculated to enter the lake from the two Moon Creek channels. During this same time 1,114 ac-ft entered through Unnamed Creek and 395 ac-ft through Cedar Creek. Instantaneous flow back-calculated from the monthly total volumes during the Phase I period ranged from 14.7 cubic feet per second (cfs) in March 1990 to 0.5 cfs in June in the main (north) channel of Moon Creek, and 2.2 cfs in April to 0.07 cfs in August in the secondary (south) channel. Unnamed Creek averaged 4.4 cfs in July to 0.3 cfs in February and Cedar Creek 1.9 cfs in July to 0.01 cfs in October that year.

During the 1994/95 pre-treatment study only 3,202 ac-ft of water entered through the Moon Creek channels while 146 ac-ft entered at Unnamed Creek and 55 ac-ft at Cedar Creek. The back-calculated instantaneous flow for that period ranged a high of 12.6 cfs in February to a low of 0.9 cfs in August in the Moon Creek main stem. The smaller Moon Creek channel carried a high of 1.6 cfs in February that year and a low of 0.02 cfs in August. Unnamed Creek instantaneous flows ranged from 0.4 cfs in April to 0.06 cfs in September and Cedar Creek flows ranged from a high of 0.2 cfs in February to zero during December and January.

During the 1995/96 study year Moon Creek inlets brought 6,554 ac-ft into the lake, Unnamed Creek brought 437 ac-ft and Cedar Creek brought 596 ac-ft. In 1996/97 Moon Creek brought 11,198 ac-ft, Unnamed brought 504 ac-ft and Cedar Creek brought 726 ac-ft.

Once the lake inflow quantities were measured and totaled, the lake "flushing rate" could be determined. This rate, also referred to as the "retention time", provides an indication of the time it takes water to move through the lake and is calculated simply by the lake volume divided by the total inflow. The resulting retention time during the Phase I project was 1.00 years. During the Phase II monitoring, retention time was calculated to be 1.67 years in 1994/95, 0.87 year in 1995/96 and 0.55 year in 1996/97, which follows the increased inflow seen during the Phase II study years.

Table 2. Variation in surface inflows seen in the three primary inlets from restoration study data (Soltero et al, 1991, 1995 and 1997).

	Accumulated annual inflow (ac-ft.)			
	1990/91	1994/95	1995/96	1996/97
Moon Creek	4,952	3,202	6,554	11,198
Unnamed Creek	1,114	146	437	504
Cedar Creek	395	55	596	726
TOTALS =	**6,461**	**3,404**	**7,587**	**12,428**

Water Quality. Monthly monitoring of water quality parameters was conducted by EWU-Biology in 1990/91, 1994/95, 1995/96, and 1996/97. Analyses routinely performed included dissolved oxygen profiles, pH, conductivity, alkalinity, hardness, ammonia, nitrate and Kjeldahl nitrogen, total and ortho phosphorus, suspended solids, fecal coliform bacteria and chlorophyll a. These studies also included biological components phytoplankton (algae), zooplankton (invertebrates) and aquatic plants. The data developed for these studies is voluminous and has been published elsewhere (Soltero et al. 1991, 1995 and 1997) and selected parameters have been summarized (RMI 1998). The following summary of key components has been extracted from RMI 1998. Information on aquatic plant populations seen during these studies is summarized in the Aquatic Plant Characterization Section below.

• Total Phosphorus. During 1990/91, total phosphorus (TP) ranged from 5 to 270 µg/L in the Sacheen Lake water column (µg/L is essentially equivalent to parts per billion). Generally, TP was less than 100 µg/L except at depths below 8 meters (found only at the Northeast sample site) between June 25 and October 15. The annual mean of TP concentrations from all sites and depths for 1990/91 was 32.3 µg/L and the growing season mean (June through September) was 44.0 µg/L.

In 1994/95 the range of TP data was 6 to 629 µg/L with most results being less than 50 µg/L except, again, at the 10 and 12 meter depths between June and October. The ranges of TP data for 1995/96 and 1996/97 were somewhat lower (9 to 253 µg/L and 9 to 350 µg/L, respectively) but were similar in the depths and time periods. The annual mean TP concentration for 1994/95 was 32.2 µg/L which was only slightly lower than the growing season mean of 36.7 µg/L. The annual and growing season means from 195/96 and 1996/97 were all very similar, being between 26.4 and 29.9 µg/L.

In spite of the apparent decline in TP concentrations in 1995 and 1996, statistical comparison of TP data between sample sites and like depth and date did not reveal any significant differences between these years (Soltero et al. 1997).

By the end of this study, volume-weighted mean TP concentrations at the Northeast site had decreased by 2 μg/L from the 1990/91 levels, while the annual loading of phosphorus had increased by nearly 89 kg/yr. Variation in total annual loading of phosphorus to Sacheen Lake from year to year primarily reflected annual variations in TP loading from inflowing tributaries. Although there were considerable annual variations in TP loading, few statistical differences were found in inlet TP concentrations indicating that discharge was probably more important than concentration in determining phosphorus load entering the lake.

In 1990 aquatic plant TP release was calculated to be 13.4 kg and by 1994 it had risen to 17.9 kg. This correlated with an observed increase in plant biomass to nearly 1,950 g/m^2. Following the herbicide application TP release was calculated to drop to 5.7 kg in 1995, corresponding to a 65% reduction in biomass. Plant biomass was further reduced in1996 resulting in a calculated release of only 0.5 kg.

Another point of note regarding the phosphorus budget is the apparent reduction in TP which is retained in the lake. During the 1990/91 and 1993/94 study years approximately 48% of the TP load was retained in the lake. This is assumed to be assimilated by aquatic plant and algal communities or absorbed / adsorbed by the sediments. Following herbicide treatment the proportion retained dropped to approximately 14% in 1995/96 and 2% in 1996/97. While the removal of Milfoil is likely the predominant cause of this, algal populations were also reduced following the herbicide treatment.

• Secchi Disk Transparency: Water transparency measurements made using a standard 20 cm diameter Secchi Disk ranged from 2.4 m (7.9 ft) to 4.3 m (14.1 ft) in 1990/91, 3.6 m to (11.8 ft) to 5.0 m (16.4 ft) in 1994/95, 2.1 m (6.9 ft) to 3.8 m (12.5 ft) in 1995/96 and 2.4 m (7.9 ft) to 5.6 m (18.4 ft) in 1996/97. The growing season and annual mean values show a slight reduction in mean transparency in 1995 and 1996. The statistical comparisons performed by Soltero et al. (1997) indicated that 1995 was significantly different (lower transparency) than the other years.

• Chlorophyll a: There was a considerable variation seen in chlorophyll a data between the four monitored years indicating variations in the algal populations. In 1990/91 the range of concentrations measured was 1.8 to 135.2 mg/m3. The range of values seen in 1994/95 was 1.8 to 9.27 mg/m3 and in 1995/96 0.8 to 8.3 mg/m3. The 1996/97 range was 0.7 to 6.7 mg/m3. The growing season and annual mean chlorophyll a were the highest of the four years in 1990/91 but no statistically significant differences were found.

Water Rights. A search of the WDOE's Water Rights Applications Tracking System indicated that there are 184 Certificates, Permits or Claims for surface water from Sacheen Lake. While the current validity or use of these listed water rights has not been determined, the purposes

given included "domestic single" (84), "domestic" (65), "Irrigation" (21), "Fire" (8) and "Domestic Multiple" (5).

Fish, Wildlife and Bird Usage. Information on the use of Sacheen Lake by fish and wildlife was obtained through communications with various Washington Department of Fish and Wildlife (WDFW) personnel. Regarding fish usage, there are both warmwater (spiny-ray) and cold water (salmonid) species residing in the lake. Warmwater species composition is determined through annual surveys and the results of the 2000 survey are shown in **Table 3** (below). From this it can be seen that Brown Bullhead dominated the warmwater population in terms of both total weight and number. Second in terms of overall weight were Tench, but in terms of number were Largemouth Bass. Other species which were found in significant numbers were Yellow Perch and Green Sunfish.

Cold water fishes present (stocked) include Rainbow and Eastern Brook Trout. The WDFW maintains an annual trout stocking program which in 2000 included 25,000 Eastern Brook Trout fry and in 2001 19,500 Eastern Brook catchable size plus 5,000 Rainbow fry (Vail, 2001). An incidental catch in the warmwater survey from 2000 indicated that Brown Trout are also present (see **Table 3**). There are no native trout in the lake and no bull trout known in Sacheen Lake or the West Branch Little Spokane River.

Table 3. Warmwater fish species composition summary for Sacheen Lake, WA (from WDFW, 2000).

Composition:	by Weight		by Number		Size Range (mm)	
	(kg)	(%)	(#)	(%)	Min	Max
Type of Fish:						
Brown Bullhead	112.10	43.11	892	44.51	130	285
Tench	60.49	23.26	109	5.44	187	460
Largemouth Bass	43.43	16.70	394	19.66	75	490
Yellow Perch	26.89	10.34	302	15.07	107	268
Eastern Brook trout	5.39	2.07	39	1.95	200	297
Green Sunfish	4.00	1.54	209	10.43	44	182
Black Crappie	3.93	1.51	57	2.84	76	233
Brown Trout	3.75	1.44	1	0.05	670	670
Pumpkinseed	0.04	0.02	1	0.05	125	125

Regional staff of the WDFW were interviewed regarding the quality of the Sacheen Lake fishery and the effects of past 2,4-D treatments for Milfoil control on the lake. Both John Whalen, Regional Fisheries Manager, and Kurt Vail, Fishery Biologist, indicated that the fishery was "descent" although it is not as successful for trout as in the past due to current

restrictions on the agency's management (use of rotenone has been limited due to water rights and other issues). Regarding the effect of past 2,4-D treatments, Mr. Whalen felt that there did not seem to have been any adverse effects on native aquatic plants. Mr. Vail indicated that he supported the use of 2,4-D in the control of Milfoil as a positive step to maintaining fish habitat.

Wildlife and bird/waterfowl use of Sacheen Lake was documented as part of a historical and natural study that was performed in conjunction with the Phase I project (Hutson 1991). **Table 4** is excerpted from that study.

Table 4. Mammals, birds and other species common to the Sacheen Lake area.

MAMMALS COMMON TO THE STUDY AREA:

Beaver	Red squirrel
Muskrat	Northern flying squirrel
Mink	Least chipmunk
Ermine	Yellow pine chipmunk
Long-tailed weasel	Black bear
Raccoon	White tailed deer
Porcupine	Coyote
Striped skunk	Washington ground squirrel
Snowshoe hare	

Also: Bats , Mice, Moles &Voles

MAMMALS SEEN INFREQUENTLY:

Moose	Mountain lion
Bobcat	

OTHER SPECIES SEEN IN STUDY AREA:

Frogs	Bull frogs	Toads	Turtles
Garter snakes	Rubber boas	Salamanders	Crawdads

BIRDS COMMON TO THE STUDY AREA:

Great Blue heron	Canada Goose
Red-necked grebe	Mallard
Wood duck	Canvasback
Green-winged teal	Pintail
Redhead	American coot
Common goldeneye	Bufflehead
Osprey	Red-tailed hawk
Coopers hawk	American kestrel
American Bald eagle	Great horned owl
Western gull	Killdeer
Belted kingfisher	Common nighthawk
Ruffed grouse	Spruce grouse
Blue grouse	Pileated woodpecker
Common flicker	Red-breasted nuthatch
Violet-green swallow	Tree swallow

Calliope hummingbird	Allens hummingbird
Red-winged blackbird	Yellow-headed blackbird
American crow	American robin
Steller's jay	Gray jay

Table 4. continued

BIRDS COMMON TO THE STUDY AREA (continued):

Mountain chickadee	Black-capped chickadee
Oregon junco	American goldfinch
Varied thrush	Cedar waxwing
Western bluebird	Black-billed magpie
Western meadowlark	Winter wren
Sparrows	Evening grossbeak

Rare, Threatened or Endangered Species. Following communication with representatives of the Natural Heritage Program at the Washington Department of Natural Resources, it appears that there are no rare, threatened or endangered plant species in the Sacheen Lake Vicinity (see letter in **Apprndix E.**). Information on rare, threatened or endangered animal species was obtained from the Priority Habitats and Species Program of the WDFW. This information included a Habitats and species map as well as descriptions of the occurrence of species of concern. The map is not included with this IAVMP report due to the fact that the species involved are found locally in low numbers and are vulnerable to human disturbance. The Habitats and Species report listing some details of the priority species listed for the Sacheen Lake area is included in **Appendix E.**

Priority habitats found in the Sacheen Lake area are the wetlands and riparian zones. The specific wetland listed is that along the West Branch Little Spokane River downstream of the lake. No specific riparian zones are listed so it is assumed that all lakeshore riparian areas are implied. The only priority fish species listed was rainbow trout which are resident to Moon creek, the West Branch and other streams. There were no anadromous fish listed.

There were three bird species listed in the Priority Habitats and Species information: Osprey, Northern goshawk and Red-necked Grebe. Each documented occurrence was listed as a "breeding occurrence". Two occurrences of Osprey (1989 and 1996) and one each of the Goshawk (1989) and Grebe (1991) were documented. The Goshawk nest, which was located some distance north of the lake was subsequently observed to have "no activity" in 1992. From personal observations made over the last eight years, it can be said that breeding pairs of Red-necked Grebes and Osprey are a regular occurrence along the lakeshore **(Hutson, 2002)**.

AQUATIC PLANT CHARACTERIZATION

Phase II Aquatic Plant Monitoring

Data developed from the Phase II project aquatic plant surveys included species ranking according to abundance (using biomass estimates), biomass by depth interval and phosphorus content of each plant species. The results of the biomass determinations from the Phase II Completion Report (RMI, 1998) follows.

The pre-treatment aquatic plant survey was conducted in July 1993 in anticipation of the herbicide treatment taking place in the spring of 1994. Plant samples were collected by SCUBA methods along the 13 transects established for the Phase I study plus eight additional transects. Since the herbicide treatment could not be performed in 1994, as described above, a second pre-treatment survey was conducted in August 1994. The post-treatment surveys were conducted in August 1995 and August 1996.

From the pre-treatment survey, it was determined that *Potamogeton* robbinsii was ranked first in abundance occupying 49.1% of the total biomass. Milfoil was second with 35.5% and *Elodea canadensis* was third with 10.8% of the biomass. Other species found occupied less than 5% of the total. These included *P. praelongis, P. ampolifolius, P. zosteriformis, Ceratophyllum demersum, Brasenia schreberi,* and *Chara* species.

Aquatic plant biomass in1994 was similar to that in1993 but with some notable exceptions. *P. robbinsii* was still one of the most prevalent species with 44.7 % of the biomass but Milfoil was found to be slightly dominant with 46.7%. The third most abundant *was P. amplifolius* with 4.3% in place of *E. canadensis* which showed only 2.3 % of the total. Other species in1994 were *P. pectinatus, P. zosteriformis, B. schreberi, C. demersum* and Nitella sp. *P. praelongis* and *Chara* were not seen in the transects in 1994.

In 1995 post-herbicide treatment plant abundance shifted back to P. robbinsii dominance, 91.8% with the virtual elimination of Milfoil. Milfoil was still found to occupy 4.0% of the biomass in that year although the divers reported that most of the Milfoil plant mass was only leafless stems. *E. canadensis* also appeared to be reduced somewhat in 1995 from pre-treatment levels. Other species seen in 1995 were similar to those present in 1994 with the addition of *Chara* sp.

In 1996 the aquatic plant population diversity was considerably different than that seen previously. *P. robbinsii* was the only species of the pre-treatment top four which was found in the transect samples, although it was still the dominant plant at 67.5% of the total. *Chara* species (21.3%) replaced *E. canadensis, P. amplifolius* and Milfoil seen previously.

From the summary presented in the Completion Report it can be seen that total aquatic plant biomass prior to the herbicide treatment ranged from 650.6 to 1,005.5 grams per square meter. In 1995 the total had dropped to 351.1 grams per square meter and in 1996 the total

was 45.8 grams per square meter. Given the continued absence of invasive species such as Milfoil, it was predicted that it would take four to six years for the Sacheen Lake plant community to exhibit species diversity and relative abundance similar to that existing prior to the invasion of Milfoil.

2001 Aquatic Plant Mapping

The 2001 mapping effort consisted of diver survey of all plants along 28 transects (including 21 established for the restoration) which was performed by Aquatic biologists Dave Lamb and Kelly Hunt. Also, reconnaissance for Milfoil was performed using divers, who were towed by a boat parallel to the entire shoreline at the five to 15 foot depths, and snorkelers, who swam the three to 10 foot depths in shoreline areas inaccessible to the boat. The Milfoil reconnaissance was performed by Sacheen volunteer divers Perry Pearman and Bill Slusser, with oversight and assistance from Dave Lamb. The transects were placed perpendicular to the shoreline to the limit of plant growth at the locations shown on **Figure 3**. The tows were made parallel to the shoreline at the five to ten foot depths. In both efforts plant density was estimated ("sparse", "moderate" or dense") along with species identification. In the transect survey, lake depth was determined at each change in plant or plant assemblage. Both types of surveys used Global Positioning system (GPS) equipment to map the locations of different species assemblages or densities of the plant beds. The results of the transect survey are given in **Table 4** in **Appendix B**. The map produced from the 2001 survey is presented as **Figure 4**.

Current Aquatic Plant Characterization

There were 11 different species of submersed aquatic plants identified in the 2001 transect survey, plus two species of "macroalgae". This survey did not include sample collection and biomass determination, as was done by EWU-Biology, but the observations made by the divers of the relative density of each species at apparent intervals (apparent boundaries of specific plant species or species assemblages) along the transects has allowed a determination of the dominant species. The data shown in Table 4 has been summarized by interval and by transect.

Of 113 observed intervals, 63 were dominated by Pondweed (Potamogeton species). The species identified were *P. amplifolius, P. robbinsii, P. crispus, P. pulsillus* and *P. zosteriformis. P. amplifolius* and *P. robbinsii* were the most prevalent of the pondweeds. *Elodea canadensis* was found to dominate 32 intervals. *Potamogeton* species and *Elodea* co-dominated nine intervals. Milfoil was found to dominate eight intervals and the macroalgae *Nitella* dominated one interval.

The most prevalent species seen in this survey were found in almost every transect. In addition, there was no apparent relationship between depth and dominant species. Therefore, it is perhaps more meaningful to consider dominance on a transect basis rather than an interval basis. As indicated in **Table 4**, *P. robbinsii* was seen to be the dominant plant

in 12 of the 28 transects surveyed. *E. canadensis* was dominant in four transects, Milfoil in three and *P. amplifolius* in one. However, there were eight transects which did not have any one species as apparent dominant (these are indicated by "mixed" in **Table 4**).

Another important observation from the 2001 transect survey is that there was no strong areal differences around the lake. In other words, at least the dominant species were widely distributed throughout the lake's littoral zone. This is also shown by the fact that Milfoil, while dominant in only three transects was found at some level in 24 of the 28 transects.

Two of the 2001 transects were located near the mouths of the two Moon Creek inlets (#14 by the north channel and #31 by the south channel). These transects provide only a hint of the diverse assemblage of plants that grow densely in these two areas, supported by the nutrients brought into the lake by this creek. However, neither of these transects included submersed plants growing in the channels. As indicated in the introduction to this Plan, Sacheen Lake was assumed to have became re-infested with Milfoil following the whole lake Sonar treatment because of Milfoil which survived in these two inlet channels. Cursory examinations of the creek channels, and also the pond which is located approximately 1,000 yards upstream of the lake on the south channel, indicated that Milfoil is

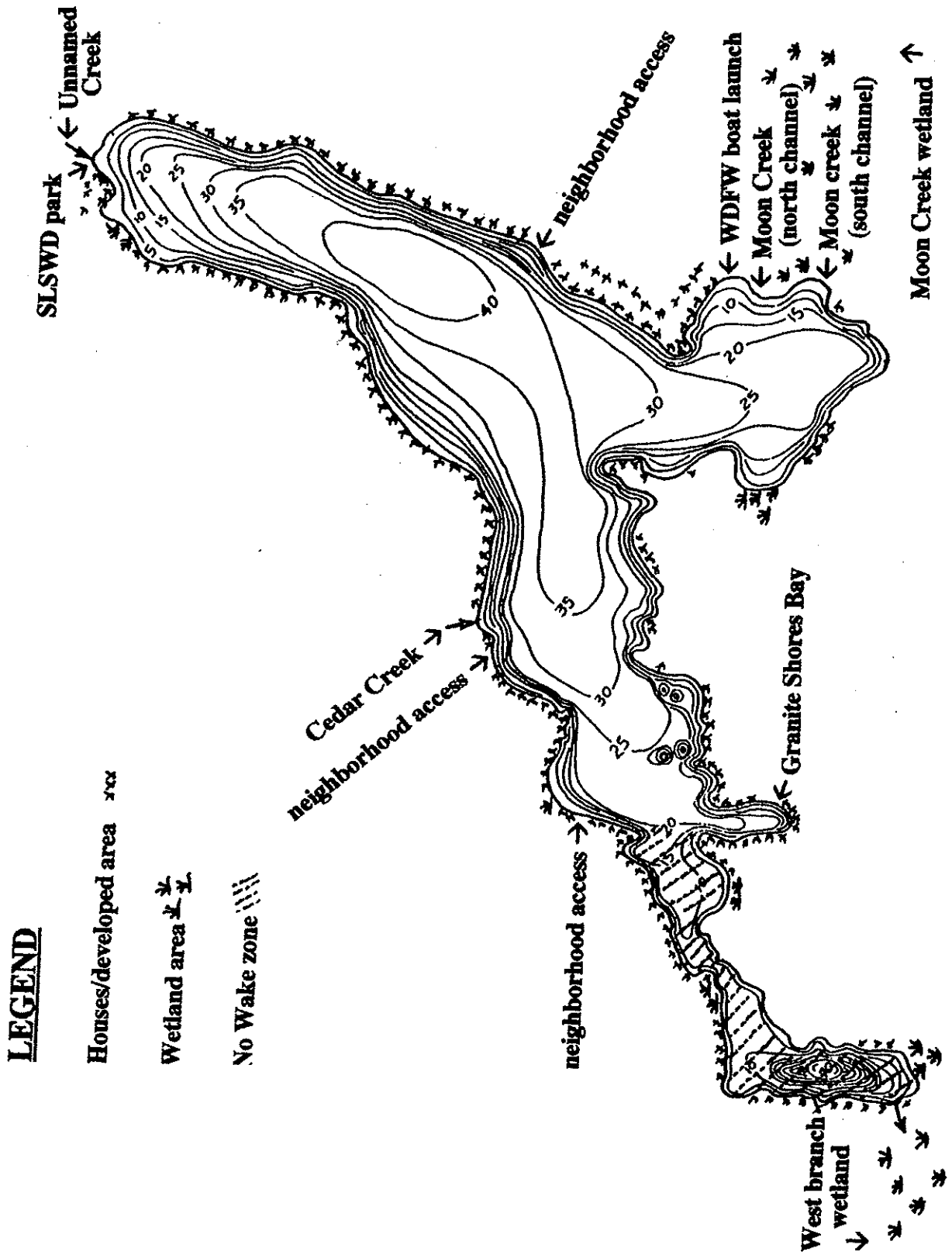

Figure 3. Sacheen Lake showing bottom contours and 2001 aquatic vegetation survey transect locations.

Figure 4. GIS map showing aquatic plant distribution in Sacheen Lake, 2001.

still present in these areas. Removal of the Milfoil in these stream areas is considered to be of paramount importance to the on-going control of this plant in the lake.

BENEFICIAL USES

The current beneficial uses of Sacheen Lake were identified by the Board of the SLSWD and representatives of the SLBA. In order of priority the beneficial uses are:

1. Swimming
2. Boating and motorized water sports
3. Non-motorized boating (canoeing, kayaking, rowing, sailboarding)
4. Recreational fishing
5. Aesthetics
6. Fish habitat
7. Wildlife habitat

Swimming, boating, fishing, aesthetics and fish habitat are beneficial uses that are important in all areas of the lake, especially along the developed shorelines. Motorized boat sports, (skiing and high speed personal watercraft) are limited in the western, narrower portions of the lake where there is a no-wake zone (see **Figure 2**). Wildlife use of the lake is somewhat limited in the higher density housing areas.

MANAGEMENT GOALS

The development of the Problem Statement, the assessment of watershed and lake characteristics and the determination of desired beneficial uses have led to the following management goals for Sacheen Lake:

- Maintain recreational uses of the lake by removing or controlling excessive submersed aquatic plant growth from residential shoreline areas

- Keep swimming and boat launch areas free of aquatic plants

- Protect and enhance fish and wildlife habitat

- Choose aquatic plant control techniques which have the widest public support, a low cost to benefit ratio and prevent adverse environmental problems either in the lake or downstream.

- To the extent possible, reduce Milfoil growth to the point that chemical herbicides are not needed during each successive year.

Sacheen Lake Dive Survey, August 2001

1000 0 1000 2000 Feet

N W E S

AquaTechnex
"Advancing the Science of Lake Management."

Milfoil-Dense Milfoil-Moderate Milfoil-Sparse Littoral Zone: Mixed Pondweed ssp. and Elodea

The "action limit" for this management plan is zero Milfoil plants; that is, controls are recommended whenever Milfoil is found in the lake or in the lake's inlets or outlet within a 600 foot distance from the lake. Milfoil is to be treated where ever it is found within these bounds using the moderate or high intensity controls as outlined in this Plan.

CONTROL ALTERNATIVES

General Considerations and Permitting

This section of the Integrated Aquatic Vegetation Management Plan presents information on available techniques which can be used in the management of aquatic plant growth. Much of this information is excerpted from A Citizen's Manual for Developing Integrated Aquatic Plant Management Plans (**WDOE 1994**) and the Supplemental Environmental Impact Statement for the Department of Ecology's Aquatic Plant Management Program (**WDOE 2001c**).

Additional information on new and developing control technologies is also presented where it appears to be appropriate in the near future (two to five years). While all possible techniques are addressed here, only those which are specifically applicable to Sacheen Lake, the developed Problem Statement and the Management Goals are discussed in detail. Following from the review of appropriate techniques, an "Action Plan" has been developed which is presented in the next main section of this Management Plan.

• • Note: essentially all aquatic plant control activities require a permit from one or more State agencies. All manual, mechanical, and physical techniques described herein require issuance of a WDFW Hydraulic Project Approval. Application of chemicals to State waters to control algae or aquatic plants must be covered under a National Pollutant Discharge Elimination System (NPDES) permit. An NPDES permit has been issued to the Washington Department of Agriculture for control of State-listed noxious weeds and individual treatments must request coverage under this permit and certain monitoring must be performed. Dredging may require a permit from the US Army Corps of Engineers. Permit guidance in the "Aquatic Plants and Fish" pamphlet (**WDFW 1998**) was developed in recognition of the importance of controlling aquatic noxious and nuisance weeds, the need to protect the aquatic resource and to facilitate the approval process for HPA projects. This guidance does not include efforts related to the NPDES permit.

Submersed Plant Controls

The No-Action Alternative. The focus of this IAVMP is on the plant species which has been shown to negatively affect the beneficial uses in Sacheen Lake. Based on the public opinion that there is a problem with aquatic plants, this Plan has investigated options for controlling or eliminating this problem. In order to maintain a perspective on the costs and benefits of

various plant and algae control options, the costs and benefits of the "no-action" alternative also must be kept in mind.

If organized action is not taken against nuisance submersed plant growth, there is a potential that the problem will get worse. With the nutrient enriched conditions in Sacheen, and the fact that the plants present are able to absorb nutrients directly from the water column, this is almost a certainty. Therefore, the "no-action" alternative is not acceptable due to the potential reduction of beneficial uses of the lake and potential negative environmental impacts (ie. fish habitat degradation). The impact of continued, excessive submersed plant growth on fish habitat could include effects on water quality, on fish themselves and on fish food organisms. Impacts on water quality include pronounced stratification of temperature due to interception of solar radiation and reduction in circulation, as well as changes in chemical factors such as dissolved oxygen, pH and alkalinity due to daily cycles of photosynthesis and respiration. Perhaps a more significant impact to water quality can result from the rapid dieoff of dense plant beds which can happen on a seasonal basis. Excessive aquatic plant growth in a shallow lake system can directly contribute to elevated water temperatures.

The reduction in oxygen levels can have direct negative effects on fish and fish food organisms. Low oxygen also causes the production of hydrogen sulfide and ammonia, both of which can also have toxic effects on fish and fish food.

Maintenance of dense beds of submersed plants can also foster the growth of mosquitoes and possibly other nuisance organisms.

Advantages of No-Action alternative:
- no treatment cost

Disadvantages of No-Action alternative:
- lake quality will decline,
- recreational opportunities will decline,
- fish and wildlife habitat will be reduced or impaired,
- property values will decline.

Appropriateness for Sacheen Lake:
- The No-action alternative is not appropriate for Sacheen due to the degradation that uncontrolled Milfoil growth will cause and the desire of the lake residents to protect the identified beneficial uses described herein.

Currently Available Techniques - Preventive. The preventative techniques which may have utility in Sacheen Lake's submersed plant control efforts focus on control of inputs of the growth nutrient phosphorus. This element has the greatest potential to be controlled and thus control (limit) algal growth. These techniques include both structural and non-structural (Best Management Practice) options.

• **Watershed Controls**: The Phase I study report indicated that 53.7% of the phosphorus entering Sacheen Lake comes from surface water inlets, with the remainder from groundwater input (2.7%), nearshore runoff, waterfowl inputs, direct precipitation (12.2%) and internal recycling from the sediments (14.3%) (Soltero et al. 1991). As discussed in the Phase II non-point source report, implementation of non-point phosphorus source reduction measures in this watershed should have a beneficial impact on phosphorus loading to the lake. The recommended measures (primarily Best Management Practices) are summarized in **Soltero et al. 1995**.

Advantages of Watershed controls (in general):
- reduce nutrient loading at their sources,
- provides shade and lowers stream temperatures
- reduces streambank erosion and sedimentation in lake,
- provide benefits over wider area than the lake.

Disadvantages of Watershed controls (in general):
- may require changes in land use
- may require construction or modification of facilities, purchasing of property and hiring of maintenance personnel,
- may require regulatory support and personnel

Costs of Watershed Controls:
- vary greatly (not determined)

Appropriateness for Sacheen Lake:
- Watershed controls are appropriate for water quality protection at Sacheen Lake but would not be expected to effect the growth of Milfoil in either the short or long term. Therefore watershed controls are not recommended for inclusion in the Integrated Treatment Action Plan.

• **In-Lake Nutrient Controls**: The primary focus of many of the lake management alternatives described in the Phase I study was the reduction in nutrients (primarily phosphorus) as a means of limiting algae and aquatic plant growth. This is a valid approach and the information presented should be considered, especially for long term reduction in productivity. It is, however, beyond the scope of this IAVMP to re-evaluate the technical merit or costs of these nutrient-focused alternatives. Several of the recommended techniques will be discussed herein because they also control or remove the actual aquatic plant growth.

• **Public Awareness and Involvement Program**: The understanding and involvement of lake and watershed residents will be necessary if the process of nutrient, algae and aquatic plant growth controls is to succeed. Therefore a public education and awareness program is strongly recommended. Such a program would focus on and promote lake stewardship but would also keep the lake "community" informed about measures that are to be, and have been, performed in and around the lake. Especially important will be evaluation of control

program effectiveness and program "adjustments" over time. Through newsletters, public meetings, exhibits at fairs and local media coverage (to name a few) information on the lake should be disseminated and opportunities given for reply from the community.

Some subjects which can interest lake residents and users are: simplified algae and aquatic weed information, sources of, and solutions to, nutrient enrichment, shoreline stabilization and revegetation, options for lawn fertilizer use, pet waste management, non-phosphate detergent use, and discouraging bird and waterfowl feeding. Training to teach plant identification can be very pertinent as well.

Whenever possible, the lake community should be directly included in information collection and synthesis as part of the public involvement program. This can include the presence of citizen representatives on monitoring (data collection) trips performed by consultant technicians.

Advantages of a Public Awareness and Involvement Program:
- provides education and public awareness,
- provides opportunity to gather consensus and public support,
- provides opportunity to involve the lake residents and users in the process.

Disadvantages of a Public Awareness and Involvement Program:
- requires committed organization to implement and provide continuity.

Costs of a Public Education and Awareness Program:
- $2,000 to $8,000 per year.

Appropriateness for Sacheen Lake:
- An ongoing Public Awareness and Involvement Program is very appropriate for Sacheen Lake and is recommended to be included in the Integrated Treatment Action Plan described below.

Currently Available Techniques - Physical Control. These techniques include manual or mechanical efforts that can remove, cover, shade or dry out all or part of problem plant growth.

• **Hand Removal**: Removal of submerged vegetation by hand digging or pulling is an intensive but generally small scale management option. This method involves removing the entire plant (leaves, stems and roots) by hand or with a hand-held gardening tool, collecting the plant materials in a storage bag for transport and disposal on shore. In water depth greater than about three feet, the use of SCUBA divers is typically needed in order to effectively manage a location.

The effectiveness of plant removal depends on sediment type, visibility (water clarity), plant type, and thoroughness in removing the entire plant. Based upon these variables, the level of plant control will may from one month to multi-year management.

Advantages of Hand Removal:
- immediate clearing of the water column,
- highly selective technique, in that individual plants are removed,
- can be implemented in sensitive area where disruption must be kept to a minimum,
- effective in aggressive control of sparse or small infestations in the lake, around docks or in swim areas.

Disadvantages of Hand Removal:
- technique is time consuming and labor intensive,
- visibility may become obscured by the disturbance of sediments during harvesting thus delaying plant removal,
- management can be costly in deeper water, especially when divers are used
- control may only be short-term or seasonal; based on location and surrounding infestations.

Costs of Hand Removal:
- no cost if performed by volunteers,
- $800 - $1,600 per day for two divers and a support boat & operator,
- typical coverage from 400 to 2,000 square feet per day.

Appropriateness for Sacheen Lake:
- Hand removal of Milfoil is appropriate for Sacheen Lake considering the current level (and distribution) of the infestation and the stated lake management goals. Therefore, hand removal is included in the Integrated Treatment Action Plan described below.

• **Bottom Barrier Installation**: Bottom barriers are highly effective in the small to moderate scale control of aquatic vegetation. The barriers are typically synthetic (geo-textile) fabrics, or burlap, but a variety of other materials have been used including sand-gravel, polyethylene, polypropylene, synthetic rubber, fiberglass screens and nylon film. These materials cover the lake sediments and existing plants and prevent further growth. By covering the lake bottom that the plants emerge from, all plants are effectively prevented from growing in those areas. Washington State typically allows the use of burlap when covering native plant areas and burlap or synthetic material when covering noxious weed areas. These barriers are typically 100% effective in the installed areas initially and installation can be conducted at any depth with the assistance of divers and a support vessel. Bottom conditions do not typically impede most barrier installations, but logs and debris are typically cleared from the area. Duration of control is dependent upon type of material used, application techniques, sediment deposition and permit (WDFW Hydraulic Project approval) requirements.

Since gases are produced in the sediments under the barrier, the barrier must be attached or weighted to the bottom and allow these gasses to pass through it. Over time, these barriers can lose effectiveness if sediment builds up on them, providing a substrate for plants to root. Yearly maintenance by a dive team can prolong the effectiveness of this technique

indefinitely (except with burlap which will decompose and must be replaced to maintain effectiveness).

Bottom barriers are expensive when used on a large scale. In addition, there can be environmental impacts if large areas of a lake bottom are covered with these materials. Bottom barriers are most applicable for individual properties and are recommended for around docks. Bottom barriers may not work well in swimming areas when placed over soft sediments, however. If swimmers walk on them, they tend to push the mats into the sediment.

Advantages of Bottom Barriers:
- no toxic chemicals are placed in the water,
- provides immediate removal of nuisance plant conditions upon placement,
- easily applied to small, confined areas around docks, moorage's or beaches,
- they are hidden from view (in deeper waters),
- effective in isolated management practices, especially in Milfoil control
- some materials are reusable.

Disadvantages of Bottom Barriers:
- potentially high material cost for synthetic products,
- labor intensive and high costs for utilizing divers,
- limited durability of certain materials,
- not species specific,
- potential permit restrictions on location of barrier (spawning areas), type of material, type of plants attempting to control and length of time barrier will be allowed in place,
- gas accumulation under barrier can cause barrier to be lifted hindering boat passage or swimmers,
- periodic maintenance needed to remove sediment build up and secure placement,
- may need to be removed after two years to allow native vegetation to re-establish.

Costs of Bottom Barriers:
- $0.35 to $0.85 per square foot for materials (burlap or geo-textile),
- $0.35 to $0.60 per square foot for labor to place barriers,
- $0.30 to $0.50 per square foot for labor to remove barrier.

Appropriateness for Sacheen Lake:
- Bottom barriers are not considered appropriate of use at Sacheen Lake at this time due to the extent of the infestation and the stated management goals.

• **Water Column Dyes**: This technique involves the addition of dark colored dyes to the lake to suppress aquatic growth by shading plants or algae from sunlight. These can be blue or a blend of blue and yellow to absorb key portions of the visible light spectrum needed by submersed plant and algae growth. Dyes are most effective at depths of two feet and greater.

Use of this technique is limited to lakes or ponds which have minimal dilution with clear water and no outflow.

Advantages of Water Column Dyes:
- treatment could control both algae and aquatic plants,
- no water use restrictions; treated water will not harm fish, waterfowl, pets or wildlife,
- no special equipment or applicator certification required.

Disadvantages of Water Column Dyes:
- not species specific (can effect all plants and algae),
- not effective when plants or algae are near surface,
- dilution from inflowing creeks would necessitate frequent reapplication,
- dyes may not be allowed due to outflow and domestic water rights.

Costs for Water Column Dyes:
- $12.00 to $15.00 per acre foot for materials.

Appropriateness for Sacheen Lake:
- Water column dyes are not appropriate for use at Sacheen Lake due to their lack of target specificity and their limited expected efficacy.

• **Sediment Removal**: Removal of lake sediments can provide a nutrient and plant control option in lakes and ponds. Stormwater drainage, surface runoff, stream inputs and erosion can all contribute to the build up of sediments in lakes. These sediments represent a pool of nutrients which can stimulate the growth of aquatic plants and algae. In shallow lakes the establishment of significant aquatic plant populations can result in accelerated accumulation of sediments and filling of the lake. The purposes of sediment removal, therefore, are to remove nutrients and aquatic plants and to deepen shallow areas so that future plant growth is reduced (both by reducing nutrient availability and by increasing the water depth and thus shading).

Sediment removal operations can be conducted using a variety of mechanical equipment from backhoes and drag lines which dig the sediment from the shore to floating barge hydraulic systems that remove a slurry of sediment and water and pump it to a settling pond on-shore. A significant consideration with sediment removal is the disposal of removed sediments and water. Lakes act as sinks for not only nutrients but also potentially toxic materials. Sediment testing is often required prior to establishing an appropriate sediment disposal plan. The water contained in the removed sediment is often substantial as well, which adds to the challenge.

Advantages of Sediment Removal:
- effective in removing existing plants and nutrient rich sediments,
- increases the depth of the system and reduces the areas available for plant growth,
- site specific management.

Disadvantages of Sediment Removal:
- operation costs are typically expensive and labor intensive,
- problems with equipment access and location for disposal,
- potential for increased turbidity and short-term impacts to water quality,
- not species specific
- may remove beneficial habitat.

Costs for Sediment Removal:
- $200,000 to $400,000 for design, inspection, environmental monitoring,
- $0.15 to $0.80 per cubic foot for hydraulic dredge,
- disposal costs not possible to estimate; would be significant.

Appropriateness for Sacheen Lake:
- Sediment removal is not considered appropriate for Milfoil control at Sacheen Lake due to the lack of target specificity, the need for sediment disposal areas and its high cost.

• **Water Level Drawdown**: Drawdown (or pump down) of the lake water levels, especially during the winter months, can have a dramatic impact on some aquatic weed problems. This methodology is possible where there is a water control structure which will allow lakes or reservoirs to be drained. Alternatively, high capacity pumps must be used to draw water levels down.

Drawdowns will expose the lake sediments to loss of water and, depending on location, on freezing. Freezing in particular can have a dramatic impact on aquatic plants that have no over-wintering structure like seeds, turions, tubers or winter buds. The impact on the root crowns of prolonged exposure to sub-zero temperatures is often fatal. As the lake is refilled regrowth from these crowns either does not occur or is severely stunted. There can also be a reduction in some other types of problematic vegetation using this technology if the drawdown is prolonged. The loss of water, and concurrent compaction that can result from drawdown can also be a benefit as it can slow the colonization and growth of some rooted plants.

This technique is not one that can claim eradication normally, and plants will survive in portions of the lake where water remains over the sediments. If the drawdown can extend to the deep edge of the plant communities it is obviously more effective than shallower drawdown that only expose nearshore areas.

Drawdown can have minimal cost if an outlet control structure of sufficient height is in place. This is not the case in the Sacheen Lake. Given the lake bottom topography and expected continued inflows, it is unlikely that the lake could be drawn down more than six to eight feet. Finally, this technique can negatively effect the fish and wildlife habitat in the lake and would have obvious implications for water rights users. For these reasons, drawdown is not recommended in this lake system.

Advantages of Drawdown:
- no addition of toxic chemicals to the water,
- useful for repair and maintenance of shoreline features.

Disadvantages of Drawdown:
- likely adverse environmental impacts,
- temporary loss of recreation,
- low probability of success given lake morphology and levels of inflows.

Costs of Drawdown:
- (not determined).

Appropriateness for Sacheen Lake:
- Drawdown is not considered appropriate for Sacheen Lake due to the lack of target specificity, the significant impacts that this would have to the lake biota (and potentially water quality), the potential difficulty in refilling the lake to ensure recreation uses will be available and the cost.

Currently Available Techniques - Mechanical Control.

• **Hand Cutting**: This technique involves cutting of plants below the water surface, but roots are not generally removed. Tools used in cutting include scythes, thin cables, rakes or other specialized devices that can be pulled through the weed beds by boat or from shore. One popular device consists of two single-sided stainless steel blades forming a "V" shape which are connected to a four foot handle and tied to a rope.

Advantages of Hand Cutting:
- immediate removal of nuisance submerged plant growth,
- costs are minimal,
- can be performed throughout the season as needed.

Disadvantages of Hand Cutting:
- labor intensive and time consuming,
- generally not species specific
- visibility may become impaired by turbidity generated by cutting,
- short-term plant control as the root system is not removed; cutting is typically needed multiple times each season,
- may be difficult to contain and remove plant fragments.

Costs of Hand Cutting:
- cutting devices range from $50 to $800
- no labor cost if performed by volunteers,

Appropriateness for Sacheen Lake:
- Hand cutting is not considered appropriate for Sacheen Lake due to the likelihood that plant fragments would be released, thus spreading the infestation, and the difficulty in cutting Milfoil in the many rocky areas of the lake shoreline.

• **Mechanical Harvesting**: An extension of the hand cutting discussed above involves the use of larger equipment that can cut or mow aquatic plants below the water surface. Barge mounted weed cutters, for instance, will cut the stems of submerged vegetation over large areas, with that vegetation typically floating off or being collected by the operator with some other implement. Aquatic weed harvesters are an improved version of a large weed cutter. These systems cut, collect and transport the vegetation for disposal on shore. A typical weed harvesting system will consist of the harvester and a shore station for unloading the harvested vegetation into a transport system for disposal.

Aquatic harvesters have a number of cutting blades located on the harvesting head and a conveyor system behind the knives that collects the plants and deposits them on a barge. There is typically a storage conveyor system that the plants fall onto when cut that facilitates unloading the machine at the shore station. The shore station equipment is usually either a shore conveyor that mates to the harvester and lifts the cut plants into a dump truck or other transport system, or a trailer conveyor that performs the same function as well as transports the harvester from lake to lake. Harvesting systems normally cut the plants from five to seven feet below the surface and can harvest up to two acres per day depending on the distances to off-loading sites.

Aquatic plant harvesters work well at cutting the plants and removing the bulk of the plant material from the lake. They do allow some plant fragments to escape, however, and they do not necessarily inhibit the continued growth of the cut plants. Harvesting is also not species specific (unless used in single species dominated areas) aquatic plant harvesters remove significant amounts of young fish and invertebrates during harvesting operations. Harvesters should not be used on lakes that are infested with Milfoil in the pioneering or early colonization stages since additional fragments will accelerate the spread of the plant.

It is worthy of note that a number of Sacheen Lake shoreline landowners brought in a harvester to address Milfoil growth in selected lots the year before the Sonar treatment. This effort was considered by the harvester operator and the landowners to be a failure due to the difficulty in harvesting and collecting plant fragments around docks and in the many rocky shoreline areas.

Advantages of Mechanical Harvesting:
- no toxic chemicals added to lake,
- immediate removal of plants and contained nutrients,
- limited interference with use of the water body,

- minimal bottom disturbance,
- reduction in sediment accumulation by removing organic matter which normally decays and adds to the bottom sediments
- harvested plants can be used as compost.

Disadvantages of Mechanical Harvesting:
- slow process (two acres per day under ideal operating conditions), dependent on availability of off-loading sites,
- labor and equipment intensive; must involve cutting and collection of plant material,
- typically requires repeat cutting for full season control,
- creates plant fragments which have potential to spread and establish in other portions of the lake (especially a concern with exotic species),
- non-selective and can be detrimental to non-target plants and animals
- high capital costs for machine purchase or use by management consultant

Costs of Mechanical Harvesting:
- $600 to $900 per acre for contract commercial aquatic plant harvesters,
- $100,000 to $180,000 for harvester/off-loader purchase,
- cost of disposal not determined.

Appropriateness for Sacheen Lake:
- Mechanical harvesting is not considered appropriate for Sacheen Lake because of the need for regular, repeat cuttings, the difficulty in cutting effectively in the rocky shoreline areas and the cost.

• **Rotovation**: Rotovation, or underwater cultivation, is a newer concept in mechanical aquatic plant management. It can provide for longer term control of some aquatic plants (than with harvesting) and it can remove plants to greater depths than conventional harvesters (approximately 12 feet versus five to seven feet). Rotovators are basically underwater rototillers which churn the bottom sediments to a depth of up to 12 inches. This action dislodges plants and root crowns. Typical rotovation will provide one to three years of acceptable weed control.

Dislodged plants must be collected as they float to the surface. As with plant cutting or harvesting, rotovation should not be considered in lake or river systems where plants are in the pioneering stages of an infestation and/or spread by fragmentation. Rotovation would not be expected to control non-rooted plants such as Coontail (*Ceratophyllum demersum*).

Advantages of Rotovation:
- removes entire plant including roots,
- longer effectiveness than with harvesting,
- plant density becomes reduced after successive treatments.

Disadvantages of Rotovation:
- does not collect plants or fragments which are uprooted,
- temporarily destroys bottom habitat and potentially fish spawning areas,
- causes turbidity and potential release of nutrients,

Costs of Rotovation:
- $1,000 to $2,000 per acre.

Appropriateness for Sacheen Lake:
- Rotovation is not considered appropriate for Sacheen Lake due to the lack of target specificity, the potential that this will significantly spread the problem through fragment generation and the difficulty in using this technique in rocky shoreline areas.

• **Diver directed suction removal**: Diver suction removal has been used since the 1970's as an improvement to hand removal of sparse colonies of Eurasian watermilfoil. The technique utilizes a small barge or boat carrying portable pumps with suction hoses that are directed by SCUBA divers. Divers dislodge the plant tissue and root system from the sediments and basically vacuum up the plant material which is carried back to the barge. On the barge, plant parts are sieved out and retained for land disposal while water and sediment materials are allowed to drop back into the lake.

Diver suction removal can be highly effective under the appropriate conditions. Efficiency of removal is dependent on sediment condition, plant size and density, and underwater visibility. It is best used for localized infestations of low plant density where fragmentation must be minimized. This technique is also selective in that divers can target a single species in a mixed population area.

An environmental concern with diver suction removal is that of turbidity and nutrient release from disturbed sediments. This is primarily applicable with light, organic sediments that often accumulate in heavy weed bed areas. However, the divers typically do not let the suction intake come near the sediments, rather they pull the target plants up out of the sediment and direct the plant into the suction intake. While sediment curtains can be used to minimize the drift of re-suspended sediment materials and also escaped plant fragments, there is no practical way of controlling nutrient release. Placement of sediment curtains is also time consuming and, thus, costly.

Advantages of Diver Suction Removal:
- species selective and site-specific control,
- minimal disruption of sediments and surrounding habitat with non-rooted plants,
- minimal release of plant fragments,

- no depth constraints, effective near obstacles,
- effective in covering large areas with light plant growth.

Disadvantages of Diver Suction Removal:
- labor intensive and expensive,
- may not be appropriate control method in dense plant beds,
- potential release of nutrients and sediments, potential short-term increased turbidity.
- may not work well in gravelly or rocky areas due to the difficulty in pulling up all root fragments

Costs of Diver Dredging:
- $1,000 to $2,000 a day for two divers and support boat,
- typical coverage from 0.25 to 1.0 acres per day.

Appropriateness for Sacheen Lake:
- Diver operated suction removal has some applicability at Sacheen Lake and this is therefore included in the Integrated Treatment Action Plan described below. However, due to the expected cost of this type of treatment it is considered only as a backup technique.

Currently Available Techniques - Biological Control. The biological control of aquatic plant problems focuses on the selection of organisms that have an impact on the growth of a target plant. By stocking a lake with these organisms, or "agents", the population of the target plant can be reduced. Biological control is not an exact science at this time. There have been a number of dramatic success stories with the control of aquatic weeds using some organisms. There have also been some undesirable effects from their use. The majority of the tools in this field are in the experimental or review stage at this time.

Biological control agents are generally of two types. There are general agents like grass carp that will consume most aquatic vegetation. As such, they are of limited use when trying to target specific plants. The second type of "biocontrol" agent are those that are target-specific for problematic species. Many of these agents focus on exotic plants that have been introduced to this country. Research typically starts in the region of the world where these plants are from, and focuses on the organisms that keep it in check there. Once identified, these organisms are brought through a quarantine protocol into this country where further research is conducted to determine if there is operational potential for control. At this time there are no biological control agents available in Washington State which are effective against *M. spicatum* other than grass carp.

• **Grass Carp**: Grass carp (or White Amur) are plant consuming fish native to China and Siberia. There are a wide range of aquatic plants that these fish will eat, but they have definite feeding preferences and will generally eat the plants they prefer first. Stocking rates

are dependent on climate, water temperature, type and extent of plant species and other site-specific conditions. The recommended maximum stocking rate in Washington is 25 fish per acre (**Bonar et al. 1996**) and the typical stocking rate is nine fish per acre (Hamel 2002). A study of grass carp usage in Washington has indicated that in most cases grass carp either have little effect or will eat all submersed plants.

Periodic restocking is generally necessary to replace fish lost to predation or disease and to maintain the number of young, actively growing (and thus actively eating) fish. Only triploid (sterile) fish can be planted in Washington and by permit only. Grass carp must be imported by approved suppliers and be certified to be disease and Zebra mussel free and sterile. Inlets and outlet screens must be installed in the lake and be approved by WDFW biologists prior to stocking.

Water Quality is seen to generally improve after introduction of grass carp; with the elimination of large mats of vegetation, bottom dissolved oxygen levels generally increase from levels lethal to fish and pH generally decreases with decreases in photosynthesis (**WDFW 1990**). However, water turbidity increases have also been documented due to grass carp stirring up bottom sediments. Effectiveness of grass carp in controlling aquatic weeds depends on feeding preferences and metabolism which vary from region to region. Some plant species which appear to be preferred include pondweed species, Coontail and Elodea. Plant control effectiveness is site specific and significant control of vegetation may not be apparent until two to four years following introduction. While grass carp have been reported to also consume filamentous algae, their effect on planktonic algal forms is unknown.

Advantages of Grass Carp:
- non-toxic
- long-term effectiveness

Disadvantages of Grass Carp:
- may not control the Milfoil that is problematic in Sacheen Lake,
- may alter composition of plant community without decreasing overall biomass,
- may decimate submersed aquatic plants and result in worst algae problems, and disruption of native fish habitat,
- inlet and outlet screens must be constructed and must allow passage of native salmonid fishes,
- carp foraging may cause turbidity and foster algal growth through re-suspension of sediment materials.

Costs of Grass Carp:
- $10.00 to $15.00 per fish (plus delivery),
- typical stocking rates are 9 to 15 fish per acre,
- inlet / outlet screen costs not determined.

Appropriateness for Sacheen Lake:

- Grass carp are not considered appropriate for use in Sacheen Lake due to their uncontrollable nature, lack of target specificity and, thus, potential adverse effects on the native plant populations and fish habitat in the lake.

Currently Available Techniques - Chemical Control. Chemical herbicides are one of the leading methods of controlling, and in some cases, eliminating, noxious aquatic plant growth. The herbicides which are approved for aquatic use by the US EPA are well reviewed and considered compatible with the aquatic environment when used according to label directions. In addition to the review and regulation provided by the EPA, the Washington Department of Ecology completed an Environmental Impact Statement (EIS) in 1992 for the aquatic plant management program which allows for the introduction of a number of compounds into state waters. This EIS was recently updated by WDOE and information contained in the Supplemental EIS (**WDOE 2001c**) as been used in the preparation of this IAVMP. The WDOE also evaluates the use of herbicides on a lake-by-lake basis through required short-term water quality modification permits. Note that the application of chemicals for aquatic pest control can only be performed by a licensed pesticide applicator with an aquatics endorsement.

There are two general types of aquatic herbicides in use; referred to as "contact" and "systemic" products. Contact herbicides kill susceptible plant stems and leaves generally leaving roots and some reproductive structures alive and capable of regrowth. As such, a contact herbicide is generally considered a maintenance tool, one that can provide relief from aquatic plant problems, but not something that can eliminate the problem from the lake system. Systemic herbicides are absorbed and carried throughout the plants thereby making them capable of killing the entire plant.

The contact herbicides approved for use in Washington State are Endothall and certain copper-containing products. The three systemic herbicides which are registered and approved for use in Washington are Fluridone, 2,4-D and Glyphosate. Glyphosate is not appropriate for control of submersed plants and will not be discussed in this IAVMP.

The WDOE is currently reviewing two additional herbicides for future use in state waters. Diquat is a contact herbicide which has been successfully used to control a broad spectrum of aquatic plants. This product is approved by the US EPA and is registered for use in most states. Triclopyr is a systemic herbicide which is effective in selectively controlling some emergent and submersed aquatic plants. These two products are described below in the Developing Techniques section.

• **Fluridone**: Fluridone is available in the SePRO Corporation products Sonar AS® (a liquid formulation), Sonar SRP® (a slow release pellet formulation) and Sonar PR® (a "precision release" pellet formulation). Fluridone is also available in the Griffin LLC liquid product Avast. A product label for Sonar AS® is included in Appendix C as an example of a fluridone product.

Fluridone can show good control of submersed and emergent plants, including Milfoil, where there is little water movement and an extended time for the treatment. It is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. Because of the eight- to ten-week recommended treatment period, treatments should take place in early spring or fall.

Fluridone interferes with the synthesis of RNA, proteins and carotenoid pigments and thereby affects photosynthesis (**WDOE 2001c**). Use of fluridone does not pose a threat to human health or to fish and wildlife when used according to the label (**SePRO 2000**). While there is a short term (seven to 30 days) precaution when using treated waters for irrigation, there are no other water use restrictions when using the liquid formulation of fluridone.

Advantages of Fluridone:
- systemic herbicide, will kill entire target plants,
- variety of plants are susceptible, based on treatment rates and program design,
- species specificity with correct application rates,
- non-toxic to humans, pets, fish and wildlife,
- no water use restrictions for fishing, swimming or livestock/pet consumption.

Disadvantages of Fluridone:
- Long exposure period required in order to effectively control plants (many times requiring multiple application or minimize flow conditions)e,
- Potential for drift from application area, requires whole lake or enclosed area treatments,

Costs of Fluridone:
-$155,000 to perform a whole-lake treatment of Sacheen Lake

Appropriateness for Sacheen Lake:
- Fluridone products are not considered appropriate for use in Sacheen Lake at this time due to the limited but spread out extent of the infestation (ie. the need for spot treatments) and the cost.

• **Endothall**: Endothall is a contact herbicide available in the **Cerexagri, Inc.** products Aquathol K® (a liquid formulation), Aquathol Super K® (a granular formulation), and Hydrothol 191® (both liquid and granular formulations). A product label for Aquathol K® is included in Appendix C as an example of an endothall containing product.

Endothall compounds are used primarily for short term (one season) control of a variety of aquatic plants (and algae in the case of Hydrothol 191®). The mode of action of Endothall is not fully understood although the hypotheses indicate that this chemical disrupts biochemical processes at the cellular level (**WDOE 2001c**). Target plants for Aquathol K® and Aquathol Super K® include Milfoil (**Cerexagri 2000**). Neither Coontail or Elodea is listed as a target for Hydrothol 191® (liquid or granular). Duration of control with Endothall products is dependent upon target species, contact efficiency, lake conditions and regrowth form unaffected root masses.

Use of Endothall involves several water use restrictions and it can be toxic to fish although there is a wide margin of safety between allowed application rates and rates that are toxic. At application rates needed to control Milfoil (2.0 to 4.0 ppm) the water use restrictions are: do not use fish from treated areas for food for three days and do not use water from treated areas for watering livestock, preparing agricultural sprays for food crops, for irrigation or for domestic purposes for seven to 14 days after application. There is no swimming restriction for Endothall products. Fish toxicity is not a factor, according to the product labels, at doses below 100 ppm (**Cerexagri 2000**).

Advantages of Endothall:
- fast acting injury to plant tissue which is typically apparent in one to two weeks,
- little or no off-target drift impacts,
- spot treatments possible,

Disadvantages of Endothall:
- only provides temporary reductions in plant growth,
- non-target plant impacts are difficult to mitigate as this is a fairly broad spectrum herbicide (Elodea is not listed as susceptible),
- water use restrictions in place,
- rapid action may cause oxygen depletion and rapid release of nutrients into water

Costs of Endothall:
-$650.00 per treated acre

Appropriateness for Sacheen Lake:
- Endothall products are not considered appropriate for use at Sacheen Lake due to the lack of systemic action and the lack of target specificity.

• **Diquat**: Diquat dibromide is a fast acting, broad spectrum contact herbicide and algaecide found in the product Reward® which is manufactured by **Syngenta** (formerly Zeneca Ag Products, Inc). A Reward® label is included in Appendix C.

Diquat is effective on a variety of submersed plants, including Milfoil, and also some types of filamentous algae. Diquat's mode of action is to generate "reactive oxygen radicals" which disrupt photosynthesis. Diquat kills plants rapidly so depletion of oxygen and release of nutrients from plant decay is a potential problem. As with all contact herbicides, plant roots are not effected and repeated applications may be needed for complete season control.

Contrary to this general efficacy, Diquat has been used in Hayden Lake, ID with some apparent systemic effect. In this case, Reward was applied by a diver or a "drop hose" to the lower third of plants in dense Milfoil beds. The diver used a wand and nozzle connected to a pressure tank onboard a nearby support boat to treat one acre while the boat treatment involved holding the wand and nozzle down into the water while travelling across a two-

acre bed. Followup diver inspection of these treatment areas one year later found only occasional Milfoil sprigs (new plants) in the diver-treated area and approximately one-half acre of live plants in the boat treatment area (Daniel 2002)

Diquat has slight toxicity to most animals and freshwater fish. It is slightly to highly toxic to aquatic invertebrates. It is for this reason that diquat has not been permitted by WDOE for use in Washington State waters since 1992. Diquat is currently being reviewed for possible re-approval for future aquatic uses. The effectiveness of diquat on target plants such as Eurasian watermilfoil is found to be heightened through the use of tank mixes with copper containing products such as Nautique.

Water use restrictions which would be in force with diquat applications for Milfoil control (two gallons Reward per surface acre) are three days for drinking, one day for livestock drinking, three days for irrigation to turf and ornamental and five days for irrigation to food crops. There is no restriction for fishing or swimming in treated water (**Zeneca 2000**).

Advantages of Diquat:
- effective against many plant species,
- rapid action,
- no bioaccumulation,
- no fishing or swimming restriction.

Disadvantages of Diquat:
- persistent, especially in sediments,
- water use restrictions in place,
- potentially toxic to aquatic organisms,
- repeat applications needed to maintain control
- rapid action may cause oxygen depletion and rapid release of nutrients into water

Costs of Diquat:
- $282.00 per acre for Reward®

Appropriateness for Sacheen Lake:
- Reward (diquat) is not considered appropriate for use at Sacheen Lake due to the lack of systemic action and the lack of target specificity.

• **2,4-D**: 2,4-D is a fast-acting systemic herbicide with two formulations approved for freshwater applications in Washington State. The two formulations are the butoxyethyl ester (BEE) formulation found in the granular products AquaKleen® (produced by Rhone Poulenc and marketed by CerexAgri) and Navigate® (marketed by Applied Biochemists); and the dimethylamine (DMA) formulation found in the liquid product DMA4® IVM, produced by Dow AgroSciences LLC. Product labels for AquaKleen®, Navigate® and DMA4® are included in Appendix C.

The mode of action of this chemical is primarily as a stimulant of plant elongation and cell division (**WDOE 2001c**). 2,4-D is a post-emergent herbicide that is primarily used to control watermilfoil and water stargrass. Typical submersed monocot plants (ie. the pondweeds) are not susceptible to 2,4-D so this product can be used for selective plant control.

2,4-D can be effectively used in spot-treatment programs in lakes or ponds. Effectiveness of the treatment is dependent upon the timing of the application and density of the target plant community. Two treatments may be required when targeting dense communities. Susceptible plants will begin to show signs of injury one to two weeks after treatment, followed by plant breakdown and death.

There is no fishing or swimming restriction associated with the use of 2,4-D although the WDOE recommends "that due to risk of dermal contact, a swimming advisory shall be posted advising swimmers to wait 24 hours before reentering directly treated areas to allow time for granules to disperse" (**WDOE 2001c**). 2,4-D cannot be used in waters used for irrigation, agricultural sprays, watering dairy animals or domestic water supplies (**Applied Biochemists 2002**). The recent risk assessment prepared for WDOE as part of the 2001 Final Supplimental Environmental Impact Statement for the aquatic plant management program (**WDOE 2001c**) indicated that "no significant adverse impacts on fish, free swimming invertebrates or benthic invertebrates" should be expected from 2,4-D (either formulation) applications at appropriate label rates. Additional toxicity information from this risk assessment is included in Appendix C following the Navigate and DMA4 labels.

Advantages of 2,4-D:
- fast-acting systemic herbicide which is effective in removing selected plants with little or no impact on certain non-target plants at labeled rates,
- applications conducted easily with granular or liquid material in a large or small scale applications,
- treated waters can be used for swimming within 24 hrs (WDOE restriction),
- no fish consumption restrictions.

Disadvantages of 2,4-D:
- application must be conducted 0.5 miles or greater from active drinking/domestic water withdrawals (unless approved by WDOE),
- 24 hour swimming restriction imposed by WDOE,
- treatment windows apply to areas were Endangered Species Act (ESA) listed salmonids occupy (according to WDFW specifications).

Costs of 2.4-D:
- $600 per acre applied, target dose 1 ppm.

Appropriateness for Sacheen Lake:
- 2,4-D (either of the listed formulations) is appropriate for use in Sacheen Lake due to the specificity for the target species (Milfoil), the rapid systemic action and dissipation of the

herbicide, the demonstrated efficacy in Sacheen and the general acceptance of this chemical based on past uses. This is the preferred treatment method as described in the Integrated Treatment Actin Plan, below.

• **Copper Compounds**: There are currently two products containing copper that may be used for control of aquatic weeds although copper compounds are not currently allowed in Washington state. They are: Nautique®, manufactured by SePRO Corporation, and Komeen®, manufactured by Griffen. These are both "chelated" or complexed compounds. A product label for Nautique is included in Appendix C as an example of a copper herbicide.

Although copper is an essential element for plant growth, high concentrations of copper will inhibit photosynthesis and result in death of plants and algae. Chelated copper complexes where developed to maintain concentrations of the copper ion in water column over a longer period of time. The extended exposure of the copper ion in solution provided improved control plants and algae. Copper products for aquatic weed control are applied by subsurface injection. Effectiveness of applications is enhanced by warm temperatures and sunlight. These conditions stimulate copper uptake by plant cells and increase the rate at which the plants will be controlled.

Given the known toxicity of copper compounds to aquatic life, primarily fish, and given the recent Endangered Species Act listings of several salmonid species in Washington State waters, the WDOE made a policy decision in March 2000 to disallow the use of copper in salmon-bearing waters.

Advantages of Copper:
- relatively low cost treatments,
- no water use restrictions,
- provide effective and rapid control of algae blooms.

Disadvantages of Copper:
- acts as contact herbicide therefore does not kill plant roots,
- not allowed for use in waters discharging to or occupied by salmonid species (requirement of WDOE, not part of EPA label),
- remains bound to sediments and organic over a long period of time
- limited to treatments in hard water lakes and ponds
- may require extensive water testing and monitoring in systems with outflow

Costs of Copper:
- $730 per acre for Nautique, applied (water depth of 8 feet and target dose of 0.8 ppm).

Appropriateness for Sacheen Lake:
- Copper compounds are not considered to be appropriate for use in Sacheen Lake due to their lack of systemic actions, the WDOE restriction on their use in salmonid bearing waters and potential environmental concerns over accumulation.

Developing Techniques. There are a number of techniques which are under investigation as possible plant and algae control agents; these being primarily biological agents. These include plant pathogens, herbivorous insects, competitive plants and plant growth regulators. The research with these agents has focused primarily on their effect on noxious submersed plants such as Eurasian watermilfoil and Hydrilla

• **Triclopyr**: This is a systemic herbicide produced by SePRO Corporation that is not yet fully registered for aquatic uses. EPA registration is expected to be completed in 2002, however, for the product Renovate® which is a water soluble triethylamine salt formulation containing three pounds of triclopyr acid equivalent per gallon.

Triclopyr is a product that has been tested extensively and found to be effective on broad-leafed (dicotyledonous) plants such as Milfoil. This product is specific for this type of plant and can be used in habitat recovery programs focusing on selective removal of these plant pests. It will not affect plant species in the monocot family, which is the majority of native aquatic and wetland plant types. Renovate® is a liquid product with a contact time requirement of 24 to 48 hours so it has applicability in spot treatments. Suseptible submersed plants exhibit epanasty (bending and twisting of plant tissue) in 6 - 12 hours after treatment. Treated plants begin to sink slowly three to five days after treatment and one to three weeks later plants should be well below the surface, often near the bottom.

Photodegradation is the major route of triclopyr degradation in aquatic environments. The first order half-life for Renovate® is 0.5 - 3.0 days. No accumulation occurs on sediment and no bioconcentration is believed to occur in sport fish or bottom feeding species. Toxicity testing on fish and other non-target organisms performed by or for the manufacturer has indicated that Renovate® has a low toxicity potential (SePRO Corporation 2002).

Renovate has been used locally under an Experimental Use Permit, particularly in Diamond Lake and in the Pend Oreille River. The observed efficacy of this product was very good in a 1.5 acre bay in Diamond Lake but was poor in a six acre bay above Albeni Falls Dam (this latter most likely due to dilution from the flow in the river). Water use restrictions may be a factor in the use of Renovate®; information on this will be listed on the product label.

Advantages of Triclopyr:
- selective for broad leafed plants,
- short contact time needed,
- systemic action so entire plant is killed.

Disadvantages of Triclopyr:
- not currently registered for aquatic use,

Costs of Triclopyr:
- $1,700 per acre, applied (water depth of 8 feet and target dose of 1.5 ppm).

Appropriateness for Sacheen Lake:
- Renovate® (triclopyr) would be appropriate for use in Sacheen Lake, if it were fully labeled, due to its short contact time requirement. The current cost of this chemical is substantially higher that the preferred 2,4-D. Triclopyr should be re-evaluated for use at Sacheen when it does become labeled.

• **Milfoil Weevils**: A potential biological control agent that has received considerable research attention in several northwest, northeast and mid-western States, including Washington, is the aquatic weevil *Euhrychiopsis lecontei*. This organism has been associated with declines of *M. spicatum* in the United States (e.g. Illinois, Minnesota, Vermont, and Wisconsin). Researchers in Vermont found that this weevil can negatively impact Milfoil by suppressing the plants growth and reducing its buoyancy (Creed and Sheldon 1995).

The following description is excerpted from University of Minnesota, Department of Fish and Wildlife website (http://www.fw.umn.edu/research/milfoil/milfoilbc.html): The milfoil weevil is native to North America and is a specialist herbivore of watermilfoils. Adult weevils live submersed and lay eggs on milfoil meristems. The larvae eat the meristem and bore down through the stem, consuming the cortex, and then pupate (metamorphose) lower on the stem. Development from egg to adult occurs in 18-30 days at summer temperatures. The consumption of meristem and stem mining by larvae are the two main effects of weevils on the plant and this damage can suppress plant growth, reduce root biomass and carbohydrate stores and cause the plant to sink from the water column. Although the weevil has been quite effective at some sites, it has not been effective at other sites. Currently, we cannot predict when, where and how the weevils will or will not be effective. The aim of our work is to improve our understanding so we can predict effects and appropriate circumstances for use of biocontrol.

In Washington State, the Milfoil weevil is present primarily in eastern Washington (including Sacheen Lake) and occurs on both *M. spicatum* and northern watermilfoil (*M. sibiricum*), which is native to the State (Tamayo et. al. 1999). During the summer of 1999, researchers from the University of Washington determined the abundance of the Milfoil weevil in 11 lakes in Washington. They found that weevil abundance ranged from undetectable levels to 0.3 weevils (adults and larvae) per stem. Fan Lake, Pend Oreille County had the greatest density per stem or 0.6 weevils (adults, larvae and eggs per stem) although the weevils there were present on northern watermilfoil not *M. spicatum*. These abundance results are well below the recommendations made by other researchers in Minnesota, Ohio, Vermont, and Wisconsin of having at least 1.5 - 2.0 weevils per stem in order to control Eurasian watermilfoil.

To date, there have not been any documented declines of Eurasian watermilfoil in Washington State that can be attributed to the Milfoil weevil, although Creed speculated that declines of Eurasian watermilfoil in Lake Osoyoos and the Okanogan River may have been caused by the Milfoil weevil. In Minnesota, Cenaiko Lake is the only lake in that state that

has had a Eurasian watermilfoil crash due to the weevil; other weevil lakes are yet to show declines in Eurasian watermilfoil.

The WDOE and the Pend Oreille County Noxious Weed Control Board are currently involved in culturing Milfoil weevils for use in experimental treatments on *M. spicatum* control. At the time of this writing there were still a number of factors related to the growth and survival of the weevil and their efficacy in causing declines in Milfoil growth that need to be better understood before this organism can be seen to be an effective option.

Advantages of weevils:
- non-toxic
- potential long-term effectiveness

Disadvantages of weevils:
- Weevils may not control M. spicatun in lakes with populations of native watermilfoils,
- Weevil densities may be reduced below effective levels due to predation by sunfish and other environmental factors.

Costs of Milfoil weevils:
- Milfoil weevils currently cost $1 each from commercial producers.

Appropriateness for Sacheen Lake:
- Milfoil weevils are not currently appropriate for use in Sacheen Lake. This technique should be re-evaluated when more is known about their growth and effect on Milfoil.

INTEGRATED TREATMENT ACTION PLAN

Overview

Integrated Aquatic Vegetation Management Plans (IAVMPs) are designed to be site specific based on the type of plant problem present and the needs of the water users. An IAVMP reviews all control options available and selects the best mix to apply to the problem over time. An IAVMP is not a one-year management tool; it evolves as conditions in the lake or river system change. For example, if a lake has a major Eurasian watermilfoil infestation, the first years of the program may focus on that problem and select tools to target that plant. In later years, there may still be problematic weed growth, but it could be from native plant communities or from different aquatic weed species. Different tools might be considered in these cases and applied. The management plan should have both short-term and a long-term strategies.

Control Intensity

The current aquatic plant problem at Sacheen Lake is related to the ongoing growth of Eurasian watermilfoil. Specific problem areas are the shoreline areas. As a result, preventative and high intensity controls are recommended for the short term and preventative and low intensity controls are recommended for the long term. These controls (detailed in the Recommended Control Strategy section below) are:

- **Short Term (2002 - 2005):** Institute Education / Awareness Program, Diver hand removal 2,4-D applications for Milfoil control (or diver directed suction removal if 2,4-D is not available).
- **Long Term** Continue Public Awareness and Involvement Program, institute and continue locally funded Milfoil control maintenance activities focusing on non-chemical methods.

Recommended Control Strategies

The management of aquatic plants and algal growth in Sacheen Lake must work within the limitations of what is feasible based on the physical, chemical and biological state of the lake, financial resources and the political and regulatory environment.

Public Awareness and Involvement Program. The Sacheen Lake residents have indicated their concern for the protection of the beneficial uses of "their" lake and also their willingness to be involved in lake management efforts at various levels. As a result, it is highly recommended that residents be given as many options as possible to continue and/or increase their involvement. These options should include training in aquatic vegetation identification, Milfoil survey and removal techniques, involvement in actual survey and removal efforts and also involvement in monitoring and data collection. More specifically, volunteers will be needed for participation in diver hand removal efforts and boat operators will likely be needed for both the diver removal work and surveying efforts. It is expected that most property owners around the lake will likely have the greatest interest in their own shoreline area so individual or small group efforts with this local focus should be fostered. Much of the property owner participation is also expected to be simply attendance at meetings and training sessions so these sessions should be made as interesting and focused as possible to maintain or expand this level of participation as well.

Annual Surveillance and Mapping. The annual Milfoil surveillance efforts which have been performed at Sacheen Lake since 1998 should be continued in perpetuity. This program includes three days for two divers and a manned support boat to perform tows through the lake's littoral zone. However, it is not feasible for divers to be towed in between residence docks or in water less than four feet deep. Therefore, snorkeling or observations made from boats or the shore should also be performed to supplement the diver work. Altogether, it typically takes five days per complete survey.

The survey performed in 2001 included the use of Global Positioning System (GPS) equipment to help document the locations of the Milfoil infestations, either individual plants or dense patches of plants. The GPS data was then imported into a Geographic Information System computer program and Milfoil distribution map was prepared (see Appendix B). It is recommended that GPS / GIS mapping be performed as a regular component of the annual surveillance. The GIS map produced and an explanatory report should be prepared and provided to the Sacheen residents as part of the Education / Awareness program.

2,4-D Applications. Based on past Milfoil control efforts at Sacheen and other local lakes, as well as the information presented in the CONTROL ALTERNATIVES section of this Plan, it appears that spot applications of granular or liquid 2,4-D, combined with diver surveys and diver hand removal, present the greatest opportunity to break the current Milfoil growth cycle and meet the Management Goals stated above. It should be noted, however, that these Goals also indicate that it is desirable that Milfoil control does not involve chemical applications every year. The herbicide 2,4-D has its' greatest utility in dense Milfoil growth areas with sparse growth being targeted by divers.

2,4-D was used for Milfoil control in 1999 and 2000 in Sacheen Lake with good success. These treatments were performed under the provisions of Enhanced Substitute Senate Bill 5424 which limited 2,4-D applications to not more than 20% of the lake's littoral area (14 acres). It can be seen from annual diver survey results that Milfoil growth increased by perhaps five to ten percent each year in spite of the 1999 and 2000 2,4-D treatments and diver hand removal (**Lamb 2001**). It is now apparent that the area treated on an annual basis needs to be greater, at least for a period of two to four years, to more effectively reduce the growth and generation of fragments. In addition, it is imperative that Milfoil growing in the Moon Creek inlets be removed if further in-lake Milfoil controls are to succeed.

The 2,4-D treatments performed to date in Sacheen Lake used cyclone spreaders or granular blowers to spread the herbicide over the water surface. The application rate was 100 pounds per acre as stated on the product label. This technique should continue to provide good results, although underwater injection of a liquid formulation should also provide the necessary contact at the depths Milfoil is found.

The Moon Creek inlet s present the challenge of achieving the necessary contact time in a flowing water situation. There are two channels in this system with the south channel having low flows (typically 5 to 15 gallons per minute) during the June through October period and the north channel having moderate flows (130 to 200 gallons per minute) during this period (**Soltero et al. 1997**). It is expected that continuous application will be necessary over a 24 to 48 hour period, at least in the north channel. This can be accomplished using a "turkey feeder" type applicator which will deliver the appropriate amount (flow weighted) of granular material, or a drip system to deliver liquid material. The use of liquid 2,4-D is preferable due to the greater accuracy in calculating instantaneous dosage and the DMA4 product is labeled for use in drainage ditches, streams and other low flow situations (**Dow**

AgroSciences 2001) while the granular formulation products are not so labeled. In either case the delivery system will have to be secured in an enclosure to prevent tampering.

The point of application on the north channel should be at the driveway crossing which is approximately 100 yards from the mouth. The south channel has a pond and wider, slower moving water so it is feasible to apply either granular or liquid herbicide in that area one or two times to achieve the necessary contact. Treatment of both Moon Creek channels should be started prior to the lake treatment to ensure that no viable Milfoil fragments are carried into the lake after the herbicide has declined there.

Milfoil growth in Sacheen Lake was not treated in 2001 except for a low-level diver hand removal effort. This was because of the uncertainties surrounding the Ninth Circuit Court decision regarding the Talent Irrigation District and the need for NPDES (but lack of) permits for all chemical treatments to surface waters. The result of not treating is expected to be a large increase in the spread of Milfoil, the extent of which will not be known until further survey is performed. The effect that the Talent case has had on this planning effort is to increase the recommended, initial treatment area to at least 30 acres per year, plus up to five acres in the Moon Creek inlets.

Due to the need for the herbicide treatments to be performed by experienced and State licensed (and insured) personnel, it will be necessary for the SLSWD to contract with a lake management contractor for this work. Due to the expected annual treatment cost, it will be necessary to advertise for Statements of Qualification / Proposals. In order to ensure that a true competitive process is followed, it is recommended that a public notice be placed in a newspaper of fairly wide distribution, at a minimum, the Spokane Spokesman Review. The SOQ / proposal solicitation process should be begun as early in the spring as possible (April or May) so that it can be completed and a contractor Agreement finalized by mid-June. It is recommended that the SLSWD obtain the assistance of the Pend Oreille County Noxious Weed Control Board in reviewing submitted proposals. It is further recommended that any monitoring that is desired or required relative to the herbicide treatments should be conducted by the SLSWD with oversight by a qualified water quality specialist and using lake resident labor to the extent that this is available.

It should be reiterated that there are water use restrictions indicated on the herbicide labels that the lake residents and users must be made aware of. While public and resident notifications will be described in the NPDES permit, the following are applicable to the use of 2,4-d in aquatic systems:

"Unless an approved assay indicates the 2,4-D concentration is 100 ppb (0.1 ppm) or less, ... do not use water from treated areas for irrigating plants or mixing sprays for agriculture or ornamental plants."

"Unless an approved assay indicates the 2,4-D concentration is 70 ppb (0.07 ppm) or less, do not use water from treated areas for potable water (drinking water)."

There are no fishing or swimming restrictions stated on the product labels but, as noted in the 2,4-D section above, the WDOE recommends that "due to risk of dermal contact, a swimming advisory shall be posted advising swimmers to wait 24 hours before reentering directly treated areas to allow time for granules to disperse".

Diver Operated Suction Removal. The other impact that the Talent case has had on this Planning effort in that there is an apparent need for a secondary, or backup treatment program. While the WDOA has received a state-wide permit to cover herbicide treatments of noxious weeds, there is still a need for a back-up treatment option. This back-up method is recommended to be diver operated suction removal. The costs of substituting suction removal for 2,4-D are substantially higher (see below) and it is recommended that a minimum of 40 days of suction dredging be performed per season (assuming one suction unit operating). Disposal of collected Milfoil should be arranged for at locations well away from the lake by the SLSWD.

If diver operated suction removal of Milfoil is undertaken it will involve a considerable effort that will span much of the summer. Therefore, it is recommended that a qualified, experienced contractor be hired to manage and implement this work, including providing and operating / maintaining one or more boat-mounted suction units. As with the herbicide treatments, this will require the competitive solicitation of Statements of Qualification / proposals. It is not expected that water monitoring will be required or necessary in conjunction with this Milfoil control measure but if it is this should be preformed by the SLSDW with appropriate oversight and local labor if possible.

Diver Hand Removal. Diver hand removal is recommended to be performed in conjunction with either 2,4-D application or diver directed suction removal. An effort of five to ten days per season is recommended. This work could be contracted out (included in herbicide application or diver suction removal contracts for ease of administration) or performed with local labor, if available. If this work is done with local labor, there should be a designated manager who will coordinate and direct this effort following the results of the herbicide or diver suction work. If is not expected that water monitoring will be needed for this effort.

Monitoring and Evaluation

Continued monitoring of aquatic plant populations and lake quality will be necessary to help guide the implementation of desired control measures and to evaluate the effectiveness of these measures. Monitoring should focus on an annual submersed plant survey and periodic sampling/analysis of basic water quality parameters. The following is a recommended program which should become an integral part of the submersed plant control program. Estimated costs associated with this work are provided in the Costs section below.

In addition to the monitoring of conditions in the lake, an annual evaluation of this IAVMP is recommended. This evaluation should include a review of the monitoring results and discussion of possible changes in the methods to be implemented. The discussion should involve participation of all interested groups including SLBA/SLSWD, Pend Oreille County Noxious Weed Control Board, WDFW, WDOE and any other affected parties. Changes could be desired following changes in funding availability, regulatory changes or other factors.

Aquatic Plant Surveillance and Mapping. This should include diver inspection of the lake's littoral area through a combination of transect inspection (perpendicular to shore at set locations) and boat tows (parallel to shore). Information on all plant species present and relative densities should be collected and a map should be prepared (preferably using GPS / GIS technology due to its greater accuracy) and to build a historical record of conditions and responses. This survey should be performed at least once a year after plants have come up in the early summer (June).

It is further recommended that the diver inspections be augmented by snorkeling and boat surveys of near-shore areas, and by shoreline walking as well. The combination of diver and non-diver methods is necessary to expedite the complete coverage of the littoral areas.

If GPS / GIS mapping is desired (or required) for this surveillance, it will be necessary to contract with a consultant firm that has this capability, in addition to having experienced diver staff who can identify the range of plant species present. Again, due to the expected annual cost of this work, a competitive solicitation process will be necessary. It is recommended that this surveillance and mapping work be included in the solicitation for an herbicide (or diver suction) contractor but made an option so that applicator/diver only firms may respond as well as surveillance/mapping only firms. This will at least make the most of the cost of the public notices.

Herbicide Treatment Monitoring. Herbicide residue analysis of surface water (lake and stream) samples will be required under the NPDES permit. The minimum recommended program for this to collect four depth-composited samples following each treatment. The first two samples will be collected the day after treatment, one sample from within a treated area and one sample outside (within 200 feet of) that treated area. Two additional samples will be collected from the same two locations four days after treatment. All samples will be submitted to an accredited laboratory for 2,4-D analysis on the day of collection. If more than one area is treated at the same time, the minimum sampling will be conducted at the largest treatment area.

Al samples shall be composits of the water column at the sampling location. This requires the use of a device that can determine the depth at a location and also a device that be lowered into the water to collect samples at desired depths. Separate samples shall be collected from the lower, middle and upper third of the water column and equal volumes of each shall be placed in bottles provided by the analytical laboratory

Sampling and analytical methods used will conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 or to the latest revision of the *Standard Methods for Examining Water and Wastewater* (APHA). In addition, sampling shall be performed by, or with oversight by, a qualified water quality specialist.

Water Quality Monitoring. Water quality monitoring should be performed by citizen volunteers with oversight by a qualified water quality specialist. The recommended sampling and data collection frequency is five times a year: March, May, July, September and November. In each of these months samples should be collected from mid-depth at two sites (EWU designation "NE" and "SW") for laboratory analysis of total phosphorus, ortho phosphorus, nitrate + nitrite nitrogen and ammonia. In addition, field data should be also be collected at the surface, mid depth and bottom of the same sites for temperature, dissolved oxygen, pH and conductivity (specific conductance). The Secchi Disk transparency should be determined at each site. Water samples should be collected using a Kemmerer type sampler in bottles supplied by the analytical laboratory. Field data can be collected using a properly calibrated Hydrolab unit or another direct reading unit(s) which allow reading the parameter "in situ", that is, in place (without having to collect a sample and bring it to the surface to analyze). Note if financial constraints place a limit on the water monitoring effort, the preferred plan would be to do the recommended monitoring at one site only and the SW site would be the most representative of the whole lake.

Project Costs

The estimated annual cost, in 2001 dollars, for the recommended integrated aquatic plant control strategy would have the following components.

TASK	ESTIMATED COST (before sales tax)
• Planning/Coordination/Administration (PER YEAR)	$1,000
• Education / Awareness Effort (PER YEAR)	$2,000
• Aquatic Plant Surveillance and Mapping (PER YEAR)	$4,750
• Water Quality Monitoring (PER YEAR)	$2,500
• 2,4-D Treatment (PER YEAR): (35 acres treated @ $600 per acre applied + permitting + monitoring)	$25,000
• Diver Directed Suction Removal (PER YEAR) OPTION (40 days equipment rental + labor + permitting)	$54,000
• Diver Hand Removal (PER YEAR)	$12,000

(10 days for two divers and support boat with operator)

Local Funding Strategy

Funding can be a limiting factor in an organization's ability to effectively manage noxious aquatic weeds. The fact that the Sacheen Lake Sewer and Water District is in existence and is interested in performing lake management projects means that some basic level of Maintenance and Operation funds will be available given voter approval. For additional work (with costs above the local funding capacity), there are a number of funding mechanisms available to assist local groups like the SLSWD. State law allows for the selling of bonds to obtain funding which must be paid back over a period of time. This was done to support the Phase I and II Restoration projects.

In addition, there are also grants available from WDOE's Freshwater Aquatic Weed Fund, although this fund is not a long-term source. There is some anticipation that the US Army Corps of Engineers Eurasian Milfoil Control Funds may be reestablished for use in Washington State in coming years. If this does occur, that could provide another source of funding for the Milfoil control program elements recommended at Sacheen Lake .

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APPENDIX A

Public Meeting Information

1. Public Meeting Announcements
2. Public Meeting Agenda
3. Project Summary Handout
4. Questionnaire
5. Attendees List
6. Public Meeting Minutes
7. Table 1. Questionnaire Response Summary

The Miner
Wednesday, September 26, 2001

NOTICE OF PUBLIC HEARING

The Sacheen Lake Sewer and Water District will hold a public hearing Sunday, Sept. 30, at 2:00 p.m. at the Sacheen Lake Fire Station regarding the development of an Integrated Aquatic Vegetation Management Plan under Department of Ecology guidelines. The purpose of this hearing and plan is to update management priorities and review public perspectives regarding the Lake's aquatic vegetation.

/s/SHEILA G. PEARMAN
Sheila G. Pearman,
Managing Secretary

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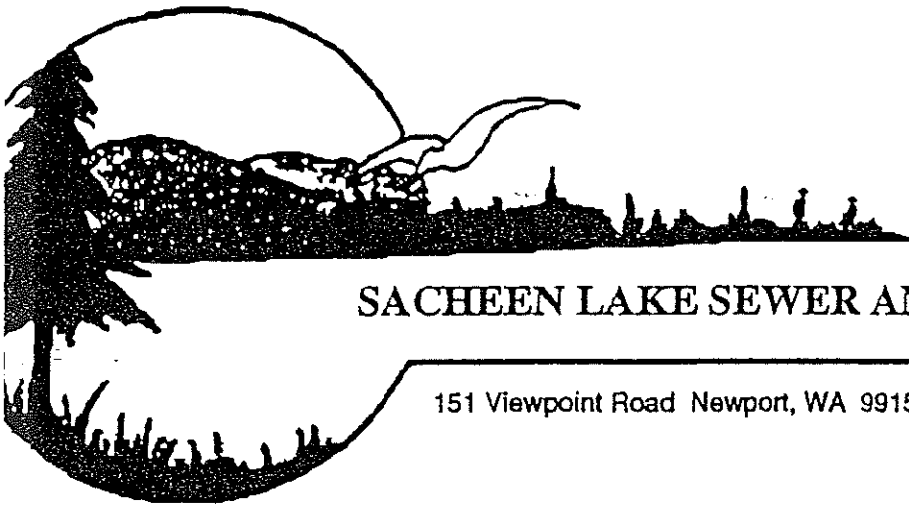


SACHEEN LAKE SEWER AND WATER DISTRICT

151 Viewpoint Road Newport, WA 99156 (509) 447-4618

September 23, 2001

The nights are cool and the days are sunny and warm.... must be September at Sacheen Lake. Summer is beautiful, but I think for many of us, September is the best month of all. As we head into fall, the Board would like to update everyone on what we have been working on.

During July and August, we had divers combing the lake for the dreaded milfoil plant. Sorry to say it was not hard to find. It has been determined that we have 15 to 20 acres of plants that should be targeted for treatment. Due to recent litigation regarding the use of aquatic herbicides, it was decided to postpone any treatment until early next season when the State has developed it's new permitting process. Several days of diver hand pulling were done in areas with smaller plant concentrations.

Our old friend David Lamb returned to Sacheen to dive and take an aquatic plant survey. We plan to use this survey to develop an Integrated Aquatic Vegetation Management Plan (IAVMP). With this plan we feel we can better update management priorities and develop long-term strategies for milfoil and other aquatic vegetation. **As part of the development of our IAVMP we will be conducting a public hearing on Sunday, September 30, 2001 at 2:00 p.m. at the Sacheen Fire Station.** At this hearing David Lamb will summarize the plant portion of our previous Phase II restoration project, present information on how and to what extent our aquatic plant effect our lives on the lake, and distribute a questionnaire on what property owner's goals and objectives regarding our aquatic plants are. If you are able to make the hearing, your presence would be greatly appreciated.

During October, we will be submitting a grant application to the Department of Ecology for funding through their Aquatic Plant Management Program that could assist us in our continued efforts against milfoil. Having the above mentioned IAVMP is one component of this grant application. Another important component of this grant is having community support. To that end we extend a big thank you to all district members for supporting our work against milfoil in the past ten years, both in the form of attendance at meetings and monetary support through your passage of our requested M&O levies.

In November, voters will select a new Sewer & Water Commissioner. Julia Vervair and Ken Zarko have submitted their names to fill the unexpired 4-year term left by Dick Materne. Julia presently holds the position as she was appointed to the board in February. Please get to know these candidates and make your choice accordingly.

Sacheen Lake, Pend Oreille County, WA
Integrated Aquatic Plant Management Plan

PUBLIC MEETING, September 30, 2001

AGENDA

INTRODUCTION

RESTORATION PROJECT SUMMARY
- Phase I study findings
- Phase II restoration accomplishments
- Post-restoration monitoring findings

POST-RESTORATION MILFOIL CONTROLS
- 2,4-d Treatments under Senate Bill
- Hand removal by divers

2001 IAVMP PROJECT
- Project Summary
- Aquatic vegetation survey
- Determination of Beneficial Uses and Effects of Aquatic Plants
  (see questionnaire)
- Determination of Management Goals

CLOSING COMMENTS

Sacheen Lake, Pend Oreille County, WA
Integrated Aquatic Plant Management Plan

PROJECT SUMMARY

General Project Goal: The goal of this project is to develop an Integrated Aquatic Plant Management Plan (IAVMP) for Sacheen Lake. The process followed to develop this Plan will utilize the local community (landowners), lake users and agencies with jurisdiction over the lake and its' watershed. This Plan will consider the need to maintain a certain level of aquatic plant as in the lake to ensure good water quality and fish / wildlife habitat. This need will be balanced with recreational and other uses that people make of the lake. Control of invasive, non-native plants, such as Milfoil, will be specifically addressed.

General Project Scope: The IAVMP project, while not funded by the State, will follow guidelines presented in Washington Department of Ecology (WDOE) Program Guidelines, the publication titled "A Citizen's Manual for Developing Integrated Aquatic Vegetation Management Plans and recent WDOE vegetation management plan guidance. The Aquatic Weeds Management Fund is a program, which is a source of funds, which can be used for aquatic weed control efforts.

The IAVMP process includes the following tasks:

- Planning
- Field reconnaissance
- Development of control options
- Development of an action plan for implementation of options and monitoring of results

Some pertinent notes regarding the work anticipated for these tasks is as follows:

- Planning. Planning efforts include development of a problem statement, definition of management goals, listing of lake and watershed characteristics and listing of beneficial uses of the lake. These last two items were essentially done during Phase I of the restoration project. A "Use map" of Sacheen Lake will be prepared showing priority use areas including natural habitat areas. The planning effort will also include holding a public meeting where the IAVMP process will be explained, the current growth of aquatic plants will be described and where citizen and agency input

can be solicited. This input will be incorporated into the management goals, beneficial use descriptions and Use Map.

- Field Reconnaissance. Field reconnaissance efforts will determine the current status of aquatic plant growth throughout the lake; both of beneficial native species and noxious invasive species. This work was completed this past August by aquatic biologists and volunteer divers who inspected the lake bottom area where plants can grow (the "littoral" zone). The plant species locations and lake bottom depth information collected by the divers will be presented to the public meeting in a map form.

- Development of Control Options. Work on this task will utilize the products of the previous tasks and will identify selected aquatic plant control options along with their respective estimated effectiveness, environmental impact, human health risks and cost. Some of this was done during the Phase I project although there have been several significant developments in the technology of aquatic plant controls which need to be incorporated into this.

  The Use Map will be used to determine specific problem areas, areas that are not likely to be susceptible to aquatic plant growth, level (intensity) of controls needed and the best combination of options for site-specific plant controls. Also in this task, surveillance and effectiveness monitoring strategies will be developed for aquatic plant control implementation projects. Finally, organizational alternatives and short and long term revenue sources for on-going aquatic plant management will be described.

- Development of Action Plan for Implementation. The work on this task will be to review the findings of the Control Options task with representatives of the Sewer District and Betterment Association and develop a final recommended control program. This program will be described in the IAVMP report

SACHEEN LAKE IAVMP MEETING 9/30/01

Thomas Wimpy DLIA
Eleanor McMurray
Jerry Johnston
[illegible]
Pat + Jim Wood
Hillard M. Sale
Julie S. Johnson
[illegible]
Pat Ed Bill Green
BOB Dickorson
JERRY NUMBERS
Gerald Baker
Turner Larry & Thede
John Bergman
Mike Harrison
BRAD + DIANE WEAR
Kathleen Werr
Merry Sterling
Perry Pearman
Sheila Pearman

Sacheen Lake, Pend Oreille County, WA
Integrated Aquatic Plant Management Plan

Public Meeting, September 30, 2001

QUESTIONNAIRE

This questionnaire is designed to solicit information about Sacheen Lake from those who use the lake or are involved with its' management. This information will be used to develop management goals and which will meet the communities' needs. Please circle the following or fill in the blanks:

• Please indicate your involvement with Sacheen Lake:

PROPERTY OWNER VISITOR MANAGER/AGENCY REPRESENTATIVE

• How would you rate the water quality of this lake?

POOR FAIR GOOD

• What is the most important factor to you about good water quality?

• How would you rate the effect of aquatic plants on the usability of Sacheen Lake?

LITTLE EFFECT MODERATE EFFECT SIGNIFICANT EFFECT

• What is the most important factor to you about aquatic plants?

_____

• How would you rate the overall usability of Sacheen Lake?

POOR FAIR GOOD

• What is the most important factor to you in making this rating?

_____

• What uses do you make of Sacheen Lake?

FISHING SWIMMING BOATING WILDLIFE OBSERVATION

OTHER: _____

We want to keep all Sacheen Lake property owners and other interested people and agencies informed of water quality and aquatic plant issues that effect this lake. Please make sure that you have signed the attendees list for today's meeting. Are there any other questions or concerns that you would like to have considered on the subject of lake water quality and lake management?

COMMENTS / QUESTIONS:

_____

_____

_____

_____

_____

Minutes of the September 30, 2001 Public Hearing

This hearing, held at the Sacheen Lake Fire Station at 2:00 p.m. as per published in the Newport Miner was regarding the development of an Integrated Aquatic Vegetation Management Plan under Department of Ecology guidelines. The meeting was conducted by David Lamb.

David introduced himself and gave a brief history of the water quality and vegetation management efforts that have been completed on the lake over the past 10 years. He then explained what the purpose of developing an Integrated Aquatic Vegetation Management Plan is.

Approximately 35 people were in attendance. David had everyone around the room introduce themselves and give a little "history" of their personal uses of Sacheen Lake. He then passed around a questionnaire that further delineated possible uses for attendees to rate and asked that each household in attendance fill one out. He also made this form available to our Betterment Association's e-mail list so that those not able to make the hearing could also submit a completed questionnaire.

David then talked about some of the vegetation control options available to us and answered a few questions that people had. The meeting was concluded at 3:15.

Respectfully,

Sheila G. Pearman

Note: Some comments are cut short in printed version of this table. Final comments are not included in printed version.

Codes used: for involvement: PO = property owner, M = manager, agency representative
for rating water quality and overall usability: P = poor, F = fair, G = good
for effect of aquatic plants: L = little effect, M = moderate effect, S = significant effect
for uses of lake: F = fishing, S = swimming, B = boating, W = wildlife observation

	Involvement	rate WQ	most important factor about good water quality	effect of plants
Questionnaires returned at meeting:				
1	PO	G	clean, pure water	M
2	PO	G	overall health of the lake, healthy plants and good WQ	M
3	PO	P	clarity	S
4	PO	F-G	visibility, outlet kept open for free flowing	M
5	PO	F-G	treat with 2,4-d on a regular basis & have a reserve fund to take care	L
6	M	G	keep the lake clean	S
7	PO	G	(none given)	S
8	PO	F	recreation use ie swimming, boating) clarity important	S
9	PO	F	non-polluted, Milfoil free	M
10	PO	G	(none given)	M
11	PO	F-G	that it is clean and safe to swim and fish in	M
12	PO	G	pollution, weeds	M
13	PO	G	lake use	S
14	PO	F	clarity & safe for swimming	S

	Involvement	rate WQ	most important factor about good water quality	effect of plants
Mailed in questionnaires:				
15	PO	G	mostly clear, no odor	M
16	PO	G	fishing, swimming	L
17	PO	F	usability of the lake	S
18	PO	P	the lake be free flowing with no restrictions at inlet or outlet	S
19	M	(none given)	That it allows the residents and visitors to use the lake and the aqua	M
20	PO	G	Clarity and non-toxic water, health for swimmers, want to be able to	S
21	PO	F	aquatic weed control but with acceptable levels of pesticides	S
22	PO	G	water is fairly clear	S
23	PO	f	creating a new sewer system	S
24	PO	G	disease free and a minimum of aquatic plants	S

	most important factor about plants	overall usability of lake	most important factor in this rating	uses
Questionnaires returned at meeting (continued):				
1	elimination of Milfoil	F	good swimming & boating, poor fishing	F, S, B
2	keeping Milfoil & other invasive plants under	G	personal use, lack of problems such as swimr	F,S,B,W
3	they trap silt	P-F	silt 7 weeds, thus outflow & clarity	F,S,B,W
4	keep growth to a minimum	F-G	water quality 7 water level too high	F, S, B
5	(none given)	G	(none given)	F, S, B, W
6	keep them in control	G	(none given)	F, S, B, W
7	Milfoil	F	can't swim or boat because of seaweed growt	S, B, W
8	(none given)		(none given)	
9	that there are just beneficial plants	G	we've never had any problems with usability	F, S, B, W & scenic beau
10	(none given)	G	(none given)	F, S, B
11	that Milfoil goes but other beneficial plants st	F-G	weeds	F, S, B, W
12	(none given)	G	water is usually clear except when there is a l	F, S, B, W
13	control	G	fishing, swimming	F, S, B, W
14	they highly restrict the use of the lake	G	use of boats	F, S, B

	most important factor about plants	overall usability of lake	most important factor in this rating	uses
Mailed in questionnaires (continued):				
15	they serve their part in the ecology	G	I think it is over used by over-powered boats	F, S, B, W
16	maintain fishing, wildlife	G	recreation	F, S, B, W
17	the oxygen they provide to the lake water	G	swimming in the lake	F, S, B, W
18	Once again to keep the lake free flowing to el	F	desire for clean moving water	F, S, B, W
19	that noxious weeds are controlled and native	(none given)	(none given)	none
20	We want the right balance with no Milfoil	G	"All of the above"	F. S. B
21	decrease Milfoil but also other plants that bec	F	too many areas thick with aquatic plants	S, B, W
22	they are taking over the lake	F	fishing is poor because of the weeds	S
23	controlling Milfoil	F	quality of water	F, S, B, W
24	too many make for poor swimming, fishing &	G	most of the problems are under control	F, S, B, W

APPENDIX B

2001 Aquatic Plant Survey Information

1. Table 4. survey results summary

ABBREVIATIONS USED:

D = dense plants of species
M= moderate plants of species
S = sparse plants of species

PA= Potamogeton amplifolius
PR = Potamogeton robinsii
PZ = Potamogeton zosteriformis
PP = Potamogeton pusillus
PC = Potamogeton crispus
PM = Potamogeton misc species
EC = Elodea canadensis
CD = Ceratophyllum demersum
EWM = Myriophyllum spicatum
CH = Chara
NI = Nitella
UV= Utricularia vulgaris
VA= Vallisneria americana

MAP CODES USED:

P. D. = Potamogeton species dominated
E. D. = Elodea canadensis dominated
P-E.D. = Potamogeton & Elodea canadensis co-dominated
M. D. = M. spicatun dominated
O. D. = other species dominated
'+' = M. spicatum present

1	3.5	PA-D	PR-D	EWM-M			P.D. +	mixed
2	4.5	PR-D	PA-D				P.D.	
3	5.0	PR-M	PA-M	EWM-S			P.D. +	
4	9.0	EWM-M	CH-S	EC-S			M.D. +	
5	10.0							
TRANSECT 9								
6	3.0	PA-M	PR-M	CH-S			P.D.	PR
7	4.0	PR-D	PA-D	EWM-S			P.D. +	
8	5.0	EC-D	PR-D	PA-S	EWM-S		E.D. +	
9	6.0	EC-D	PP-M	EWM-M			E.D. +	
10	8.0	EC-D	PP-M	PR-M	EWM-S		E.D. +	
11	10.0							
TRANSECT 16								
12	2.5	PR-D	PA-M	EWM-S			P.D. +	PR
13	3.0	PR-D	EWM-S				P.D. +	
14	4.5	PR-D	EC-D	PA-M			P.D.	
15	5.5	PA-D	EC-D	PR-M			P.D.	
16	6.0	EC-D	PP-M	PR-M	PA-S	EWM-S	E.D. +	
17	10.0							

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density						MAP CODE	Transect dominated by:
TRANSECT 2									
18	3.0	EC-D	PR-D					E.D.	PR
19	6.0	PR-D	PA-M	EC-S				P.D.	
20	7.0	PR-D	PA-S	CD-S				P.D.	
21	10.0	PR-M	EC-M	EWM-S	PM-S			P.E.D+	
22	10.0	EC-D	PR-D	PA-M	PP-S	EWM-S		P.E.D.+	
23	13.0	EC-D	EWM-M	PP-M	PR-M	CD-S	CH-S	E.D.+	
24	13.0								
TRANSECT 22									
25	2.0	PR-M	PC-M	EC-S	EWM-S			P.D.+	PR
26	3.5	PR-D	PC-D	EWM-S				P.D.+	
27	5.0	PA-D	PR-D	EC-M				P.D.	
28	6.0	EC-D	PA-S	EWM-S				E.D.+	
29	8.0	EC-D	PR-M	PP-M	EWM-S			E.D.+	
30	10.0	PP-M	EC-M	PA-S	CD-S	EWM-S	PP-S	P.D.+	
31	15.0								
TRANSECT 15									
32	4.0	PR-M	PA-M	CH-M				P.D.	mixed
33	7.0	PP-M	EWM-M	EC-M				P.D.+	
34	10.0								

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density					MAP CODE	Transect dominated by:
TRANSECT 1	NOT INSPECTED							
TRANSECT 8								
35	3.0	NI-M	EWM-S	PR-S			0.D.+	EWM
36	4.0	PR-M	EWM-M				P.D.+	
37	8.0	PP-M	EWM-M	EC-S	NI-S		P.D.+	
38	11.0							
TRANSECT 26								
39	2.0	PA-S	PR-S	EWM-S			P.D.+	PR
40	3.0	PR-S	PZ-S				P.D.	
41	4.5	PZ-M	PR-M	PA-S	CH-S		P.D.	
42	8.0							
TRANSECT 21								
43	3.5	EWM-M					M.D.	EWM
44	6.0	EWM-M	EC-M				M.D.	
45	8.0	PP-M	EWM-M	EC-M			P.D.+	
46	9.0	EC-M	PP-M	EWM-M	PR-S	CH-S	P-E.D+	
47	9.0							

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density					MAP CODE	Transect dominated by:
TRANSECT 7								
48	9.0	EC-D	PA-M	PR-M	PP-S		E.D.	EC
49	12.0							
TRANSECT 14								
50	2.0	EC-D	PA-S				E.D.	EC
51	4.0	EC-D	WB-S				E.D.	
52	11.0	EC-M	PZ-S	PA-S	CD-S		E.D.	
53	11.0	PZ-M	CD-M	EC-M	EWM-M		P-E.D+	
54	12.0	PP-M	CD-M	EC-M	EWM-M		P.D.+	
55	14.0	PP-M	EWM-S	EC-S	PA-S	PR-S	P.D.+	
56	15.0							
TRANSECT 6								
57	2.5	PA-D	PR-D				P.D.+	mixed
58	4.5	PA-D	PR-M	EWM-S	EC-S		P.D.+	
59	6.0	EC-D	PP-M				E.D.	
60	7.0	EC-M	PR-M				P-E.D.	
61	9.0	EC-D	EWM-M	PP-S	PA-S	PR-S	E.D.+	
62	10.0							

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density				MAP CODE	Transect dominated by:
TRANSECT 13							
63	2.5	PA-D				P.D.	mixed
64	5.0	PR-D				P.D.	
65	6.0	EC-D	PA-S	PR-S		E.D.	
66	9.0	EC-M	EWM-S	PP-S	PA-S	E.D.+	
67	13.0	PP-M	EC-S	CH-S		P.D.	
68	17.0						
TRANSECT 20							
69	4.5	EWM-M	EC-S			M.D.	EWM
70	8.0	PP-M	EWM-S	EC-S	PR-S	P.D.+	
71	10.0						
TRANSECT 19		NO PLANTS					
TRANSECT 25							
72	1.0	PR-D	EWM-M	PA-M		P.D.+	PR
73	4.5	EWM-S	NI-S	EC-S	PR-S	M.D.	
74	6.0	PR-D	EWM-S			P.D.+	
75	8.0	EC-D	PR-D	PP-S		P-E.D	
76	6.0	EC-D	PR-D	EWM-S		E.D.+	
77	2.5						

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density					MAP CODE	Transect dominated by:
TRANSECT 12								
78	2.5	EC-D	PA-M				E.D.	EC
79	5.0	EC-D	EWM-S	PP-S			E.D.+	
80	7.0	EC-D	PR-M	PP-S			E.D.	
81	9.0	PR-D	EC-S				P.D.	
82	11.0	EC-D	PR-M	EWM-S	PP-S	CH-M	E.D.+	
83	13.0							
TRANSECT 5								
84	4.0	PR-D	EC-S				P.D.	PR
85	9.0							
TRANSECT 27								
86	2.0	PR-M	EWM-M	PP-S			P.D.+	PR
87	4.5	PR-M	EC-M	EWM-S	NI-S	PP-S	P.D.	
88	13.0	PR-M	EC-M	CH-M	PP-S	PR-S		
89								
TRANSECT 18								
90	0.5	PR-D	PA-M				P.D.	PR
91	4.0	PR-D					P.D.	
92	5.0	EC-D	PR-M	EWM-S			E.D.+	
93	5.0	PR-D	EC-S				E.D.	

	(m)							dominated
TRANSECT 18 (continued)								by:
94	5.0	PR-M	EC-S	CD-S			P.D.	PR
95	6.0	PR-D					P.D.	
96	4.5	PR-D	PA-D				P.D.	
97	4.5	EC-M	PP-M				E.D.	
98	4.0	PR-D	EC-M	PA-S			P.D.	
99	2.0	PR-M	PA-S	EWM-S			P.D.+	
TRANSECT 28								
100	1.0	PR-M					P.D.	PR
101	4.5	PR-D	PA-M	EC-M	NI-S		P.D.	
102	4.5	EC-D	PR-M				E.D.	
103	6.0	PR-D					P.D.	
104	7.0	EC-D	PR-D	PA-S	EWM-S		E.D.+	
105	8.0	PR-D	EC-D	PP-S	CD-S		P.D.+	
106	9.0	EC-M	PP-M	EWM-M	PA-M	PR-M	E.D.+	
107	12.0	PP-D	PR-M	EC-M			P.D.	
108	13.0	PP-M	EWM-S				P.D.+	
109	9.0	EC-M	EWM-M	PP-S			E.D.+	
110	3.0							

113	5.0	EC-D	EWM-S	CH-S		E.D.+	
114	6.0	EC-D	PR-M	PP-S		E.D.	
115	7.0	PR-D	EWM-S	PP-S	EC-S	P.D.+	
116	11.0						
TRANSECT 11							
117	3.0	PA-M	PR-M			P.D.	mixed
118	4.5	EC-M	PR-M	PA-M	PP-M	P-E.D.	
119	7.0	PA-D	CD-M	PR-S		P.D.	
120	9.0	EC-D	PR-M	PA-S	EWM-S	E.D.+	
121	12.0	PR-D				P.D.	
122	12.5	EWM-S	PP-S	PR-S	CH-S	M.D.	
123	14.0						
TRANSECT 30							
124	8.0	EC-S	PP-S			P-E.D.	mixed
125	16.0						

Table 4. Results of Sacheen Lake IAVMP aquatic vegetation survey conducted August 4 and 5, 2001.

GPS reference	Depth (ft)	Species and relative density							MAP CODE	Transect dominated by:
TRANSECT 17										
126	2.5	PA-D	EC-D	EWM-M	PR-M				P.D.+	mixed
127	6.0	EWM-D	PA-M						M.D.	
128	10.0	EWM-S	PR-S	CH-S					M.D.	
129	13.0									
TRANSECT 3										
130	3.5	PR-D	PA-M	EC-M	NI-S				P.D.	PR
131	6.0									
TRANSECT 10										
132	3.0	PA-D	PR-D	EC-D					P-E.D.	mixed
133	6.0	EC-M	EWM-M	PR-S					E.D.+	
134	14.0									
TRANSECT 31										
135	3.0	CD-S	PA-M	EC-M	PP-S	EWM-S	UV-S	VA-S	P.D.+	PA
136	3.5	PA-D	PR-D	CD-M	PM-M	EWM-S			P.D.+	
137	5.0	PA-D	CD-M	PR-M	EWM-S				P.D.+	
138	8.0	PR-D	PP-M						P.D.	
139	13.0									
TRANSECT 29	NOT INSPECDED									

APPENDIX C

Herbicide Information

1. Navigate (2,4-D)
2. DMA 4 (2,4-D)
3. 2,4-D Risk Assessment information
4. Aquathol K (Endothall)
5. Reward (Diquat)
6. Sonar (Fluridone)
7. Nautique (Copper)

Herbicide Risk Assessment for the Aquatic Plant Management
Final Supplemental Environmental Impact Statement
Appendix C, Volume 3: 2,4-D; **Section 4 – ENVIRONMENTAL EFFECTS**
(start page 155)

WDOE Publication No. 00-10-043; Available at: http://www.ecy.wa.gov/biblio/0010043.html

4.3.2 Effects of 2,4-D on Aquatic Animals

Summary: 2,4-D DMA is generally safe to fish, free-swimming aquatic invertebrates and benthic invertebrates. E.g., 2,4-D DMA is practically non-toxic to fish and free-swimming aquatic invertebrates (acute LC50 = >100 mg a.i./L). However, some of the more sensitive species are benthic invertebrates like estuarine shrimp (Palaemonetes spp.) and seed shrimp appear to be acutely sensitive to 2,4-D DMA (acute *LC50 0 0.15* to 8.0 mg a.i./L for estuarine shrimp and seed shrimp respectively).

Although 2,4-D DMA appears to be safe for use in aquatic ecosystems, 2,4-D BEE has a very high acute toxicity to the aquatic biota (acute LC50 = 0.3 mg a.i./L for rainbow trout, Daphnia *magna (~4.0 mg a.i./L) or bright scud (0.44 mg a.i./L). Concentrations of* 2,4-D BEE would appear to be high enough for adverse impact to the aquatic biota, but its low solubility and rapid hydrolysis to the slightly to practically non-toxic 2,4-D acid mitigates 2,4-D BEE's toxic effects. 2,4-D acid appears to be practically non-toxic to fish and free-swimming invertebrates (LC50 = 20 to >100 mg a.i./L). However, while *2,4-D acid has a low toxicity to most species of benthic invertebrate (LC50 = >37* mg a.i./L to Cyclops vernalis and others), the most sensitive species (Gammarus fasciatus) is affected moderately by 2,4-D acid (LC50 = 3.2 mg a.i./L).

The chronic toxicity (NOEC) for 2,4-D DMA is also low with the predicted or empirical long-term NOECs ranging from 5.56 mg a.i./L for rainbow trout to 27.5 mg a.i./for Daphnia magna. The more sensitive benthic species appear extremely sensitive to chronic exposure to 2,4-D DMA (estimated chronic NOEC = 0.0083 mg a.i./L for glass shrimp), although for 80 of the species tested 2,4-D DMA can be classified as chronically non-toxic.

Similar to the acute effects, 2,4-D BEE appears to be toxic to the biota (predicted or empirical long-term NOEC = 0.017 mg a.i./L for rainbow trout to 0.29 mg a.i./L to Daphnia magna). However, Risk Assessments would indicate that these NOECs are higher than typical long-term EECs 0.010 mg/L; and therefore risk should be low for fish and free-swimming aquatic invertebrates. However, while the predicted NOEC (0.024 mg a.i./L) for the most sensitive benthic organisms is low enough that adverse impact may be avoided from exposure in the water column, sediment exposure may be high enough to cause adverse impact.

Since 2,4-D BEE appears to have low chronic toxicity to the aquatic biota, it is likely 2,4-D acid, which is known to have low acute toxicity to the aquatic biota, will also have low chronic *toxicity to the aquatic biota. The predicted or empirical long-term NOEC for 2,4-D acid is 1.1* mg a.e./L for the most sensitive species of fish (common carp), ~30 mg a.e./L for Ceriodaphnia dubia and 0.18 mg a.e./L for Gammarus fasciatus. While these values indicate some toxicity, Risk Assessments indicate that these NOECs are well above the chronic EEC values likely to be encountered in the field (0.01 mg /L for water and 0.06 mg/L for sediment). Field studies with *2,4-D acid at maximum use rate, while eliminating milfoil allowed tolerant macrophytes like* water celery and American waterweed to dominate the water body for up to two growing seasons.

Laboratory exposure of Coho, sockeye, and pink salmon at a rate of 1.0 mg/L for 24 hours does not appear to interfere with the parr to smolt metamorphosis. Furthermore, exposure of Coho salmon at concentrations up to 200 mg/L also does not appear to interfere with the parr to smolt metamorphosis. Although other anadromous fish species like steelhead or sea-run cutthroat trout have not been tested for their ability to
osmoregulate after exposure to 2,4-D and transfer from fresh to salt water or visa versa, based on the work done with salmon smoltification, this is not believed to be a problem.
Behavioral effects have been observed with 2,4-D DMA and 2,4-D BEE. Rainbow trout have been observed to avoid 2,4-D DMA at concentrations that would be encountered in the field (1 to 10 mg/L). Avoidance of 2,4-D BBE has been observed with grass hrimp, sheepshead minnow and mosquito fish. Absence of Uca uruguayensis from areas treated with 2,4-D iso-BEE may also indicate that this species is capable of avoiding 2,4-D. However, it is unclear if fish or invertebrates would or could avoid 2,4-D in actual field situations.

Field studies indicate that treatment with 2,4-D DMA appears to have no direct effects on numbers or diversity of free-swimming or benthic invertebrates in ponds or ditch banks. However, secondary effects such as oxygen depletion and the release of nutrients into the water column due to treatment with 2,4-D BEE can have significant impact (positive or negative) on zooplankton and benthic invertebrates. Reduction of dissolved oxygen concentration to nearly zero for one week does not affect the numbers or diversity of benthic organisms, but may cause a shift in the dominant organisms from obligate aerobes like Odonata and Ephemeroptera to facultative anaerobes like Oligochaete worms and Tendipedidae (midge). Treatment with 2,4-D acid at levels higher than 0.38 mg/ha/month for 12 months may cause significant increases (~20%) in the biomass of the benthic biota and a short-term depression of phytoplankton populations. These changes in biomass of benthic organisms and plankton can also produce changes in the survival and biomass of associated fish. Bottom feeding fish have increased survival and increased yield (biomass) since their nutrition has been improved by increases in benthic organism biomass. Planktovoric fish have a corresponding decrease in survival and biomass due to decreases in the levels of phytoplankton and zooplankton. Other field studies using 6.0 Kg/ha 2,4-D acid, were observed to increase nutrients within the waterbody and caused substantial increases (>2-fold) heterotrophic bacteria, and zooplankton in less than eight weeks of phytoplankton. However, the levels of sediment associated bacteria appeared to decrease substantially.

Fish species like largemouth bass, sunfish and others are not adversely affected by typical field concentrations of 2,4-D DMA. There was no adverse effect on numbers (including recreational or commercial fish catch) and no adverse effect on mean total length, condition, movement within the treatment area or nesting behavior. Although the use of 2,4-D BEE should have an adverse impact on fish and aquatic invertebrates based on the results of laboratory studies, field studies indicate that, under the conditions of typical application, fish do not appear to be adversely impacted.
Sensitive, endangered and threatened species of aquatic animals that may need protection through mediation include Coho salmon, chum salmon (summer chum),
Chinook salmon, sockeye salmon, bull trout, steelhead trout, cutthroat trout, Coastal cutthroat trout, Olympic mudminnow, mountain sucker, lake chub, leopard dace, Umatilla dace, and river lamprey. Other species which may need protection within Puget Sound, the San Juan Islands, and the Strait of Juan de Fuca east of the Sekiu River are Cherry Point Herring, Discovery Bay Herring, and South Pacific cod.

2,4-D applications to fully aquatic (lentic and lotic) systems may be toxic to aquatic animals (Table 22). 2,4-D DMA will generally be safe to aquatic animals (LC50 = >25 to >748 mg a.i./L = >21 to >620 mg a.e./L) for most ecologically relevant species.
However, direct contact with 2,4-D BEE would be unsafe to most aquatic animals (LC50 = <4.0 mg a.i./L = <2.8 mg a.e./L). The World Health Organization recommends that

2,4-D BEE be assessed for risk based on the toxicity of 2,4-D acid since 2,4-D BEE is rapidly degraded to 2,4-D acid. The half-life for 2,4-D BEE in its degradation to 2,4-D acid is considered to be less than one day with the rate of degradation being more rapid in hard basic waters common to eastern Washington. Although 2,4-D BEE is less toxic to salmonids in hard /basic water (1.1 to 4.3 mg/L) than in soft/acid water (0.8 to 1.1 mg/L), the difference is not so great as to afford significant protection to salmonid species due to pH and hardness alone (Table 10). Additional protection from 2,4-D BEE may be due to its low solubility. Low solubility would lead to a low incidence of contact by aquatic organisms when 2,4-D BEE granules are used for aquatic vegetation control. Although laboratory tests indicate some risk to salmonids from exposure to 2,4-D BEE, field data from TVA reservoirs, Currituck Sound, NC, northeastern water and northwestern water are uniform in their appraisal of no direct toxic effects as a result of 2,4-D BEE treatments.

Although these general trends apply, there are always some exceptions for every formulation. For example, 2,4-D DMA is apparently very toxic to several species of estuarine shrimp including *Palmaemonets kadiakensis* (glass shrimp) (LC50 = 0.15 mg a.i./L = 0.12 mg a.e./L), *Cypridopsis vidua* (seed shrimp) (LC50 -= 8.0 mg a.i./L = 6.64 mg a.e./L) and possibly *Palmaemonets pugio* (grass shrimp) based on phylogenic similarity. Conversely, 2,4-D BEE does not appear to be very toxic to a variety of arthropod shellfish such as the *Orconectes nous* (crayfish) (LC 50 = 100 mg a.i./L = 69 mg a.e./L) and adult estuarine crabs (*Chasmagnathus granulata* and *Uca uruguayensis*) (LC50 = 130 mg a.i./L = 90 mg a.e./L). Similarly to 2,4-D DMA, 2,4-D acid while not toxic to most aquatic animals appears to be extremely toxic to the lined scud (*Gammarus fasciatus*) (3.2 mg a.i./L). Some of these exceptions have the potential for great ecological relevance, particularly when sediment species are involved. Since the database on these species is fragmentary they often do not respond in a manner similar to model pelagic arthropods like *Daphnia magna* which are often used as surrogates for toxicity studies with sediment organisms.

2,4-D and its formulations have a low tendency to bioaccumulate except in the case of zooplankton and benthic organisms. For zooplankton and benthic organisms, the bioconcentration factor for 2,4-D BEE has been shown to be 1 to 603 and 8,267 to 10,825, respectively in the Ft Cobb Reservoir, Oklahoma (Reinert and Rogers, 1987). However, similar concentrations were not found in fish 24 hours after treatment in Lake Seminole; Georgia. Laboratory work indicates that while 2,4-D BEE may bioconcentrate to fairly low levels in aquaria, (2 to14 in channel catfish and 6 to 21 in bluegill sunfish) (Rogers and Stallings, 1972 in Reinert and Rogers, 1987), 2,4-D BEE was rapidly hydrolyzed to the acid and excreted from these fish. 2,4-D acid and 2,4-D DMA apparently do not bioconcentrate or bioaccumulate (Biever, 1996, Biever, 1998, Plakas et al, 1992 and Gangstad, 1986). The accumulation in benthic organisms that are in some cases affected by 2,4-D BEE at concentrations that may be below the acute or chronic EEC for sediment is of potential concern. At least one species of sediment organisms (*Gammarus fasciatius*) is apparently acutely susceptible to 2,4-D acid which is less toxic than 2,4-D BEE to most species. This is of particular concern when the ratio of 2,4-D BEE to 2,4-D acid is not known and not easily predicted. However, the effects of bioaccumulation are not expected to be significant in the long term for most species. See Section 4.2.2.4 for a more detailed discussion on potential for bioaccumulation or bioconcentration in fish, aquatic, invertebrates, phytoplankton and zooplankton, birds, mammals and insects.

2,4-D BEE is applied by itself from a hopper spreader and is not combined in a tank mix with other pesticides. While 2,4-D DMA is combined with other herbicide products in some cases this is not normal in Washington State. In some cases, 2,4-D acid has been combined with other pesticides to determine if the effects of the combinations were greater than additive. Only one species of animal has been studied for synergistic effects of 2,4-D acid and the insecticides,

malathion and carbaryl. Combinations of 2,4-D and these insecticides have had synergistic effects on behavioral responses with the brown planaria (*Dugesia tegrina*) (Feldhaus et al, 1998). It is unknown whether other more relevant species would exhibit synergistic effects if 2,4-D products were combined with adjuvants or other pesticides. Sub-acute and chronic effects have been studied with 2,4-D in the common carp, fathead minnow, sheepshead minnow, rainbow trout, and the grass shrimp. The sub-acute effects of 2,4-D have been seen at both environmentally relevant and non-relevant concentrations. For example, rainbow trout avoid 2,4-D DMA at concentrations as low as 1.0 to 10.0 mg/L (Folmar, 1976), and grass shrimp avoided 2,4-D BEE at concentrations as low 1.0 to 10 mg/L (Hansen et al, 1973). Avoidance may cause fish to move to marginal habitats, which may cause mortality due to predation or disease/parasites. However, authors of papers studying avoidance indicated that it was unlikely that animals exposed to 2,4-D in the field would or could avoid exposure. The estuarine sheepshead minnow and mosquito fish also avoids 2,4-D BEE (Hansen, 1969 in Hansen et al, 1973 and Hansen et al, 1972 in Shearer and Halter, 1980). Carp larvae exhibited behavioral changes, disturbances in feeding and morphological changes at 50 mg a.i. 2,4-D sodium salt (Kamler et al, 1974). The common carp is the only species that has had extensive work conducted on the acute, chronic and sub-chronic effects of 2,4-D.

Since 2,4-D is excreted by fish unmetabolized, classical synergism, with metabolic inhibitors is unlikely to occur. However, the presence of accelerators/surfactants, other "*inerts*", or other pesticides in either tank mix situations with 2,4-D DMA or incidental exposure from treatment with other pesticides may increase the potential for damage to the biochemistry or physiology of fishes. These potentiating effects could increase, acute or chronic (early life-stage) toxicity or increase the biochemical or pathological effects of 2,4-D in fish exposed to sub-acute dosages. A number of sub-acute effects have been noted due to the exposure to 2,4-D including apparent increase in the toxicity of 2,4-D sodium salt due to the presence of 2,4-chorophenol as a contaminant (Kamler et al, 1974). Behavioral effects such as avoidance may be potentiated or inhibited by the presence of pesticides other than 2,4-D. Various biochemical effects that are usually manifestations of physiological stress were also seen in the carp by Neskovic et al (1994) and Elezovic et al (1994) including increases in blood serum and liver glucose and glycogen levels and blood serum glutamide oxaloacetic transminase activity.

Pathological changes in the tissues of common carp included vacuolization and the formation of pycnotic nuclei in the liver, edema and vacuolar degeneration of the tubular epithelial cells of the kidney, and edema and other changes in gill tissue resulting in the thinning of the respiratory epithelium. Additional pathological changes were also seen in the gill tissue (Neskovic (1994). The tench (*Tinca, tinca*) was observed to have lesions in the excretory parenchyma of the kidney, which led to necrosis following exposure of fish to 2,4-D (Larraine et al, 1999). 2,4-D is primarily excreted via the kidney and across the gill membrane (Rogers and Stalling (1972I in Gallagher, 1992). However, most of these effects can be considered to be of little importance in absence of environmental assault from sources other than the presence of 2,4-D acid at typical expected environmental concentrations (EECs) of 0.19 to 4.0 mg a.e./L. Typical EEC concentrations are much lower than the 250 to 400 mg a.e./L tested in sub-acute toxicity studies. To discover the long term effects of 2,4-D at environmentally relevant concentrations would require the conduct of multigenerational laboratory experiments with species considered to be ecologically sensitive.

Accelerators and thickening agents are rarely used with herbicides sprayed directly on the surface of a water body, but some applicators and scientists believe that surfactants like CideKick® and X-77® improve effectiveness and should be used with 2,4-D DMA products when surface (floating) weed control is necessary (Getsinger, 2000 personal communications). A

thickener like Nalquatic® or Polysar® will often be used to allow a subsurface application to sink down into the water column where it will be most effective against rooted aquatic macrophytes. If the herbicide is sprayed on, thickeners also control potential drift. Although all adjuvants registered for use with aquatic herbicides should be safe to fish and other aquatic animals when used according to the label, they are not without risk to aquatic life (Watkins et all, 1985). Their 96-hour toxicity (LC50) ranges from 0.96 mg/L to > 1000 mg/L. In lakes and ponds with reasonable depth, dilution should prevent toxic effects from occurring due to the use of additives. This is particularly so if the control measure is a spot or margin treatment. A more detailed discussion of the effects of adjuvants can be found in Section 4.2.4 and in Table 12.

4.3.2.1 Acute Effects on Aquatic Animals

_ Acute effects on fish

Toxicity information indicates that the commercial product 2,4-D DMA is not acutely toxic to the species of fish tested (Table 2 and Table 22 and Appendix 1); that is it has an LC50 of greater than 100 mg/L (Table 12 and Appendix 2). 2,4-D DMA has a 96-hour LC50 that ranges from 100 to >560 mg a.i./L for all tested species including trout and salmon. (100 to 377 mg a.i./L), bluegill sunfish (106 to 524 mg a.i./L), smallmouth bass (236 mg a.i./L), fathead minnow (266-344 mg a.i./L), Cyprinid carp (>100 to >1000 mg a.i./L), channel catfish (119-193 mg a.i./L) and the estuarine inland silverside minnow (469 mg a.i./L). In the case of the rainbow trout, a species known for great sensitivity to pesticides, fry and juvenile tests still yielded low toxicity to 2,4-D DMA (>100 mg a.i./L).

Based on these LC50s, 2,4-D DMA can be placed in the ecotoxicological risk category of practically non-toxic (LC50 > 100 mg a.i./L). This risk category classification does not mean that 2,4-D DMA will not have an adverse impact to fish when they are exposed to the expected environmental concentration. This determination of risk compares the general toxicity of 2,4-D DMA with other registered pesticides; based on this comparison, 2,4-D has a very low acute toxicity.

The application rate for 2,4-D DMA in the United States to control aquatic macrophytes typically ranges from 2 to 4 mg a.e./L (2.4 to 4.8 mg a.i./L) (JMPR, 1997). Typical use rates in the United States are much less. WHO/FAO estimates that the typical use rate would be 1.13 mg a.e./L (1.36 mg a.i./L). Therefore, aquatic biota should be largely unaffected by these treatments.

The other commercial 2,4-D product registered and the one of primary interest in Washington State is 2,4-D BEE (Aqua-Kleen® and Navigate®). The acute toxicity of this product to fish is fairly high. However, due to its rapid degradation to 2,4-D acid researchers feel it is safe to use in the aquatic environment, except where sensitive threatened or endangered species are present and then an assumption should be made for higher risk due to use of the herbicide.

Based on the toxicity of 2,4-D BEE to fish this 2,4-D ester is placed in the Ecotoxicological Risk Categories of highly toxic (0.1 to 1 mg/L) for salmon fry and smolts, moderately toxic (>1 to 10 mg/L) for salmonid juveniles, catfish juveniles, fathead minnow juveniles and bleak, and categories ranging from highly toxic (0.1 to 1 mg/L) to moderately toxic (>1 to 10 mg/L) for bluegill sunfish. The exact acute categories are not of great importance since the LC50 exceeds expected concentrations in the environment. However, exposure to 2,4-D BEE is likely to be negligible due to its low solubility and rapid conversion to 2,4-D acid even though the concentrations immediately after application ranges from 0.19 mg/L at the surface to 3.25 mg/L at the bottom in the root zone.

When the level of concern (0.1) is exceeded so dramatically with all species, the use of the compound would not be acceptable unless mitigating factors could be considered. An acceptable

mitigating factor would be to follow the WHO/FAO suggestion that 2,4-D acid be considered the toxin of concern for the reasons elaborated above.

After hydrolysis of 2,4-D BEE, 2,4-D acid is not significantly toxic to the fish species tested; that is the LC50 is typically >40 mg a.e./L for all environmentally relevant species. Based on the toxicity of 2.4-D acid to fish, it is placed in the Ecological Risk Category of slightly toxic (>10 to 100 mg/L). Therefore, 2,4-D acid and 2,4-D BEE are both unlikely to be acutely toxic to the resident fish biota. A formal risk assessment in Section 4.3.2.5 supports the conclusions of this toxicity review. For a detailed risk assessment and evaluation of potential risk of 2,4-D DMA, 2.4-D BEE and 2,4-D acid on fish, see Section 4.3.2.5

_ Acute effects on aquatic invertebrates

Toxicity information indicates that the commercial product 2,4-D DMA is not acutely toxic to most species of invertebrates tested (Table 2 and Appendix 2). Exceptions to this appear to be with sediment (benthic) organisms like glass shrimp (*Palaemonetes kadiakensis*) and seed shrimp (*Cyridopsis vidua*). Another species, which may be sensitive, is the grass shrimp (*Palaemonets pugio*) based on phylogenic similarities. 2,4-D DMA LC50s that range from >100 to >1,000 mg a.i./L for all free-swimming invertebrate species tested except the sediment (benthic) organisms, which have LC50s that range from 0.15 to 8.0 mg a.i./L. Based on these LC50s, 2,4-D DMA can be placed in the ecotoxicological risk category of practically non-toxic LC50 > 100 mg/L for the pelagic (nektonic) aquatic invertebrates and highly toxic (LC50 = 0.1 to 1.0 mg/L) to moderately toxic (LC50 = >1.00 to 10 mg/L) for sediment organisms. This risk category does not imply that 2,4-D DMA will or will not have an adverse impact on these specific groups of invertebrates when they are exposed to the expected environmental concentration.

However, this determination of risk compares the general toxicity of 2,4-D DMA with other registered pesticides; based on this comparison, 2,4-D DMA has a very low acute toxicity to free swimming invertebrates and a fairly high toxicity to benthic invertebrates. The labeled application rate for 2,4-D DMA to control aquatic macrophytes in the United States typically ranges from 2 to 4 mg a.e./L (2.4 to 4.8 mg a.i./L) (JMPR, 1997). Typical use rates in the United States are much less than this and WHO/FAO estimates that this use rate would be 1.13 mg a.e./L (1.38 mg a.i./L). Typical environmental concentrations (1.36 mg a.i./L) will probably not affect free-swimming invertebrates since they are well below the LC50s (> 100 mg a.i./L) for this segment of the biota. However, these environmental concentrations will probably affect the most sensitive benthic invertebrates since they far exceed the LC50 (0.15 mg a.i./L) for the most sensitive benthic invertebrates (glass shrimp). Even if a very liberal Federal drinking water standard is used as being typical of pore water or over-lying water concentrations, the most sensitive benthic species may still be affected by environmental concentrations of 2,4-D DMA since the LC50 exceeds the EEC by only two-fold. Even though 2,4-D DMA does not partition significantly to the sediment layer, enough of the herbicide may reach the sediment under heavy treatment scenarios to adversely affect the most sensitive species of benthic organism. For example, Wojtalik et al, (1971 in Shearer and Halter, 1980) found 0.100 to 0.450 mg/L 2,4-D in the Jagger Branch of the Gunthersville Reservoir, Alabama for up to three months after heavy treatment.

It appears likely that 2,4-D DMA will have adverse impact to benthic invertebrates even if further analysis is conducted. However, depending on half-life considerations 2,4-D DMA may prove to be safe to the free-swimming (zooplankton) biota. The concentrations of 2,4-D DMA found in water shortly after treatment can vary considerably depending on the treatment rate, rate of uptake and release from plant material and mass of water movement through the treatment area. For example, the 2,4-D concentrations seen in water of TVA reservoirs can vary from virtually zero (0.05 to 0.5 mg/L) 24 hours after treatment to 5 mg/L five days after treatment

with the variability being primarily due to the amount of water exchange that occurred (Shearer and Halter, 1980). For a determination of risk see Section 4.3.2.5.

The other 2,4-D product with aquatic use and the one of primary interest in Washington State is 2,4-D BEE (Aqua-Kleen® and Navigate®). The acute toxicity of this product to fish and aquatic invertebrates is fairly high. However, due to 2,4-D BEE's low water solubility and rapid degradation to 2,4-D acid in water, researchers feel it is safe to use in the aquatic environment.

2,4-D BEE has the highest toxicity of all the 2,4-D formulations on acute basis. However, this does not take into account special characteristics of the 2,4-D BEE formulation. 2,4-D BEE is a slow release formulation and when properly applied the concentrations in the water column will range from 0.19 mg/L at the surface to 3.25 mg/L at the bottom in the root zone. Furthermore, 2,4-D BEE is rapidly hydrolyzed to 2,4-D acid. The hydrolysis of 2,4-D BEE is usually less than one day and the acid degrades to non-toxic constituents. Under these conditions the persistence of 2,4-D BEE in Canadian waters at concentrations of greater than 0.1 mg/L was 2 to 6 days (Gallagher, 1992). Due to the low solubility, short hydrolysis time and rapid degradation of 2,4-D BEE to 2,4-D acid, WHO/FAO (JMPR, 1997) recommends that the toxicity of 2.4-D acid is more relevant to actual exposure.

Based on the toxicity of 2,4-D BEE to free-swimming zooplankton this 2,4-D ester is placed in the ecotoxicological risk categories of highly toxic (0.1 to 1 mg/L) for estuarine crab, scuds and chironomids, moderately toxic (1.0 to 10.0 mg/L) for *Daphnia magna*, various species of estuarine shrimp, *Cypridopsis vidua*, stonefly, eastern oyster and the copepod (*Nitocra spinepes*), slightly toxic (10 to 100 mg/L) for the crayfish and practically nontoxic (>100 mg/L) for the juvenile and adult estuarine crabs and adult stoneflies.

The exact toxicity categories may not be of great importance since the evaluation presented here does not constitute a risk assessment and exposure to 2,4-D BEE is likely to be negligible for most species even though potential exposure concentrations exceed the LC50 in most species tested. Furthermore, *Daphnia magna*, because of its habits, will be exposed to high concentration of 2,4-D (3.25 mg a.i./L) when seeking shelter from predators, but while feeding and during most normal activity, this species is exposed to a very low EEC (0.19 a.i./L) which may not be toxic to this species since the LC50 is 4.0 mg a.i./L).

The most sensitive species appear to benthic and sediment invertebrates to which 2,4-D BEE is extremely toxic. For example, *Gammarus spp.* has an LC50 of ~0.44 mg a.i./L, *Chironomus plumosus* has an LC50 of ~0.40 mg a.i./L; the estuarine crab (1 st zoel) (*Chasmagnathus granulata*) is the most sensitive species with an LC50 of 0.3 mg a.i./L. These benthic and sediment species will not be protected from 2,4-D BEE unless mitigating circumstances occur. This information may place these species at risk since under conditions of poor time release, the sediment concentration of 2,4-D BEE can be high (from 0.95 to 56 mg a.i./L) for at least 4-days post treatment (Shearer and Halter, 1980).

When environmental concentrations exceed the LC50 so dramatically with all species, the use of the compound would not be acceptable unless mitigating factors could be considered. Fortunately, this is not considered to be a typical exposure scenario. Concentrations of 2,4-D generally dissipate in water to levels of 0.100 mg/L with a half-life of less than six days (Gallagher, 1992). More typical residue levels in sediment were much lower than previously described. E.g., concentrations of 2,4-D from application of 2,4-D BEE pellets were approximately 0.100 mg/L for one week at Lake Seminole, Georgia (Whitney et al, 1973 in Shearer and Halter, 1980) and 0.200 to 0.650 mg/L for three weeks at Currituck Sound, North Carolina (Daly, 1974 in Shearer & Halter, 1980). In the Northwest (Lake Okanogan, B.C.), concentrations of 2,4-D were measured at 0.050 to 0.460 mg/L immediately after treatment and

residues remained present at day 8 (Lim and Lozoway, 1978). These concentrations are far more acceptable. But even these more reasonable rates, the most sensitive species may not be protected. A formal risk assessment in Section 4.3.2.5 supports the conclusions in this toxicity review.

However, at Lake Okanogan, B.C., the most sensitive species (*Gammarus fasciatus*) may be protected since the LC50 is significantly higher than the EEC. The most strict interpretation of risk would still find this EEC level to pose a potential risk to the invertebrate biota. It is useful to note that 2,4-D sodium salt appeared to be somewhat less toxic than 2,4-D acid to the species tested and the LC50s for this salt are great enough so that the risk quotient level of concern are not expected to exceed (LC50 = 932 to 2400 mg a.m./L for *Daphnia magna* and *Macrobranchium spp.*, respectively. Therefore, using the 2,4-D salts as surrogates for the acid may add valuable information in assessing acute risk of 2,4-D against aquatic invertebrates.

4.3.2.2 Chronic Effects of 2,4-D on Aquatic Animals

_ Chronic effects on fish

To this date, the amount of chronic or early life-stage effects data for 2,4-D on aquatic animals (fish) is rather minimal (Table 2 and Appendix 3). Most studies deal with early life-stage (egg, egg to sac-fry, egg to fry). There are studies that deal with the early life stage (egg to fry) toxicity of 2,4-D BEE in the Chinook salmon, with early life-stage (egg to fry) toxicity of 2,4-D DMA, 2,4-D BEE, 2,4-D 2-EHE and 2,4-D acid in fathead minnow, and a 10 month life-cycle toxicity study of 2,4-D BEE with fathead minnow (Table 24).

Not all of the above listed studies are of good enough design to pass current EPA guidelines as early life-stage studies. The most sensitive and well-designed studies are an egg-fry Chinook salmon study with 2,4-D BEE (Finlayson & Verrue in Ecology, 1989) and egg-fry fathead minnow studies by DOW (1990 in Brian, 1999). The studies conducted by Hiltibran (1967) provide good supplemental data but were not conducted for a long enough period to be considered chronic studies. However, Hiltibran's data will be considered definitive if it is the only data available with a particular product and a particular species. In these studies the NOECs ranged from 17 to 40 mg a.i./L with 2,4-D DMA. The EEC for 2,4-D DMA is less than 4.8 mg a.i./L since the highest concentration at the time of application on a United States site could be no higher than the maximum use rate. Since the NOEC is higher than the EEC, our most credible studies indicate that these species should not be affected by proper use of 2.4-D at the maximum use rate.

However, since the database is so small, one cannot say that no credible risk exists for chronic exposure of fish to these products. Further research to expand this database on the chronic toxicity of 2,4-D DMA to fish needs to be conducted to give the chronic toxicity NOECs greater credibility. Typical tests that would be conducted are early life-stage tests with fathead minnow, rainbow trout and sheepshead minnow. These species are easy to rear in the laboratory and the procedures for conducting early life-stage tests are accepted by state and federal regulatory agencies.

With 2,4-D BEE, the amount of chronic data that has been generated is extremely limited. Only a few studies with fathead minnow and Chinook salmon have been conducted. The range of NOECs for fish was 0.040 mg a.i./L for Chinook salmon in an 86-day early life-stage tests to 0.3 mg a.e./L in a 10 month life-cycle test with fathead minnow. In field residue studies with 2,4-D BEE, the residue levels started out at concentrations that were 0.19 mg/L at the surface of the water column and 3.25 mg/L in the root zone (bottom of water column) after treatment with 2,4-D BEE, but had decreased to <0.100 mg/L within two to six days. Within 5 to 22 days, the concentration in treated open waterways of the Okanogan Valley had decreased to <0.001 mg/L [Canadian ministry of the Environment (1980 in Gallagher, 1992)]. This concentration can be considered the EEC for public waterways. Since long term concentrations in the environment are

much lower than the NOEC concentration, these species would probably not be adversely affected. However, it is difficult to draw conclusions on safety to the biota. Early life-stage tests conducted with species of known sensitivity like rainbow trout, fathead minnow and sheepshead minnow would improve the credibility in determination of risk.

Determination of the chronic toxicity of 2,4-D acid is not necessary since chronic toxicity of the commercial aquatic products is low enough for the protection of the fish biota. However, the chronic NOECs for the acid range from 29 mg a.i./L for the Medaka and 63 mg a.i./L for the fathead minnow. The NOECs are difficult to determine in surrogate studies done with 2,4-D sodium salt and potassium salt because they were not standard statistical values but LC1s for tests with rainbow trout, goldfish and largemouth bass. However for the most sensitive species (rainbow trout) the LC1 for an egg toxicity test was ~0.027 mg a.i./L (0.025 mg a.e./L). Since the long term NOEC is greater than the EEC <0.001 mg/L risk to these fish species is probably low. However, early life-stage tests conducted with species of known sensitivity like rainbow trout, fathead minnow and sheepshead minnow would improve the credibility of this risk analysis. The formal risk assessment in Section 4.3.2.5 supports the conclusion of this toxicity review.

_ Chronic aquatic invertebrate toxicity

The amount of data that has been generated on life-cycle effects of 2,4-D against aquatic invertebrates is minimal (Table 2 and Appendix 4). Twenty-one day life-cycle tests have been conducted on 2,4-D DMA, 2,4-D 2-EHE, 2,4-D BEE and 2,4-D acid with *Daphnia magna*; also 4 and 7 day life-cycle tests have been conducted on 2,4-D acid with *Ceriodaphnia dubia*; and 28 day chronic tests have been conducted on 2,4-D Iso-BEE with the estuarine crabs (*Chasmagnathus granulata* and *Uca uruguayensis*).

The life-cycle NOEC for 2,4-D DMA is 27.5 mg a.i./L on Daphnia magna. This is well above the maximum exposure rate of 4.8 mg a.i./L (4.0 mg a.e./L) expected after the initial application of 2,4-D DMA. The EEC for 2,4-D DMA is less than 4.8 mg a.i./L since the highest concentration at the time of application on a United States site could be no higher than the maximum use rate, 2,4-D DMA is not likely to have chronic affects on Daphnids at typical use rates.

However, since the database is so small one cannot say that no credible risk exists for chronic exposure of invertebrates to 2,4-D DMA. Further research on the chronic toxicity 2,4-D DMA to aquatic invertebrates needs to be conducted to give the life-cycle NOECs greater credibility. Additional tests that should be conducted include life-cycle tests with *Ceriodaphnia dubia* and the mysid shrimp. These species are easy to rear in the laboratory and the procedures for conducting life-cycle studies are accepted by state and federal regulatory agencies.

With 2,4-D BEE, the amount of chronic and life-cycle data that has been generated is extremely limited. Only estuarine crabs (*Chasmagnathus granulata and Uca uruguayensis*)(28-day chronic toxicity studies) and *Daphnia magna* (21-day life cycle studies) have been conducted. The LC50 for 28-day chronic estuarine crab studies was over 50 mg a.i./L for adult crabs; this species appears to be extremely tolerant of 2,4-D Iso-BEE. However, the NOEC for 21-day life-cycle studies with *Daphnia magna* was 0.29 mg a.i./L. In field residue studies with 2,4-D BEE, the residue levels started at concentrations of 0.19 mg/L at the surface of the water column and 3.25 mg/L in the root zone (bottom of water column) after treatment with 2,4-D BEE but had decreased to <0.100 mg/L within two to six days. Within 5 to 22 days, the concentration in treated open waterways of the Okanogan Valley had decreased to <0.001 mg/L [CanadianMinistry of the Environment, 1980 (in Gallagher, 1992)]. This concentration can be considered the EEC for public waterways, which leads to the conclusion that typical use concentration will not affect the species that have been tested. However, the data is extremely limited making it is difficult to draw conclusions on safety to the biota.

Additional life-cycle tests conducted with species of known sensitivity like *Ceriodaphnia*

dubia or mysid shrimp would improve the credibility of this risk analysis. Risk analysis for 2,4-D acid is not necessary since chronic toxicity of the commercial products has shown acceptable risk quotients for the protection of the fish biota. However, the life-cycle NOECs range from 26 mg a.e./L in a 7 day *Ceriodaphnia dubia* life cycle test to 79 mg a.e./L in a 21 day *Daphnia magna* life-cycle test. Again using the "Chronic" EEC of 0.001 mg/L allows for the conclusion that typical environmental concentrations will not affect the species tested. However, life-cycle tests conducted with species of known sensitivity like *Daphnia magna, Ceriodaphnia dubia* and mysid shrimp would improve the credibility of this risk analysis. A formal risk assessment in Section 4.3.2.5 supports the conclusion of this toxicity review.

4.3.2.3 Impacts of Single Versus Multiple Applications

It is extremely rare for lakes in Washington State to be treated with 2,4-D products more than once in a season. Therefore, very little practical field knowledge is known on this subject. However, some laboratory work with insects (Ahmed and Ali, 1994) and some fish-pond farm work in India (Sarkar, 1991) to control general weeds involved multiple exposures to 2,4-D. Additional laboratory work indicates that chronic exposure at high concentrations of 2,4-D acid (mimicking multiple exposures) may cause both pathological and biochemical signs of stress in the common carp (Neskovic et al, 1994 &
Elezovic et al, 1994) and the tench (Gomez et al (1999). These exposure were very high (150 to 400 mg/L for 12 to 14 days); so levels of acute toxicity (96 hour LC50s~300 mg/L) were being approached in these studies. Such exposures are high and probably unreasonable as a multiple exposure model based on theoretical exposure rates.
However, even low exposures may cause additional stress making sensitive species more susceptible parasites, disease, predators, and other pesticides.

Exposure rates that would be typically encountered in the field for 2,4-D DMA and 2,4-D acid do not demonstrate acute or obvious chronic effects (Table 2, Table 23, Appendix 1, Appendix 2, Appendix 3, and Appendix 4) nevertheless, fathead minnow exposed continuously to concentrations of 2,4-D DMA that ranged from 0.12 to 2.0 mg/L exhibited somewhat subtle chronic effects. After exposure for two months, no effects were found on growth, survival, egg production or fry survival, but the exposed animals spawned one month prematurely due to a general increase in metabolic rate as determined by a separate radio-iodine uptake test with the same fish. Other physiological changes noted included a reduction in bone collagen levels (Mayer, et al, 1977 in Shearer and Halter, 1980). The significance of these changes in reproductive timing and bone collagen levels is not entirely understood but is presumably indicative of some degree of chronic physiological stress.

Similar studies conducted with the fathead minnow after exposure to 2,4-D BEE at concentrations ranging from 0.7 to 1.8 mg/L did not effect the histopathology, sexual condition or development time of eggs and fry (Mount and Stephan, 1967 in Shearer and Halter, 1980). Except for mortality of eggs and fry, even the highest concentrations did not adversely affect fathead minnow. The NOEC for this life cycle study was determined to be 0.3 mg/L (Table 2 and Appendix 3). Since the chronic exposure EEC could range between <0.1 mg/L and <0.001 mg/L in Northwestern waters (Gallagher, 1992 cites Canada, 1976), these natural field rates should be safe for chronic exposure of this species.

Cumulative effects of 2,4-D acid on the development time in the southern house-mosquito has also been noted. The effects seem to run counter to those observed in the fathead minnow. The cellular generation time as determined by the mitotic index was observed to increase in mosquito larvae exposed to concentrations as low as 1.0 mg 2,4- D acid/L. This effect at the cellular level resulted in increases in the larval duration time from 180 hours to 200 hours after one generation to 230 hours after three generations with an exposure time of 4-hours per generation (Ahmad and Ali, 1994).

Such differences in the development time between predator and prey species has a potential to produce adverse effects in wild populations. If the spawning time is early for the predator species and the development time is late for the prey species, the prey may not be developed to an appropriate size when the predator fish fry need nutritional input most.

_ Potential impacts on numbers

Shearer and Halter (1980) reviewed a number of field studies on the effects of 2,4-D DMA and 2,4-D BEE on aquatic invertebrates (mainly benthic invertebrates). For example, 2,4-D acid which is probably the main concern from treatment with 2,4-D BEE appears to be extremely toxic to the lined scud (LC50 = 3.2 mg a.e./L, Table 23). While the lined scud appears to very tolerant of 2,4-D DMA (LV50 = >100 mg a.i./L = 86 mg a.e./L, Table 23), there are estuarine benthic organisms (*Palaemonetes spp.* and *Cypridopsis vidua*) that appear to be very susceptible to 2,4-D DMA (LC50 = 0.15 mg a.i./L to 8.0 mg a.i./L, Table 23). While these laboratory studies suggest that 2,4-D in the form of 2,4-D BEE may adversely impact benthic invertebrates, field trials do not support this conclusion. Given the absence of noted effects, the number of studies reported, and the 20 to 30 year collection period, the assumption that any measurable direct effects on invertebrate populations would have been detected by this time seems reasonable.

Four studies have reported on the effects of 2,4-D following the treatment of invertebrate habitat. Brooker (1974 in Shearer and Halter) monitored the invertebrate populations of an English drainage ditch for six months after application of a mixture of 2,4-D DMA and dalapon to emergent ditch-bank vegetation. Since no undesirable effects were noted, the fact that a mixture of herbicides was used was not a complication. Sediment cores and net sweeps were taken at two-week intervals, and density fluctuations in the five major taxonomic groups present were considered normal. There was no change in the population density of 49 species, increases in 7 species and serendipitous appearances of 29 species in either the control or treatment streams.

In a rather limited experiment conducted in Stone Valley Lake, Pennsylvania Marshall and Rutschky (1974) found that there was a decrease in the numbers of benthic organisms five-weeks after treatment. There was also a shift in the dominant species from dragonfly, damselfly and mayflies to oligocaete worms and tendepedid midges. This study was complicated by emergence of the insect species and a drop in the dissolved oxygen content of the hypoliminion which no doubt causes a shift of species from those which require water with a high oxygen content to those which can tolerate a low oxygen content.

Effects of 2,4-D on bottom fauna of fishponds were measured by Sarkar (1991) "Commercial grade" 2,4-D was applied at rates of 0.42, 0.20, 0.375, 0.524, 0.708 and 0.875 Kg/Ha (0.038, 0.18, 0.33, 0.48 0.63 and 0.78 lbs/acre) as liquid uniformly splashed over pond surfaces for a total of 12 applications. Subsequent applications were made every 30 days for a total of 12 applications. During every month, bottom fauna were collected with a bottom sampler from eight areas in the ponds and were analyzed. Populations of bottom organisms were reported for total annual herbicide applications of 0.5, 2.5, 4.45, 6,5, 8,5 and 10.5 kg/ha/year (0.45, 2.23, 4.0, 5.8, 7.6 and 9.4 lbs/acre/year). At 2,4 D applications of 0.5 and 2.5 Kg/ha/year, the mean biomass was not significantly different from the control (no herbicide application).

The higher 2,4-D treatments (4.5 to 10.5 Kg/ha/year) resulted in mean biomass increases of 22.15, 20.40, 21.30 and 21.1 percent of the control values, respectively. Dominant forms of bottom fauna identified during the study included *Chironomus lobaticceps* (27.9%), *Branchiura sowerbyi* (17.5%), *Planorbis exustus* (5.3%), unidentified *Odonota* (4.3%), *Viviparus bengalensis* (5.0%) *Lymnaea leuteola* (6.0%) *Branchiodrilus hortensis* (14%) and *Chaoborus spp.* 20%). However, effects on species diversity from the 2,4-D applications were not reported. This increase in benthic fauna was attributed to an increase in benthic (sediment) bacteria numbers and an unspecified enhancement in metabolic capacity due to the exposure to 2,4-D.

The increase in benthic bacteria numbers was attributed to an increase in nutrient levels due to mass mortality of phytoplankton in the early stages of development and an unspecified *stimulatory effect of 2,4-D and its metabolites.*

In a similar, shorter term experiment, Patnaik and Das (1991) found that unspecified zooplankton increased about three-fold in eight weeks after treatment with Fernoxone® (2,4-D sodium salt) at rates of 6 Kg a.i./ha (5.4 lbs a.i./acre). This increase in zooplankton count mimicked the nutrient levels of nitrate and phosphate, which appeared to stimulate the growth of heterotrophic bacteria and phytoplankton found in the water column (Table 15). This stimulation of the growth of microorganisms provided an increased food supply for the resident zooplankton and a subsequent increase in their numbers.

There is not a large literature base concerning negative or positive impacts of 2,4-D treatment on numbers of fish and invertebrates in natural ecosystems. There is data on the effect of failure to remove weeds when they become so dense they interfere with the action of indigenous fishes, but even this data is ambiguous. Klussmann et al. (1988 in Bain and Boltz, 1992) found that catch rates for largemouth bass was greatest when the plant densities were highest, while Colle et al. (1987 in Bain an Boltz, 1992) found that largemouth bass catches were unaffected by a reduction in plant density. Ideal plant cover of about 36% appears optimal for production of largemouth bass (Ware and Gasaway, 1978 in Bain & Boltz, 1992) and complete removal of aquatic plants can cause a major decline in forage fish and largemouth bass abundance (Moxley and Langford, 1985 in Bain & Boltz, 1992). There can be a decrease in the numbers of certain size classes (intermediate size largemouth bass) and not others (large largemouth bass) if foliage is entirely removed (Klussmann et al., 1988 in Bain & Boltz, 1992).

A detailed study on the numbers and diversity of fish conducted by Olaleye et al. (1993) concluded that areas heavily infested with waterhyacinth contained a very low number (8 per unit area) of the *Ctenopoma kinglayae* (Anabantid), and no other fish species. However, if no waterhyacinth or other weeds were present, the numbers of this Anabantid went up to 30 per unit area and eight other families of fish were present at low levels. Since this work was conducted in Nigeria, it may not be directly applicable to the State of Washington.

The toxic potential of 2,4-D BEE as measured in the laboratory is apparently not realized under the 2,4-D BEE concentrations and environmental conditions present during actual field use. The fairly rapid hydrolysis of 2,4-D BEE to 2,4-D acid in nature is probably the key factor responsible for this observed lack of environmental toxicity. See Section 3 for details on the environmental fate of 2,4-D BEE. Shearer and Halter (1980) have reviewed the effects of 2,4-D on a number of species. Studies monitoring field application of 2,4-D BEE have been unable to show direct adverse effects on fish populations as a result of 2,4-D BEE treatments. Such studies have generally consisted of holding caged fish in treatment areas, plus systemic or random net-capture surveys of fish populations at various time periods post treatment.

Various reports (all cited by Shearer and Halter, 1980) by Smith and Ison (1967) in TVA reservoirs, Whitney et al, (1973) in Currituck Sound, Ganstad (1978) in southern waters of the United States, Pierce (1960, 1961) in the northeast and Lim and Lozoway (1978) in British Columbia are uniform in their appraisal of no observable direct effects on fish populations as a result of 2,4-D BEE treatments.

Additional review by Shearer and Halter (1980) on the field effects of 2,4-D DMA found results that were similar to those achieved with the 2,4-D BEE product. Schultz (1973 in Shearer and Halter, 1980) exposed bluegill sunfish, largemouth bass and channel catfish in outdoor plastic pools to one time dosages of 0.5, 1.0 and 2.0 mg/L 2,4-D DMA for 84- days, and observed no adverse effects on fish. Similarly, no fish died when Stallings and Huckings (1978 in Shearer and Halter, 1980) used the same protocol to study 2,4-D DMA dynamics in bluegill sunfish. Schulz

and Harmon (1974 in Shearer and Halter, 1980) reported no fish mortality but successful bluegill reproduction in ponds treated with 2,4-D DMA. According to Scott et al (1978 in Shearer and Halter, 1980), bluegill sunfish in ponds treated with 2 mg/L 2,4-D DMA showed no toxic effects but did grow faster than fish in control ponds. Whether this was due to indirect or direct effects of 2,4-D was not stated. In a recent study by Bain and Boltz (1992), the dominant species of aquatic weeds Eurasian watermilfoil (*Myriophyllum spicatum*), and also incidental coontail, Uruguayan waterprimrose, giant cut grass and alligator weed were removed by application of 2,4-D DMA at 2 mg/L in nearshore waters of the Gunthersville Reservoir, Alabama. Overall, the results of this study indicate that there is no evidence that localized herbicide application changed the abundance, size structure, condition or movement of largemouth bass.

A study conducted on fishponds in India evaluated the effects of "commercial grade" 2,4-D application on bottom fauna productivity and on bottom- and column-feeding fish species (Sarkar, 1991). Application of 2,4-D at rates ranging from 0.5 to 10 kg/ha/year (0.45 to 9.38 lbs/acre/year) over a 1-year period increased the bottom-fauna biomass. Survival rates of each fish species (*Labeo rohita, Gibelion catla, Cirrhinus mrigala* and *Cyprinus carpio*) were measured at the end of the 1-year period when the ponds were drained (Table 26). Survival rates of different species of fish treated with 2,4-D applications at rates of 0.5 to and 2.5 Kg/ha/year did not differ significantly from the control. However, at 4.5 Kg/ha/year (4.0 lbs/acre/year) application rates, survival rates of *L. rohita, G. catla, C. mrigala* and common carp increased by 14.1%. 17.4%, 14.4% and 30% of the control, respectively. At 6.5, 8.5 and 10.5 Kg/ha (5.8, 7.6 and 9.4 lbs/acre/year), the survival rate of *L. rohita* significantly decreased 13.4%, 29.6% and 34.1) from the control rate, and that of *G. catla* decreased by 64%, 13.0% and 19.2%. There were increases in the survival rate of *C. mrigala* and common carp at these higher dosages. Although there was a significant increase in the yield of bottom-feeding fish by 0.5 to 60% and 35.6 to 141.7 in *C. mrigala* and common carp, respectively, there was a significant decrease in the yield of species that typically feed in the water column. Sarkar (1991) concluded that there was no clear evidence of a direct influence from 2,4-D on bottom feeding fish growth in ponds. Nevertheless, the increase in benthic microbes and hence benthic invertebrates provided a greater amount of fish food organisms; subsequently, bottom fish consumed increased bottom fauna and significantly increased yields. Sarkar (1991) assumed that planktivorous fish viability was affected by phytoplankton die-off resulting from higher 2,4-D exposure (both *L. rohita* and *G. catla* are planktivorous). Because 2,4-D appears to adversely affect phytoplankton at higher concentrations (400 to 1200 mg/L), it is unlikely that planktivorous fish are adversely affected by 2,4-D. These concentrations approximate concentrations that are known to adversely affect algae (Table 19).

A similar short term study conducted by Patnaik and Das (1991) indicated that the use of 2,4-D sodium salt at application rates of 6 Kg/ha to control the thorny lily (*Euryale ferox*) did not affect the healthy condition of resident fish populations, which included *L. rohita*, *G. catla* and *C. mrigala*. Furthermore the successful use of fish from treated ponds as broodstock for seed production suggests no long-range effects of 2,4-D on fish.

2,4-D has been shown to have an impact on insects associated with waterhyacinth (*Eichhornia crassipes*) control. Using the 2,4-D amine salt at concentrations up to 2.0 to 2.2 while not killing the plants, decreased the hardness of the leaves and thus may increase the effectiveness of the biocontrol agents such as *Sameodes albiguttalis (Lepidoptera: Pyralidae*) and *Neochetina eichhornia* and *N. bruchi (Coleoptera: Curculionidae*) (Wright and Bourne, 1990).

Incremental treatment of Calf Pond, Florida at 2.2 Kg/ha starting August, 1985, resulted in an increase in hyacinth weevil density of approximately 3-times that observed prior to treatment and the number of feeding scars doubled in that time frame. The resulting damage reduced plant density and biomass severely and by April 1987, no live waterhyacinth plants remained in the

lake. After the elimination of waterhyacinth, Calf pond was invaded by water lettuce, and as of November 1990 was extensively colonized by this aquatic weed. Effective control of waterhyacinth at this site was obtained within two years, employing the combined stresses of insect feeding damage and space limitations. Other workers have reported control or elimination of waterhyacinth within 9-months to 6-years. This time frame is dependent on both nutritional quality of the waterhyacinth plants and their past history with respect to initial weevil colonization and subsequent use of herbicides (Haag and Habeck, 1991).

_ Potential impacts on diversity

As described in the Nigerian work with waterhyacinth, high infestation rates with weeds can effect both fish numbers and fish diversity (Olaleye et al, 1993). Details on the effects of weed infestation on numbers and diversity of these fish can be found in potential impacts on numbers section.

Information on the changes in numbers of fish and invertebrates due to 2,4-D treatment has been gathered, but the changes in diversity have not been addressed. As reported previously, an English drainage channel was monitored by Brooker (1974 in Shearer and Halter, 1980) for six months after it had been treated with a combination of dalapon and 2,4-D DMA to control ditch bank vegetation. The maximum concentration of 2,4-D in channel water was 0.029 mg/L at the height of the summer season. Neither the total numbers as indicated above nor the diversity was affected. Marshall & Rutschky (1974) conducted a similar, more limited, study in a small cove in Stone Valley Lake, Pennsylvania. Five-weeks after treatment with 2,4-D BEE granules the diversity had not changed, but the numbers and species composition had changed from one dominated by species that require a high dissolved oxygen content *[odonata* (dragonflies and damselflies) and *ephemeroptera* (mayflies)] to a population dominated species that could tolerate low dissolved oxygen content. This was not surprising in light of the drop in oxygen content from 6.5 mg/L prior to treatment to ~0.0 mg/L in the hypoliminion one week after treatment. Although not addressed directly, Marshall and Rutschky cited others including Pierce (1958 & 1960), Cowell (1963), Fish (1966), Gilderhaus (1967) and Price (1967) that indicated that aquatic herbicides affect non-target zooplankton community structure. Also the planktivorous fry of largemouth bass and bluegill sunfish could be affected by a drop in the number of zooplankton. In dealing with commercial fishponds Sarkar (1991) found that "Adoption of (the) recommended 2,4-D application rate will accelerate the growth of bottom fauna and production of bottom–feeding fish and also will help fish farmers in many other ways.

_ Potential impacts on habitat use for spawning, rearing and growth effects on Trout and other salmonids

2,4-D, has been shown to have low acute and early life-stage toxicity to freshwater trout in the forms that trout are likely to encounter. 2,4-D DMA has an acute toxicity to trout (LC50 = 100 to 377 mg a.i./L). Since 2,4-D DMA is not likely to be encountered at concentrations higher than 4.8 mg a.i./L immediately after treatment, this product is unlikely to cause toxicity in freshwater trout. Due to its very short half-life salmonids are not likely to be exposed to 2,4-D BEE. Therefore, the toxin of concern would be 2,4-D acid. Shortly after initial exposure, it is estimated that the EEC for 2,4-D acid would be 0.19 mg/L at the top of the water column and approximately 3.25 mg/L at the bottom of the water column. Concentrations of 2,4-D acid would be expected to be at or below 0.100 mg/L within two to six days (Gallagher, 1992). Typical LC50s with 2,4-D acid for salmonids is 40 mg/L for 2,4-D acid although the lowest credible reported value is 25 mg/L for cutthroat trout. Under most conditions it is not likely that salmonids would be exposed to concentrations of 2,4-D acid that are high enough to cause acute toxicity.

Although trout fry have been noted to avoid 2,4-D DMA at concentrations that are environmentally relevant (1 to 10 mg/L) (Folmar, 1976), avoidance may not be possible in real field treatment situations. Trout driven from a habitat by avoidance behavior, may not be able to

obtain necessary resources for survival in other habitats. These resources could include, food, refuge, mates and appropriate egg-laying (substrate). It has been reported that fish appeared to be *driven out of an area after field application of 2,4-D to TVA Reservoirs (Smith & Ison in Shearer* and Halter, 1980), which would reduce the potential of adverse impact to fish species. No other field studies have confirmed this avoidance behavior with freshwater trout.

Probably, the greatest concern is managing aquatic plants so that maximum fish breeding opportunities can occur. Although it typically takes concentrations of ~0.300 mg/L 2,4-D BEE to *effectively manage aquatic foliage (Helsel, 1996), prolonged exposure (starting in June of any* given year) of 0.1 mg/L might eliminate *Myriophyllum sibericum* and *Potamogeton pectinatus* from prairie ponds (Forsythe et al, 1997) by the end of the growing season. The consequences of eliminating such plants from a habitat can have tremendous consequences. Due to the effects of erosion by floods, the character of a habitat may be changed from one suitable for the reproduction of sunfish to one suitable for the reproduction of salmonids.

If water that contains 2,4-D at effective concentrations passes, from a lake or pond into a river or stream, the rooted aquatic macrophytes may be destroyed. This can have a substantial impact during the next high water event. Normal spring floods in absence of rooted aquatic macrophytes can dig up and kill large numbers of benthic organisms while summer spates can completely denude streams of benthic biota.

Most biota avoid floods either by migrating to calm back waters or by having life cycles which are terrestrial or aerial at these times. However when floods occur at unusual times the fauna *may be severely depleted and require several years to recover (Goldman & Horne, 1983).*

Larger organisms, like salmonids, normally choose to ascend rivers or streams during high water because there are fewer shallow water barriers. Severe floods are detrimental to smaller biota if they leave only rocks and gravel. However, these floods may improve fish migration by removing major obstacles. Smaller floods can improve the environment for salmonid mating and egg survival by removing excessive silt. These benefits cannot occur if the lotic system has been dammed by aquatic weeds.

_ Effects on salmon smoltification

Evidence for effects on salmon smoltification is of great potential concern with herbicides that are applied in Northwestern waters. A variety of seawater challenges have been performed with salmon species that have been exposed to ecologically relevant concentrations of 2,4-D. For example, 1.0 mg/L 2,4-D BEE kills all of the salmon smolts exposed for 96 hours to this concentration. However, exposure to this concentration (1.0 mg/L) for 24 hours prior to a seawater challenge test did not affect 96 hour survival of smolts in clean seawater. Species tested included Coho salmon *(Oncorhynchus kisutc*h), sockeye salmon *(Oncorhynchus nerk*a) and pink salmon *(Oncorhynchus gorbuscha*) (Martens, 1979 in Shearer and Halter, 1980).

2,4-D DMA also does not kill Coho salmon smolts at concentrations up to 200 mg/L. Fish exposed to these concentrations of 2,4-D DMA survived seawater challenge tests and no ATP-ase effects were observed with sublethal dosages of 2,4-D DMA. This is an important observation since ATP-ase is believed to be essential in maintaining osmoregulation during the parr to smolt metamorphosis (Lorz et al, 1979 in Shearer and Halter, 1980).

These results indicate that the main 2,4-D products used for control of aquatic weeds are not likely to put salmon species at risk during the smotification process. Although most of the Northwestern relevant species have been tested, Chinook salmon, which has been shown to be sensitive of Aquathol® (Ligouri et al, 1984) and Hydrothol® (Serdar and Johnson, 1995), has not been tested in a seawater challenge test with the most common 2,4-D products.

_ Effects on sea-run cutthroat trout

No work was found on the effect of 2,4-D on sea-run cutthroat trout other than acute toxicity data with 2,4-D 2-EHE and 2,4-D acid (LC50 = >50 mg a.i./L for 2,4-D 2-EHE and LC50 = 40 mg/L 2,4-D acid). Since the EECs for 2,4-D 2-EHE and 2,4-D acid are estimated to be 0.116 and 4.0 mg a.i./L, respectively, this species is likely to be unaffected by the 2,4-D products that have been tested. Based on the toxicity of 2,4-D DMA to other salmonids (LC50 = 100 to 377 mg a.i../L), 2,4-D DMA is likely to be practically non-toxic to sea-run cutthroat. Although 2,4-D BEE, based on its toxicity to other salmonids (LC50 = 0.3 to 3.67 mg a.i./L), is expected to have high toxicity to sea-run cutthroat trout, it is not believed that exposure in the field is likely due to low solubility and rapid breakdown of 2,4-D BEE to 2,4-D acid. However, additional information on the acute toxicity and chronic toxicity of 2,4-D products to cutthroat trout would be useful to aid in risk assessment with either this or related species.

A potential complicating factor with sea-run cutthroat trout and steelhead trout *(Oncorhynchus mykiss)* is similar to the parr to smolt metamorphosis except that these sea-run trout may go through this process several times in their lifetime including each time the adults migrate to the sea and the initial parr to smolt metamorphosis. Based on the seawater challenge tests with several salmonid species, this seawater to freshwater to seawater metamorphosis is not expected to be an issue. Depending on the degree of confidence that we have that sea-run cutthroat trout are similar to other salmonids in this transformation, further research may not be warranted.

_ Effects on other species (sunfish, minnow and catfish)

The acute and chronic toxicities of 2,4-D DMA and 2,4-D acid (hydrolysis product of 2,4-D BEE) are very low in fish. The acute LC50s are generally greater than 100 mg a.i./L for most ecologically relevant species. The LC50 of 2,4-D acid is greater than 20 mg a.i./L for the most sensitive environmentally relevant species (common carp). The chronic NOECs for these forms of 2,4-D are greater than 17.1 mg a.i./L for all fish species tested. Since the acute and chronic toxicity for these forms of 2,4-D are low, 2,4-D DMA and 2,4-D acid are unlikely to adversely impact wild fish.

Although 2,4-D BEE is acutely toxic to most fish species (LC50 = 0.3 to 4.3 mg a.i./L), fish are unlikely to come into contact with 2,4-D BEE due to its low solubility and rapid hydrolysis to 2,4-D acid. In the species tested (Chinook salmon and fathead minnow), the chronic NOEC (0.040 to 0.3 mg a.i./L) is typically lower than the long-term EEC. Therefore, the chronic impact of 2,4-D BEE on fish is likely to be low.

A potential concern, are the effects of 2,4-D on behavior and metabolic responses in wild fish. A relatively high concentration of BEE (110 mg/L) impaired swimming performance in green sunfish *(Lepomis cyanellus)* within 1-hour after exposure (Moore, 1974 in Ebasco, 1993). In the common carp, 2,4-D at high concentrations also impaired swimming (96 hour LC50 = 135 mg/L) causing irregular movement, erratic jerks, sluggishness followed by hyper-excitability, and finally cessation of all activity. However, unlike the green sunfish, no abnormal swimming behavior was observed during the first 24- to 48-hours of exposure (Sarkar, 1990).

In a field study evaluating behavior of sunfish guarding their nests during 2,4-D DMA surface spray application (~4 mg/L), fish abandoned their nests in six of nine trials with bluegill sunfish and in four of seven trials with redear sunfish (Bettoli and Clark, 1992). Abandonment typically occurred within 30 seconds following applications and lasted up to 15 minutes. However, since the sample size was very small (6 controls and 7 to 9 2,4-D treatments), the effects on treated fish were not significantly different from untreated fish. Therefore, further investigation to verify these conclusions needs to be conducted. These findings may be of significance since 66% to 88% of the 2,4-D DMA treated cohorts abandoned their nests and only 20 to 50 % of the water treated cohorts abandoned their nests. This is an important potential issue since congener

predators in 100% of the treatments attacked abandoned nests. Such a dramatic impact could have a marked influence on the number of young of the year surviving to the free-swimming stage. However, once fish returned to the nest, parenting behavior (such as rim circling, fanning or agonistic displays) did not appear to be affected.

As discussed previously, Bain and Boltz (1992) found the removal of aquatic weeds with 2,4-D DMA had no significant effects on abundance, size structure, condition or movement of largemouth bass within the Gunthersville Reservoir, Alabama. This may not be the case for all species of fish and invertebrates since rainbow trout (Folmar, 1976), sheepshead minnow (Hansen, 1969 in Hansen et al, 1973) and mosquito fish (Hansen et al. 1972 in Shearer and Halter, 1980) will avoid 2,4-D when they are exposed to environmentally relevant concentrations within the laboratory environment. However, all investigators working on avoidance response stated that it was unlikely that significant numbers of exposed fish or invertebrates would or could avoid exposure to 2,4-D.

Effects on the metabolism of fish have also been discussed. The growth of carp species may be stimulated by the treatment of fish ponds with 2,4-D commercial products because the growth of bacteria and the benthic organisms that feed upon them. However, this effect was not apparent with species that fed higher up in the water column (like *Labeo rohita* and *Gibelion catla*) since 2,4-D did not have a strong effect on phytoplankton in the field (Sarkar, 1991). However, in a similar environment, Ptanaik and Das (1991) found that 2,4-D stimulated the growth of bacteria, phytoplankton and zooplankton but that these effects on fish food organisms had no effect on the resident fish population. Use of fish from treated ponds as broodstock for seed production also suggests no long range effect of 2,4-D sodium salt on fish.

_ Effects on invertebrates

Data on the field effects of 2,4-D against aquatic invertebrates is not extensive. From the laboratory data it is apparent that the free-swimming species are not normally affected adversely by 2,4-DMA. Typical field concentrations vary after application depending on the particular situation.

In California, application of 2,4-D DMA at 5.7 Kg a.i./ha to control mats of aquatic weeds did not result in concentrations of 2,4-D that exceed the Federal drinking water standard (0.07 mg/L) outside the weed mat area for more than two hours after application (Anderson, 1982 in Gallagher, 1992). However, more typical concentrations of 2,4-D DMA are seen in ponds treated for waterhyacinth control in Florida and Georgia. Concentrations in water varied depending on application rate, but for the highest rates (8.96 Kg a.e./L), the maximum concentrations that occurred were 0.345 to 0.692 mg a.e./L (0.416 to 0.837 mg a.i./L) three days after application. These concentrations are not likely to adversely affect free-swimming aquatic invertebrates (LC50 = 100 mg a.i./L for *Daphnia magna*). However, some of the benthic species may be adversely affected. For example, since the seed shrimp (LC50 = 8.0 mg a.i./L) and the glass shrimp (LC50 = 0.15 mg a.i./L) are less than tenfold higher than the EEC, benthic organisms may be adversely affected by even a low concentration of 2,4-D DMA. Since only one species of free-swimming invertebrate was tested in a chronic life-cycle test, the chronic safety of 2,4-D to the biota is difficult to ascertain. However, since the NOEC (27.5 mg. a.i./L) is very high for the one reviewed study, safety of 2,4-D DMA to the free-swimming invertebrate cannot be rejected without further analysis.

Similar comments for 2,4-D BEE can be made in regard to its toxicity to free swimming invertebrates and safety to the biota. Since the highest bottom water concentrations that are likely to be encountered are 3.25 mg/L (Gallagher, 1992) and 2.0 mg/L (Shearer and Halter, 1980), there is a potential for benthic fish to be adversely affected by 2,4-D BEE. If benthic species like *Gammarus fasciatus*, *Gammarus lacustris*, brown shrimp, nymphal stoneflies, aquatic sowbug, chironomid midge, seed shrimp or glass shrimp encounter these concentrations of 2,4-D BEE

immediately after application, the result could be fatal. However, Shearer and Halter (1980) state that "the toxic potential of 2,4-D BEE, as
measured in the laboratory, is apparently not realized under the 2,4-D BEE concentrations and environmental conditions present during actual field use. The fairly rapid hydrolysis of 2,4-D BEE to 2,4-D acid in nature is probably a key factor responsible for this generally observed lack of environmental toxicity..." See Section 3 for a detailed discussion of persistence of 2,4-D BEE in the environment.

Chronic risk is acceptable with 2,4-D BEE for all tested species since chronic EEC levels are unlikely to be higher than 0.001 mg/L; 2,4-D BEE applied to open water areas has typical maximum concentrations of 3.25 ml/L in bottom waters and 0.19 mg/l in surface waters. Typically these residues will dissipate to concentrations of <0.100 mg/L in 2 to 6 days and <0.001 mg/L in 5 to 22 days (Canadian Ministry of the Environment, 1977-1978 in Gallagher, 1991). As discussed previously, there is strong evidence that effects of 2,4-D on invertebrate breeding may be complex and site specific. Zooplankton and benthic
organisms, while not directly stimulated by 2,4-D to increase their numbers through more rapid breeding do appear to increase in number with chronic short-term (8-week) and long-term exposure.

For example, the numbers of zooplankton organisms in short-term fishpond studies in India increased in number almost immediately after treatment with 2,4-D sodium salt at 6 kg a.i./ha; increases in zooplankton numbers were documented by a pretreatment population of 432 *zooplankton/L before treatment to 624 zooplankton/L immediately after treatment and 1260* zooplankton 8 weeks after treatment. The improvement in this pond as a zooplankton breeding site was directly correlated with a similar increase in phytoplankton counts (324 to 480 to 924 phytoplankton/L) and heterotrophic bacterial counts. This could have been due to and increase in nutrient levels which stimulated the phytoplankton and heterotrophic bacteria to grow (Patnaik and Das, *1991*) (Table 9). Another possibility is that 2,4-D stimulated phytoplankton to grow by direct metabolic
stimulation (Wang et al, 1991).

Sarkar (1991) found similar effects on benthic organisms after long term, repeated treatments of a fishpond in the country of India at 4.5 to 10.5 Kg/year with a commercial grade of 2,4-D. The benthic organisms increased ~21% over.the control values. This obviously improved the suitability of this breeding habitat and Sarkar (1991) explained it as stemming from an increase in the bacterial growth rate due to the availability of a readily utilized carbon source (2,4-D) and its metabolic products. The increase in the number of bacteria may also have been due to the mass mortality of phytoplankton populations and the subsequent release of nutrients that could be utilized by the benthic microbes and other organisms. The bacteria apparently improved the nutrition of the benthic organisms, allowing them to multiply.

Similar effects were not seen with zooplankton. The mass mortality of phytoplankton actually may have prevented the growth of organisms that feed upon them. Although the decrease in survival and growth of fish that feed directly on phytoplankton (Table 26) was addressed, the effects on zooplankton numbers was not directly addressed by Sarkar (1991).

Dissolved oxygen levels can effect the suitability of breeding habitat. Marshall and Rutschky (1974) found that treatment of Stone Valley Lake, Pennsylvania with 2,4-D BEE caused a decrease in the benthic dissolved oxygen concentration to anoxic levels within one week of treatment. The authors' believed that this caused a shift in dominant organisms from odonates (dragonflies and damselflies) and mayflies, which require a high oxygen content to complete development, to oligochaete worms and tendipedid midges, which can complete development in water with low dissolved oxygen content.

According to Shearer and Halter (1980), "invertebrate populations are not permanently damaged by the direct toxicity due to 2,4-D treatments has been the conclusion offered by most reports describing past large-scale plant control programs (Gangstad, 1978; Whitney et al, 1973; Wojtalik et al, 1971; and Smith & Isom, 1967 in Shearer and Halter, 1980). While this assessment may not be inaccurate, the amount of data collected to support this contention seems, in every case disproportionately low in relation to the total scope, in the particular project." Pierce (1960 and 1961 in Shearer and Halter, 1980) studied a treatment pond for several years before the application of 2,4-D, and after two seasons of work concluded that benthic organisms and zooplankton were not affected by 2,4-D. Lim et al (1978 in Shearer and Halter, 1980) found that snail populations were immediately reduced by 2,4-D treatments but that 12 months later, the populations appeared to have returned to normal in a large indoor model ecosystem containing both plants and gastropods. Furthermore, Wojtalik et al, 1971 in Shearer and Halter, 1980) documented the persistence of 2,4-D residues in the invertebrate biota of TVA reservoirs they found that 2,4-D residues were not acutely toxic to plankton and mussels.

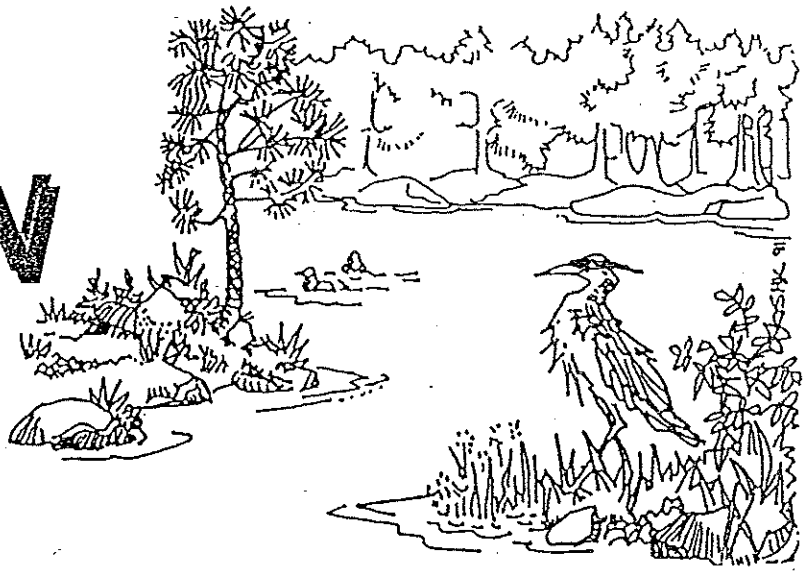
The data set presented here indicates that 2,4-D treatments do not cause adverse effects on the invertebrate biota. In some cases, growth may actually be enhanced due to direct or indirect (nutrient releases) stimulatory effects from the 2,4-D treatment.

APPENDIX D

Sacheen Lake Newsletters

1. Spring 1998
2. October 1998
3. Spring 1999
4. Fall 1999
5. Spring 2000
6. Fall 2000
7. Spring 2001
8. Fall 2001

SACHEEN SCOPE



SPRING 1998

SACHEEN BETTERMENT ASSOCIATION

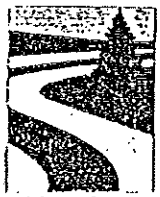
Spring has arrived much earlier this year at Sacheen. The lake is moving, fish are jumping, flowers popping up, boats tootin around, and t-shirts already being printed!

The General Meeting scheduled for Saturday, June 13th will be quite informative with respect to sewer/water issues. The details of the course of action to be taken **prior** to application being granted for a Farm Home loan, need to be heard and clearly understood by all property owners and people who care about the future of Sacheen. Rumors fly fast and the only way to avoid rumors is to be informed. In order to be informed...you need to hear it firsthand! A second meeting is tentatively set for Saturday, 8/15, 9 a.m. Mark your calendar, as this meeting will hold even more information than the June meeting. It could well determine the direction we take.

On Saturday, 5/ 9, 9 a.m. The Myers-Harter Sanctuary will be spruced up. If you can help, please bring rakes, shovels, garden carts, small hand tools, or ??? to tackle the job.

The park is a community responsibility to maintain and it is lovely. It will open Memorial Day weekend, so let's have it looking spiffy!

The annual snow melt reveals the usual highway litter and, once again, Nancy Moore will coordinate two **Adopt-A-Highway** pickups. **The first is Saturday, 5/30, 8 a.m. Meet on Fertile Valley Rd. in front of the Old Cedar Creek Resort.** It is expected that the "usual" crew will show up (they always do), but a few new feet and hands would be warmly welcome. It takes only about an hour! The second pickup is Saturday, 8/29, same time, same place!



The Board has been advised by the "Beaver Crew" that we need to install a third and possibly fourth pipe this summer. We installed one of two last summer, but ran out of time with the high water and the energy expended to remove the old cedar tube! Three formal outings (and several tweeners) were very frustrating with the mud islands in the way, but we'll try-try again.

Of course, nothing will happen without approval of a renewed hydraulics permit. The Sewer/Water District will pick up the tab for these two, as SBA picked them up last year and we have agreed to share costs.

I had a dream...actually it was a nightmare...that "THE TUBE" ran from the bridge at the west end to the Columbia River. We have sincerely met our match with these beaver types!

You can expect ro receive a Sacheen Summer Calendar with the June 13 meeting reminder. It will contain dates for different functions on and around the lake this summer and fall.

Cont'd p.2

SACHEEN BETTERMENT ASSOCIATION GENERAL MEETING & SACHEEN LAKE SEWER/WATER DISTRICT PRESENTATION

Saturday, June 13, 1998

4:00 p.m.

Sacheen Firehouse

T-SHIRTS FOR SALE, TOO!

After much discussion the Board voted to increase dues to ten dollars per member. It was not an easy decision, but there was confusion regarding the break down of $5 and $10 memberships. It is still a great bargain and insures continuation of on-going projects, and getting the SCOPE to you. The SCOPE has proved to be a great source of information for members and property owners. Also, with the need to purchase Directors & Liability Insurance for the board, at $500 per year, it seems clearly necessary.

In other matters, the Sheriff's Department has provided us with quite a few copies of the Washington State Boating Regulations, which will be available at the meeting. They plan to issue "tickets" this summer...so have those licenses in place, safety conditions met, and know the speed limits near shore before setting out to go boating! Sacheen will surely be a safer place to boat & swim!

Diane Wear
President

SEWER & WATER DISTRICT

The days are warming, the circles appear on the water's surface, can Snowbirds and summer be far behind?

Winter has been a quiet but busy time for Sewer District activities. After nearly two years of waiting to hear from the Farm Home Administration, (now called Rural Development,) we were granted audience to discuss our project and its possibility for funding. According to this group it looks as though we will qualify for mostly loan funding but as of yet have not been officially "invited to apply". Toward that end public notification of possible impact to land resources was published in the Newport Miner which showed the District map and outlined the proposed project--basically what was previously presented by Eric Eldenburg of Sewell Engineers at our firehouse meeting in the summer of 1995. Many letters have also been sent out by the engineers regarding environmental assessments for comment by all sorts of public agencies. According to Mr. Eldenburg, the next steps will be performing a wetland delineation and an archaeological cultural resource survey.

The engineers are presently fine tuning the proposal with updated figures and costs so that we can combine all the expense and funding information to present at the June 13 meeting. We are getting down to the nitty gritty, where District members will be deciding whether they wish to fund this project or not.

Please plan to attend the informational meeting so you can be fully informed on this important decision.

TAXES

The Sewer and Water District will again be asking the voters to pass a Maintenance and Operation levy this fall for collection in 1999. We are presently not collecting any M&O funds and are working off surplus funds collected in 1997. The amount that you see in the section of your tax bill that says "sewer" is strictly to pay against the District's general obligation bond. The general obligation bond was voted on in 1992 for eradication of Milfoil in the lake. Final payment date for the bond is December 2012. None of the money being collected for sewer this year is designated for maintenance and operation. The amount we will be requesting in 1999 will be determined over the summer, but included in this levy request will be monies to cover:

- Future milfoil survey- Phase II funds will be depleted after this season. It is up to all of us to ensure that we keep this nasty weed at bay. This task is estimated by David Lamb to cost approximately $12,000 per season.
- Insurance for the District and Park liability.
- Park maintenance and upkeep.
- Salary of Managing Secretary.
- Office supplies, mailing costs, and general expenses of running the District.

Please watch for further information when the election comes nearer.

WATER LEVEL

With this year's snowpack at 72% of normal in the Idaho Panhandle we definitely are not seeing the tremendous high water that we did last year. That's not to say the water isn't higher than we'd like, but that seems to be an old story. We will again apply to the Department of Wildlife for a hydraulics permit to maintain our present beaver pipes and to install a couple more. The pipes do work, but then again so do the beavers. It's a continual work in progress! Thanks again, to all those who work on the beaver patrol. Keep up the good work.

Sheila Pearman
Commissioner

FIRE DISTRICT #3

Fire District #3 has added lifesaving technics/training and equipment to the department, allowing our trained volunteers to better serve you. Along with training, we have purchased Jaws of Life and an Ice Rescue Sled, which are housed at the Diamond Lake Station. We hope to include an Ice Rescue Sled at the Sacheen Lake Station in the near future. With snowmobilers, ice skaters, and occasional curiosity seekers going onto the ice, there is the potential hazard of someone breaking through. With the Ice Rescue Sled presently housed at the Diamond Lake Station, we lose critical minutes of lifesaving time by transporting it. Also, if there are injuries, we are dealing with another deadly situation, hypothermia. The Sacheen District would like to purchase this sled in the same manner as the first one, which was through combined donations and District money.

The Sacheen Lake Station has not had any building repairs done for years. In 1997 a new roof was put on to prevent the leaks that have been occurring, and new insulation was blown into the ceiling. This year we are working on replacing the damaged sheetrock, rotting boards, a new coat of paint on the interior, and a new water system has been added.

Clarice Jacobson
Commissioner
(509-292-0550)

PHASE II RESTORATION

Well, it has been a year since the last water quality monitoring trip was performed by the Eastern Washington University Biology students and we are now in the final stages of putting together the reports which will summarize all the *restoration* work that has been done at Sacheen Lake the last six years. I think we have come a long way, but the lake will always need an active and aware group of residents (and visitors) if your investment in its improvement is to be protected. The restoration project reports will be available to anyone who is interested and the EWU folks and myself will be at one of the summer gatherings to present our summaries and answer any questions.

While the water quality sampling and analyses for this project has winded down, the Milfoil controls have one last season of grant funded efforts, we are going to give those pesky plants all we can. We plan to survey the lake using both SCUBA and snorkeling and will hand pull any Milfoil we find. I will also hold another Milfoil identification training session for interested divers which will be held in conjunction with the summer neighborhood picnic. We will collect some Milfoil and native aquatic plants, so you can see what lurks under Sacheen's waves! Finally, we will be pulling out the remaining bottom barrier from the Moon Creek area. We will be looking for volunteers to help with that effort!

So, I look forward to seeing you out on the lake this summer and, as always, I will be happy to answer any questions I can... and maybe someone can tell me where the fish are hiding!

Submitted by
Dave Lamb

ALL NEW in 1998

SACHEEN T-SHIRTS

WILL BE AVAILABLE
JUNE 13
AT THE
SBA GENERAL MEETING
@ THE FIREHOUSE!

(shirts will be available @ 3:30 pm, and will not be sold during the business meeting)

New colors...same design... t-shirts..tanktops..sweatshirts. polo shirts!

It's first come...first serve...we have ordered a limited number and when they're sold out...we'll have to wait another year...so, get there early...and don't forget your checkbook!

There will be a slight increase in price, but they're still a bargain...and a great way to promote Sacheen Lake!

SACHEEN BETTERMENT ASSOCIATION
MEMBERSHIP FORM

NAME:_____

ADDRESS:_____

_____

PHONE:_____

_____Are you the property owner ?

MEMBERSHIP DUES: $10 ANNUALLY

Make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
and mail to:
1638 E PROVIDENCE AV
SPOKANE WA 99207

BOARD MEMBERS:

President:	Diane Wear
	509-447-4030
Secretary:	
Treasurer:	Barb Floyd
Board:	Sheila Pearman
	Carol Pitts
	Mike Pielli
	Bill Storms
	Joanie Suttle
	Gordon Young
	Brad Wear
Past President:	Leonard Pielli

SACHEEN SCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

SACHEEN SCOPE

OCTOBER 1998

SEWER/WATER SYSTEM ELECTION RESULTS

The votes are in and a big thanks for the 69% turnout and the comments that accompanied the votes! As always, the involvement of the District members is impressive. With validation accomplished, we were able to determine that at this time there is <u>not</u> enough support to proceed with formation of a ULID and construction of the proposed sewer & water system. Following is a synopsis of the results:

565 BALLOTS WERE MAILED

6 BALLOTS WERE RETURNED UNDELIVERABLE

VALIDATION BASED ON 559 VOTES:

224 RETURNED VOTES REQUIRED TO MAKE 40% VALIDATION

384 BALLOTS RETURNED ON TIME FOR 69% TURNOUT

11 BALLOTS RETURNED LATE

TOTALS BASED ON 384 VALID BALLOTS:

YES VOTES 162 FOR 42%

NO VOTES 222 FOR 58%

(60% OR 231 YES VOTES REQUIRED FOR SUPER MAJORITY)

The ballots were color coded to help us track the outcome by area. The areas used were based on the makeup of the small group meetings this summer.

RESULTS BY AREAS:

#1 West end through Poirer's Addition
YES 33 NO 34

#2 Narrows through Reed's Landing & Granite Shores
YES 30 NO 27

#3 So side Granite Shores to Public Launch
YES 23 NO 33

#4 Terrace/Finnila Park
YES 33 NO 41

#5 E Shore through old Sacheen Resort
YES 18 NO 28

#6 Kohles Beach through Eisenbarth's
YES 24 NO 16

#7 Schaeffer's Beach to Reed's Landing
YES 1 NO 43

Totals Yes /162 NO/222

contd. -

There was also some interest in knowing how many people were multiple property owners, so this information was tabulated:
* 269 People received single ballots
* 101 People received 2 or 3 ballots
* 9 People received 4 or 5 ballots
* 3 People received 6 or more ballots

Thank you to the Betterment Board members who volunteered to count the votes. We appreciate the time and effort taken to do this.

WHAT NOW?

Now that we have our election results telling us that we will not be going ahead with sewer & water construction at this time, where does that leave the Sewer & Water District?

✏ Here are some of the issues the Board feels we need to address:

✔ **Milfoil...continued diligence on control:** We need to continue to monitor and control the milfoil problem. With milfoil now in both Davis and Diamond Lakes, our diligence is critical. We have used all the funds available to us with the Phase II grant, so now the money to pay for the milfoil surveys, such as those performed the past two summers, will have to come out of the general budget.

✔ **Resource for waste water information:** As people in the District want to build on or upgrade their properties, be able to provide current information on technologies and the permit processes required.

✔ **Park maintenance:** Continue to maintain the Myers/Harter Sanctuary as an asset to our community and something to be proud of.

☒ *To this end, the District will be asking the voters to pass a Maintenance & Operation Levy in the amount of $.90 per thousand dollars of assessed valuation on the November 3 ballot!*

The funds generated by this levy will pay for the general operating expenses of the District.

The proposed budget for 1999 follows:

Salaries and Benefits
$ 3,300.00

Operating and Office Supplies
$500.00

Professional Services
$13,700.00

Milfoil Prevention	$13,000.00
Legal Expenses	$500.00
Other	
$200.00	

Communications	**600.00**
Advertising	**200.00**
Insurance	**2,500.00**
Misc	**200.00**
TOTAL	**$21,000.00**

We appreciate the support the District members have shown us and ask that you continue to support the Board in its efforts to maintain the Sacheen Lake Sewer & Water District.

Ron Schmidt, Commissioner
Dick Materne, Commissioner
Sheila Pearman, Commissioner

HEEN BETTERMENT
ASSOCIATION

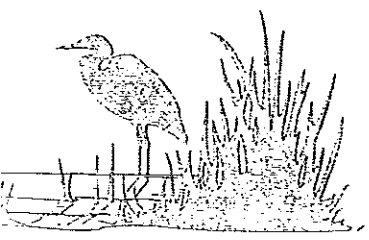
it summer we had at Sacheen!
els had to break records and I
had many new visitors... who
iem? Sacheen is truly a
ice to be year around.

:s to the folks who volunteered
nd efforts to make Sacheen a
for all of us:

lancy & Roger Moore and their
crews for Adopt-A-Highway!
eff Storms & his eager-beaver
he lake was significantly lower!
ie Myers-Harter Park clean up
ly crew in terms of broken

veryone who hosted and
sewer/water informational
d those who voted on the issue,
ow you voted!
like Grizzle and his *Sacheen*
oy next year will be outfitted
hting equipment and be a part of
#3
ie volunteer fire fighters of Fire
especially the Sacheen Station,
all kinds of calls...all hours of
night.

and the others who worked with
efine the meaning of
. Without them...well, who
e we would be!



VERY SPECIAL THANKS to our Sewer/Water District Commissioners:

- ☺ *Ron Schmidt*
- ☺ *Dick Materne*
- ☺ *Sheila Pearman*

Their efforts, at our request, to research this project has come to somewhat of an uncertain end. What does seem clear, however, is that without their efforts, the water level, water quality, and the nagging milfoil crisis could not have been addressed as effectively as it has been. We must retain the district if we hope to continue that effort and be able to pay for it.

We should also expect that these folks won't be around forever.....so.....
SACHEEN NEEDS YOU!
Please give some thought and consideration to becoming an active part of the process!

LAKE STEWARDSHIP

We mention it often, but need real diligence to make it work . Be ever mindful of how your individual action/s affect the whole of the Sacheen watershed...it wouldn't take long to spoil this natural beauty.
Be attentive...if you are aware of something that doesn't seem right, act on it!
It's everyone's responsibility.

In closing, let's say *"THANKS, again,"* Mike Grizzle. Mike served the latter part of this summer as our Reserve Marine Deputy and is greatly appreciated by most folks on the lake. He has been invited to attend a more comprehensive training course over the winter months. Mike will then be authorized to issue tickets for any boating infractions, which are a constant concern for human/boating safety, as well as shoreline protection. We are lucky to have someone who cares so much and does such a wonderful job...and with such character!!!

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	Brad Wear

SACHEEN SCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

ACHEEN SCOPE

SPRING 1999

IS ISSUE

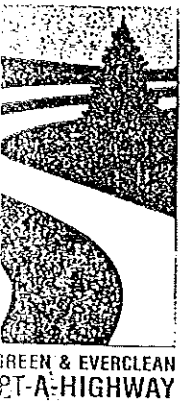
- pickup dates for 1999

~~June 6, 1999~~
:00 a.m.

~~Saturday~~
~~ist 28, 1999~~
:00 a.m.

at the former
Creek Resort
e Valley Road)

turdy shoes or
bring gloves!



REEN & EVERCLEAN
T-A-HIGHWAY

ce again,
hank You"
& Roger Moore.

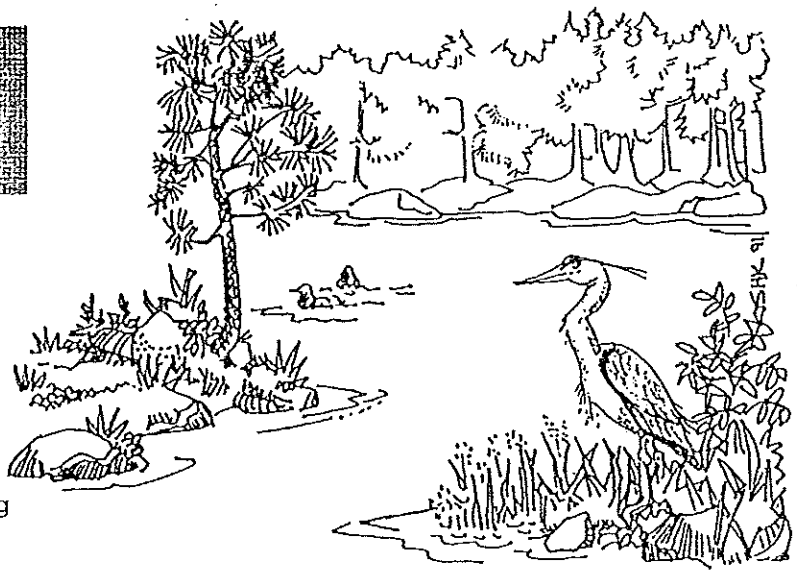
an outstanding
organizing us
his ongoing
effort!

SACHEEN BETTERMENT ASSOCIATION

Welcome back....to the Lake!

This past winter was extra long and some recent mornings have us questioning whether it's truly over. Let's hope the long hot days of summer descend early and stay late!

On cool mornings, plan to sip your favorite hot beverage from your new **Sacheen Lake mug...** on the hot days, keep the cold ones colder, with your **Sacheen Lake coozie**...then, let the smooth, rich, taste of a **Sacheen Lake "Beaver Bar"** melt in your mouth!



We will also sell what is left of the shirt supply, but will not be ordering any more this year.

The board met in April to plan summer activities, the always needed work parties, decided on fund raising projects...and more. Issues addressed included lake level, its' funding, maintenance of the beaver tubes and whether to hire help or continue to solicit in-kind service. The board recommendation for this season is to keep records of in-kind service hours and document the types of maintenance required, as well as personal costs, in terms of propeller damage, broken/lost tools, etc., then re-assess again next year.

cont'd p.2

Sacheen Sewer & Water District

Ho, Ho, Ho, Merry May! Can't believe it snowed four days last week, but I'm sure that's what I saw. If April showers bring May flowers, what do May snows bring??? Welcome back snow birds, we hope you aren't thinking of heading back south already!

The Board would like to thank all of you who supported our successful maintenance and operation levy. Your support shows that we are focused on the right things and that you feel we are properly representing you. Thank You!

cont'd p.3

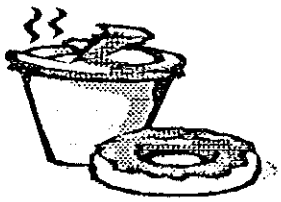
"SACHEEN LAKE" MUG & COOZIE SALE JUNE 13!

The first offering will be :
@General Meeting
Sunday, June 13...
DON'T MISS OUT!

Mugs will be offered in two colors, dark green with crème *Sacheen Lake (& heron)* insignia... or the reverse.

Coozies will be dark green, navy blue, passion purple, or burgundy...4 colors... with white insignia.

Buy a Sacheen Lake mug...fill it with FREE coffee, have a donut...



then catch up on all the latest news around the lake!

SACHEEN BETTERMENT ASSOCIATION

GENERAL MEETING

SUNDAY
JUNE 13
9:00 A.M.

SACHEEN LAKE FIRE STATION

SACHEEN BETTERMENT ASSOCIATION, CONTINUED

Another issue concerns what is commonly referred to as "the state land" south of the lake. This is the small "mountain" that is visible to almost everyone at Sacheen. The concern being addressed is the fact that it is for designated state school monies and that it may be logged off in the near future. Board member Bill Storms is researching its' designation and will report back to us in the near future.

You are encouraged to contact our local and state legislators, especially, with our continued concern about the invasive "Eurasian Milfoil" and its affect on the lake quality. It has become an up front issue in the legislature, and with larger more prevalent lakes and waterways being infested, we can't afford to have our past/present diligent efforts overlooked!

We continue to have a wonderful working relationship with the Sacheen Sewer & Water District. It is a unique relationship among lake associations and for that we are very grateful!

Mike Grizzle will hopefully be sworn in as a reserve deputy by the time you receive this newsletter. His presence on the lake is reassuring, with safety being his main concern.

With that, check the calendar...get out and help...and come enjoy the fun stuff, too. **The Fourth of July "Boat Regatta"** promises to be great fun. Decorate those boats up for a parade around the lake and bring an appetizer to share afterward, when we gather together in the middle of the lake.

Last, but not least, we can't do it without yours...
DON'T FORGET TO MAIL IN YOUR DUES...OR PAY THEM AT THE MEETING!
(membership form on the back page)

Submitted by: Diane Wear, President

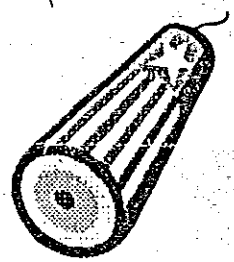
Sacheen Lake
1999
SUMMER CALENDAR

Myers-Harter Park
Spring Cleaning
Saturday, 5/22,
9:00 a.m.
(BYOTools)

Adopt-A-Highway #1
Sunday, 6/6,
8:00 a.m.

SACHEEN BETTERMENT ASSOCIATION
GENERAL MEETING
Sunday, 6/13,
9:00 a.m.
Sacheen Fire Station
(BYOChair)

1:30



FOURTH OF JULY
"BOAT REGATTA"
Sunday, 7/4,
4:00 p.m.
(rally near the boat launch with *decorated* boats)

"Boat Regatta" #2
Saturday, 8/14,
4:00 p.m.

Adopt-A-Highway #2
Saturday, 8/28,
8:00 a.m.

TRICT, CONTINUED

ıg on our continuous Milfoil control effort. We are working with ıagement Inc., to schedule scuba survey and hand pulling efforts ıt legislative session saw passage of a bill that will give those l war another resource, the use of a product called Navigate ɔlem areas. This bill has yet to be signed by Governor Locke, ıg source of interest for lakes such as Sacheen. David estimates / 12 acres that have varying amounts of Milfoil in them. Those ıcentrations of plants may be likely candidates for Navigate's ɐr handle on this possibility as the permitting process from DOE

for consideration, to the Pend Oreille Co. Weed Board, at their help us with funding of our control effort this summer. There ɐ budget for use against class B weeds, of which Milfoil is one.

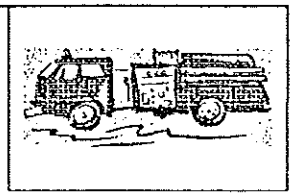
Lakes Protection Association (WALPA) annual conference in s interesting to hear of the many issues that confront the lakes ɔn. Milfoil and other non-native weeds are certainly a big issue vis and Diamond Lake now too have Milfoil and are working on rid- lso of concern are issues such as shoreline management, boating, rcraft.

d he will not seek re-election when his term expires at the end meone will come forward to fill his board position next term. ı will be on the fall ballot. If you are interested, please feel ne commissioners for more information.

r beautiful summer season on Sacheen Lake. Hopefully, it is not

man, Commissioner

Dick Materne 238-6792 Sheila Pearman 447-4641



from Ladies of The Lake, the Sacheen Better- ditional funding, Fire District 3 purchased Sled for the Sacheen Lake Station. Then, ay, the volunteers (including our own Joe d Brad Wear) donned dry suits and jumped in On a second Saturday, it was fire gear, for a 're very fortunate to have these folks right nd the other area volunteers are not only trained, but willing is necessary to achieve that training!

nger culvert is scheduled to be installed at the approach to smaller driveways will then become one large approach. A k is now at the station, affording the firefighters more on- ghting fires. An additional cistern has also been installed, e water storage when the lake or streams can not be reached in

istrict will apply for a grant to add another bay at the l also include updating the kitchen, bathrooms, and meeting ɔach and parking lots are also in the plans, should the grant

ɔner

SACHEEN BETTERMENT ASSOCIATION
MEMBERSHIP FORM

NAME:_____

ADDRESS:_____

_____

PHONE:_____

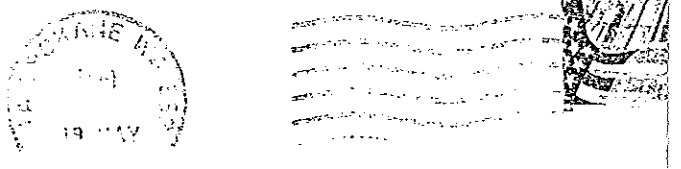
Are you the property owner of record?
Yes _____ No _____

MEMBERSHIP DUES: $10 ANNUALLY
Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
1638 E PROVIDENCE AV
SPOKANE WA 99207

BOARD MEMBERS:

President:	Diane Wear 509-447-4030 bdwear@povn.com
Secretary:	Gordon Young
Treasurer:	Barb Floyd
Board:	Kent Dyekman
	John Pargman
	Sheila Pearman
	Mike Pielli
	Bill Storms
	Joanie Suttle
	Brad Wear

SACHEEN SCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500



PERRY L. PEARMAN
8272 FERTILE VALLEY RD
NEWPORT, WA 99156

FALL 1999

SACHEEN SCOPE

INSIDE THIS ISSUE

SACHEEN LAKE
COFFEE MUGS
Dark green or cream
$3.50 each or
4 for $12

SACHEEN LAKE
COOZIES
Burgandy, dark green,
navy blue, purple
Just $1.50 each!

In Spokane call:
Joanie Suttle
466-5409
@Sacheen Lake call:
Diane Wear
447-4030

Please vote!

Then, vote-YES on the Sacheen Lake Sewer & Water District Maintenance & Operation Levy!

Sacheen Lake Coffee Mugs & Coozies

make GREAT stocking stuffers!

Sacheen Sewer & Water District

Submitted by: Sheila Pearman, Commissioner

Now that it's October, it must be time to think about the upcoming snows and beautiful winter weather that our region has. Hope you are all ready for whatever this season will bring us. I think most of us feel that summer was much too short, but we certainly lucked out with what Mother Nature gave us in September.

As we look forward to November, we will again be asking district voters to support our request for another maintenance and operation levy. The levy requests voters to approve a tax of 90 cents per thousand dollars of assessed valuation (this is the same amount that was paid in 1999 for district expenses). This levy will cover the year 2000 expenses of the Sewer & Water District, mainly to control our old nemesis-Eurasian Milfoil. This past season we worked hard at controlling the weed with both hand pulling and by use of a 2,4-D herbicide application. We anticipate similar needs during next summer's growth season. We will evaluate weed growth again in the spring when we can see what we are working against. More than $12,000 was spent on our milfoil control efforts this past season.

Some other expenses of the District are:

- Maintenance and payroll for the Myers/Harter Sanctuary
- Assistance in publication of the SCOPE and other mailings. (postage alone for each mailing is over $130)
- Insurance covering both the Board and liability for the park costs $2000
- The costs for election and periodic audits
- Payroll for the district's secretary
- Fees for legal counsel
- Office supplies and telephone

cont'd p. 2

SEWER & WATER DISTRICT, CONTINUED

With the passage of this levy, the district board can continue working toward bettering the district and keeping the milfoil at bay. Please consider the work that has already been done and support our continued weed control efforts by voting for this levy.

If you are not presently registered to vote in the district, you can still do so in person at the Pend Oreille County Auditor's office.
The Sacheen precinct has recently been put on a mail only election format, so your ballot would be mailed to you.
If you have any questions or comments about this, please contact one of your commissioners.

Ron Schmidt	447-4618
Dick Materne	238-6792
Sheila Pearman	447-4641

Resource Management, Inc.
Submitted by: Dave Lamb

Well, the last of this year's efforts in the fight against Milfoil (Eurasian watermilfoil, Myriophyllum spicatum that is) was wrapped up September 27, just before ice over (or at least that is what it felt like)! The aquatic plant growth in Sacheen, and pretty much all of the Eastern Washington and northern Idaho lakes I have been in this summer was phenomenal! I think that anyone who chanced a glance beneath the placid waters could see a dense mat of Elodea or Robinsons Pondweed or maybe the long strands of some of the thin-leafed pond weeds. While you may not know which plants these are, the chances are good that you saw or had your feet tickled by one of them. So, by comparison the growth of the noxious weed Milfoil was, overall, less noticeable and this was not by chance. I know that there are a few folks who will beg to differ with me on that, but, I did say overall.

This year we added a new "weapon" in our Milfoil control kit in the form of the herbicide 2,4-D, which was approved for certain limited uses through the passage of Substitute Senate Bill 5424. After several meetings with the Sewer District Board, and a SCUBA survey to assess the distribution and density of Milfoil, the decision was made to proceed with notification and treatment of 14 acres of the worst areas around Sacheen and to wrap up the season with three days of diver hand removal in other areas where Milfoil was sparse.

Another diver and I performed the follow-up work on August 24, September 8 and 27 and we focused this effort on the east and west shores in the northern arm of the lake. We were able to remove the sparse plants from most of this area. We did, however, find a couple of areas which should be considered for future herbicide treatments because of the excessive growth we found. We also took a look at several of the other 2,4-D treated areas and were pleased with some/shocked with others. Overall, (there I go again) the results of the treatments were not as good as were hoped for, but, it did eliminate a lot of the growth, particularly the smaller plants, and stunted the larger ones. This same effect was seen in most of the other lakes treated with 2,4-D. The reasons for this incomplete kill are not completely clear, but, could be due in part to the late treatment. While waiting for the bill to be passed and signed by the Governor, we may have been pushed past the critical time when the plants were in their initial growth phase. After considering the late start that the aquatic plants got, in general, due to the long cool spring. We recommended that the treatment proceed. While this recommendation could be argued, I am quite sure that the infestation would not have seen the control that it did if it had not been performed at all.

Where do we go from here???
We still feel that this chemical is a very effective tool which can control Milfoil growth selectively (without effects to other plants) for a reasonable price. We at RMI will be doing some project review with other Milfoil control experts to see if a refined treatment protocol can be developed and will report back to the District with that information.

Our goal remains to knock back the growth of this plant, to the point where only small scale, occasional treatments are needed!

BEAVER BUSTERS!

Submitted by: Bill Storms

The beavers continue to do what beavers do; *build dams!* There are a couple of lodges on the lake now and we should probably expect to see more. It's a continual challenge to keep the tubes clean and the water flowing. There appears to be more beavers than ever and they find new places to build that seem to work as well (or as badly) as their prior location, some of which have tubes, to allow the water to flow.

The #$%# beavers have built another dam below the Johnson's property (beyond the outlet), which is definitely affecting the lake level.

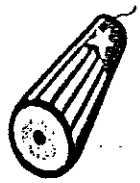
As dry a fall as it has been we should expect the lake to be as low as any time during the summer, but without the volunteers (beaver busters) to go clean the tubes the lake has now risen about 4" and may continue to rise.

Anyone who would like to help manage the lake level can call me, or one of the other beaver busters. ***We can always use the help!***

FIRE DISTRICT #3 NEEDS YOU!

If you are interested in becoming a volunteer firefighter, please call:

Perry Pearman
447-4641



1999 FOURTH OF JULY "BOAT REGATTA" WINNERS:

Best Overall
John Pargman's
Pirates of Sacheen

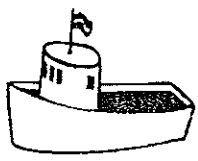
Most Patriotic
Vera Lee's
Potomac Friends

Honorable Mention
Perry Pearman
Ice Sled Escapades

While it was a cold and rainy day, these brave hearts...and others, ventured out onto the windy waters of Sacheen Lake, to celebrate their independence, picking up support...and other things...all around the lake!

"Thank you," Mike Grizzle, for leading the way in the S.S. Sacheen and thanks to all the cheerleaders around the shoreline, who kept us going!

We plan to do it again next year...so, be thinking up your theme!



SACHEEN BETTERMENT ASSOCIATION

Submitted by Di Wear, President

As I write this the landscape is brilliant with fall tones and the lake reflects like a mirror.
Sacheen remains...a beautiful place to be any time of the year!

We certainly had our **lake level** challenges this past summer and our furry friends were aided in their effort by the bees! Who'd have thought they be in cahoots. Our ever-faithful Beaver Busters made a couple of trips "down the tubes" early and it appeared as though we were again in control...then the bees became so bad they couldn't even get there and the beavers took advantage! Last spring we told you we would be assessing this summer and taking a "fresh look" next spring, but that might be too late. We have contacted the same trapper we used several years ago, to see if he is available now. We await his return call. The board will address it again in the spring with full reports/recommendations from Mike Pielli and Bill Storms. (see related article by Bill Storms)

We've heard nothing further on the **"state land"** issue, but have made the necessary contacts at the Department of Natural Resources. This issue will surely need a committee to look at it properly, so if you are interested, please contact any board member!

Sacheen Lake is under consideration to become a "warm water fishery"...After attending a Department of Fisheries hearing in August, we learned that Sacheen is on the list to become a warm water fishery, meaning **NO MORE TROUT would be stocked here!** The hearing was posted only in the Spokesman-Review and the date was incorrect, so calling the Department of Fisheries is your best bet for accurate information. The two biologists assigned to this area are:

Marc Divens	509-921-2306	divenmjd@dfw.wa.gov
Larry Phillips	509-921-2300	phillip@dfw.wa.gov

We have also asked them to notify us of any upcoming hearings, so, if you have an e-mail address, please contact us: bdwear@povn.com and we will add you to the SBA e-mail address list.

Have a wonderful winter, see you in June, 2000!

MEMBERSHIP FORM

NAME: _____

ADDRESS: _____

_____

PHONE: _____

E-mail address: _____

*Are you the property owner of record?

_____Yes _____No

MEMBERSHIP DUES: $10 ANNUALLY

Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
1638 E PROVIDENCE AV
SPOKANE WA 99207

SACHEEN BETTERMENT ASSOCIATION
BOARD MEMBERS:

President:	Diane Wear	lake/home 447-4030 bdwear@povn.com
Secretary:	Gordon Young	Cheney 235-2216 lake 447-2271
Treasurer:	Barb Floyd	Spokane489-2016 lake 447-2006 floydb@omnicast.net
Board Members:	Kent Dyekman	Richland509-943-1333 blue1jay@gte.net
	John Pargman	Spokane 928-0256 lake 447-0735
	Sheila Pearman	lake/home 447-4641 spearman@povn.com
	Mike Pielli	Spokane 484-3759 lake 447-3586
	Bill Storms	Spokane 747-7629 lake 447-5404 islndmvr@aol.com
	Joanie Suttle	Spokane 466-5409 lake 447-2579
	Brad Wear	lake/home 447-4030 bdwear@povn.com

SACHEEN SCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

SACHEEN SCOPE

Spring 2000

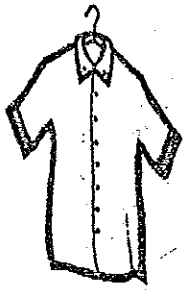
SIDE THIS ISSUE

CLASSY DUCK'
ew clothing line
the meeting contact
Joannie Suttle
447-2579

SACHEEN LAKE
COFFEE MUGS*
k green or cream
50 ea / 4 for $12
&
SACHEEN LAKE
COOZIES
andy, dark green,
avy blue, purple
ust $1.50 each!
@Sacheen call:
Diane Wear
447-4030

eneral Meeting
Saturday
June 24
9:00 am
heen Firestation

FREE COFFEE
DONUTS, tool



NEW CLOTHING LINE !

see it at the

Sacheen Betterment Association GENERAL MEETING

Saturday, June 24, 2000

9:00 am @Sacheen Fire Station

Sacheen Betterment Association

Submitted by Di Wear, President

Sacheen Lake is ***under consideration*** to become a "warm water fishery". ***WOW, did I ever stir the pot with that line in the fall issue of the SCOPE!*** **BUT,** Sacheen is still ***under consideration***, to become a designated warm water fishery and a fish survey will be done early this fall to determine which species are predominant in the lake. After the survey is completed, I have been assured by the Department of Fisheries Biologists, that we will be notified of the survey results AND public hearings will be held before any decision-making takes place re: the future of the lake designation/treatment/trout stocking. We hope to receive enough advance notice on those hearings/ recommendations, to be able to mail out a postcard.

With that behind us, **we come into the Summer of 2000 without a very dear friend, Mr. Charles Peters.** He was known as Charles, Chuck, or Mr. Peters (to those who knew him as a teacher). Mr. Peters passed away May 9, 2000. He will be very missed here at Sacheen. He loved it here at Sacheen and was actively involved in the association. His wife, Phoebe, and their family very kindly requested memorial contributions be given to the Sacheen Betterment Association, in his memory, and we thank them for their generosity. The family and the board will meet later this summer, to consider the use of these monies for a special project.

Summer 2000 brings the usual festivities to Sacheen. The calendar is set and we encourage you to attend any and all of the planned functions, beginning with **Adopt-A-Highway** (litter pick up) **Sunday, June 4, 2000, 8:00 am,** meet @Old Cedar Creek Resort (on Fertile Valley Road). For you new folks, the SBA adopted Highway 211, from Store 'n' More south-two miles.
Wear a good heavy pair of gloves and comfy shoes/boots!

cont'd p.2

Sacheen Lake Sewer & Water District

Submitted by: Sheila Pearman, Commissioner

Temperatures in the 70's!! Does this mean summer is on its way?? The snowbirds have nearly all returned to their summer nests and lake activity is beginning to buzz. It's always nice to hear spring arrive, with voices floating across the water. We've already seen swimmers and skiers, along with families of geese, and their little yellow babies. ***Welcome home!***

The main focus of the SLSWD these days is our old nemesis MILFOIL. An application of the herbicide 2,4-D, by David Lamb of RMI, is again being planned for this season. This herbicide is also scheduled for application to Davis and Diamond Lakes. The process will be as it was last year, with only areas having larger number of plants getting the herbicide, then divers coming through later to hand pull single and smaller groups of plants. **Please look at the enclosed notice/map carefully and note if the application is planned for your shoreline.**

One of David Lamb's recommendations to us has been to develop an aquatic plant management plan. Once we have a plan in place, there are grant funds available for some Milfoil control through the Aquatic Weed Management Fund. I have recently spoken with Sharon Sorby of the Pend Oreille County Weed Board regarding developing an aquatic plant management plan for Sacheen Lake. She sees a need for this on several area lakes, so, she will be working on coordinating efforts to help us all with plans. Watch for more on this.

The Myers/Harter Sanctuary will be opening for the season Memorial Day Weekend. We have hired a groundskeeper through one of the Rural Resources programs. If you are in the park one day and see Debbie working, say *"HELLO."* She should be with us through the Labor Day weekend.

We are looking forward, as always, to a wonderful season here at Sacheen Lake and hope to see many of you throughout the summer.

If you have any questions or comments, please contact one of your commissioners.
Ron Schmidt 447-4618 Dick Materne 238-6792 Sheila Pearman 447-4641

SBA cont'd from p. 1

The board met in April...did NOT raise dues, set the calendar, discussed State Hwy 211 guard rail safety concerns, designated $$ to have the 'dumpy looking cars' on the east side of the highway hauled away, to have a new/larger speed limit sign made for the boat launch area, decided this year's fund raising (another new line of *DUCKY* clothing), discussed the usual main topic of *Dam Beavers*, and ok'd the development of a Sacheen website. The website will (hopefully) be functioning before summer's end...www.sacheenSCOPE.com - We hope to register the website address ASAP after this issue of the SCOPE is in the mail.

And last, but not least, our ever enthusiastic board member, ***DUCKY* Joannie Suttle,** has selected another fine line of clothing for us to choose from. These will be available for the first time AT THE GENERAL MEETING...and when they're gone-they're gone...we will not reorder again this year, ***soooooooooo...the early DUCKS will get the best greens, reds, blues, & greys, don't miss your chance!***

Have a great summer season...hope to see you around the lake!

JUNE 2000	JULY 2000	AUGUST 2000
Adopt-A-Highway	**4th of July Boat Regatta**	**FREE Ice Cream Sundae Social**
Sunday, June 4	**Sunday, July 2**	**Saturday, August 12**
8:00 am	**2:00 pm**	**1:00 pm**
(meet @Old Cedar Creek Resort)	(rally near public boat launch)	Myers-Harter Sanctuary
General Meeting	***Tentative!***	SEPTEMBER 2000
Saturday, June 24	**Model Ship Demonstration**	**Adopt-A-Highway**
9:00 am	**Saturday, July 22**	**Saturday, September 9**
Sacheen Fire Station	(we will try to firm date/time before general meeting)	**8:00 am**
		(meet @Old Cedar Creek Resort)

NOTICE OF PROPOSED MILFOIL CONTROL TREATMENT USING 2,4-D HERBICIDE

Following the provisions of Enhanced Substitute Senate Bill 5424, the Sacheen Lake Sewer and Water District is providing notification of the intent to use granular herbicide containing the active ingredient 2,4-D for the control of Eurasian watermilfoil in Sacheen Lake. The expected treatment date is Monday, June 12, 2000. This project will comply with all pesticide label requirements and notification of appropriate agencies and lake residents as required by the Senate Bill.

This EPA approved chemical, available in two products, Navigate and AquaKleen, is a granular formulation and is very effective against Milfoil while not harming many native aquatic plants, fish pets or humans when applied following label directions. An initial treatment with this chemical, performed in 1999 at Sacheen Lake reduced the infestation but this follow-up treatment is desired to further reduce or eliminate the remaining growth in the treated areas.

The following water use restrictions are recommended in treated areas of the lake when marked by shoreline notices and buoys:

- Do not use treated water for irrigation, agricultural sprays, watering dairy animals or domestic uses.

There is no fishing or swimming restriction due to this application. However, swimming is not recommended for persons who have sensitivities to organic phenoxy compounds.

Water testing may be performed to determine when all water use restrictions will be lifted. Shoreline notices and buoys will be removed to indicate the end of restrictions. It is expected that water use restrictions will be in force for two to four days.

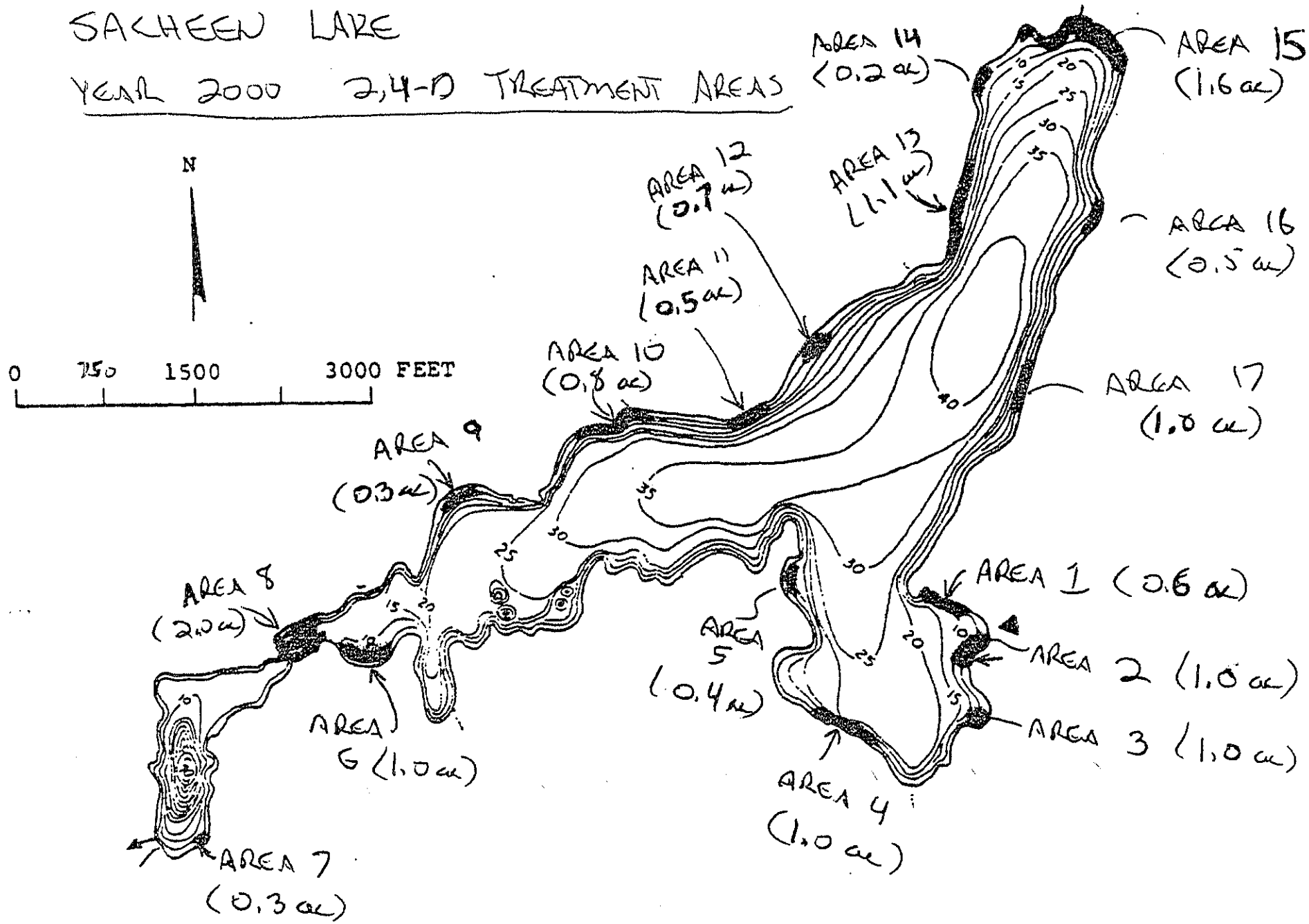
The proposed treatment areas are shown on the attached map.

If you have questions about this treatment, please contact:

Sheila Pearman, Sacheen Lake Sewer and Water District, (509) 447-4641
Dave Lamb, Resource Management, Inc., (509) 299-6306

SACHEEN LAKE

YEAR 2000 2,4-D TREATMENT AREAS



cheen Fire House News

bmitted by Perry Pearman, Captain

re District #3 responded in 1999 to 178 calls. 53 of those lls were fire related and 125 of the calls were medical re- ted. That is about a 2 to 1 ratio. Our capabilities to ndle these calls from the Sacheen Station has increased, as ll. At the beginning of the year, we had only one EMT ick Schaaf). Since then, Leonard Pielli and Dave Ainsworth ve become WA State Certified EMT's, and Perry Pearman has come a First Responder. So, in the surrounding lake area should be able to respond to your house within minutes.

he **911 system** has made many improvements this past year and t **is the best way to get the medical system activated.** The dispatcher will collect relevant data and immediately dis- tch Newport Ambulance, Medical Back-up units, our local Sa- heen crew, and the Medstar helicopter crew if it is needed.

911 should always be your first call!

Things TO DO that really help us on calls:

If possible send someone out to the road to guide us in! After we arrive, get others back out to guide in back-up dical and ambulance crews.

We need patient info: Name, Address, Date of Birth, cial Security #. If you have it written down ahead of time really helps.

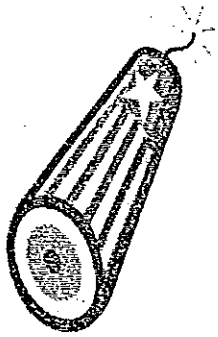
If the patient is on medication/s, have the containers ady for us to take to the hospital.

ptain Jim Wood has finally hit pay dirt! No, not in flin. After more than 20 years of service at the Sacheen ke Station, he will start collecting his retirement checks. m says we have come a looooooong way from the fire boat ys. **There will be a retirement party held in his honor dnesday, June 21, 7:00 pm, at the Diamond Lake Fire Station** n Hwy 2). All friends, family and former Sacheen fire- ghters are welcome to attend.

n Pielli, one of our Fire Commissioners, is making sure at Sacheen Lake is well represented. We sort of have dou- e representation here, because Beryl has taken over the cumentation of those meetings. ***"Many thanks to you both"*** d the combined efforts of all three commissioners! Also, **a *G thank you,*** to the Ladies of the Lake. This year they tched in to purchase three first aid kits. They always seem find ways to help us and we could not do what we do with- t their support.

you could find the time to assist your neighbors buy vol- teering as a firefighter or medical responder, or would ke to know more about it, please call:
rry Pearman 447-4641

nally, it is NOT a good thing to start a little brush pile d burn the rest of us out! Using common sense takes care that 99% of the time. Have SAFE summers...
and for burning information call 1-800-323-BURN first!



2000
4th of JULY
"BOAT REGATTA"

WHO WILL BE
Best Overall
?
Most Patriotic
?
Honorably Mentioned
?

Sunday
July 2, 2000
2:00 pm
Meet in Moon Bay!

MEMBERSHIP FORM

NAME: _____

_____

ADDRESS:

_____

_____

PHONE:

_____

E-mail address:

_____

*Are you the
property owner of record?

_____Yes _____No

MEMBERSHIP DUES:
$10 ANNUALLY
Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
1638 E Providence Ave Spokane WA 99207

SacheenSCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

SACHEEN BETTERMENT ASSOCIATION BOARD MEMBERS:

President:	Diane Wear	lake/home 447-4030 bdwear@povn.com
Secretary:	Gordon Young	Cheney 235-2216 cell 993-2402 syoung1138@aol.com
Treasurer:	Barb Floyd	Spokane 489-2016 lake 447-2006 floydb@omnicast.net
Board Members:	Kent Dyekman	Richland 509-943-1333 blue1jay@gte.net
	John Pargman	Spokane 928-0256 lake 447-0735
	Sheila Pearman	lake/home 447-4641 spearman@povn.com
	Mike Pielli	Spokane 484-3759 lake 447-3586
	Bill Storms	Spokane 747-7629 lake 447-5404 islndmvr@aol.com
	Joanie Suttle	Spokane 466-5409 lake 447-2579
	Brad Wear	lake/home 447-4030 bdwear@povn.com

'ACHEEN SCOPE

Fall 2000

IDE THIS ISSUE

"Thank You" to all those ducky folks who supported our clothing sale. We sold all the L & XL (except sweatshirts) and all the XXL sizes in *everything*. We will order more denim shirts in the spring (& more of the XXL sizes). **Joannie Suttle is still selling from the lake on weekends (447-2579)**

AND...they make great holiday gifts!

Sewer & Water District

Submitted by Sheila Pearman, Commissioner

This season saw us working against our old nemesis Milfoil. Based on the diver surveys of last fall, a 14 acre herbicide treatment using 2,4-D was completed June 15. The treatment was followed up with two days of diver survey and hand pulling on July 31 and August 1. An additional two days of hand pulling was completed in August. Upon recommendation, we treated another 5 acres in September and added two more days of hand pulling to end the season. Divers report that things look pretty clear with a couple of places that will need serious attention next season. We plan to continue similar tactics to keep on top of the Milfoil next season.

Dick Materne has officially resigned from the board. His tenure of office expired last fall, but since no one filed for the position, it officially remained with him. ***Thank you, Dick*** for the time and energies you spent while serving as a Commissioner. With Dick's resignation, the board can appoint someone to fill in until next fall's general election. At that time the position will be open for election of a 4 year unexpired term. Anyone who would be appointed to the position would need to file and run for the position at that time if they wish to continue. Please consider whether serving on the Sacheen Lake Sewer and Water District might be a way you could help serve your community. If you are interested, have any questions, or would like to be considered to fill out this term, please give Ron Schmidt or Sheila Pearman a call.

We are in the process of applying for a grant from the Department of Ecology that would help us in our continued fight against Milfoil. The DOE offers competitive grants to plan and implement aquatic plant management. These grant applications are due November 1, 2000.

cont'd p.2

n't forget to

VOTE...

s your right
&
responsibility
s a citizen

Again, this November, we are asking district voters to support our request for a maintenance and operation levy. The levy requests approval of a tax of 90 cents per thousand dollars of assessed valuation. This is the same amount that was paid in 2000 for district expenses. The levy will cover the year 2001 expenses of the Sewer & Water District to control Eurasian Milfoil. We anticipate similar needs during next summer's growth season. We will evaluate weed growth again in the spring when we can see what we are working against. More than $13,000 was spent on Milfoil control efforts this past season.

Some other expenses of the District are:

- Maintenance and payroll for the Myers/ Harter Sanctuary
- Assistance in publication of the Sacheen SCOPE and other mailings. Postage alone for each mailing is over $130
- Insurance covering both the board and liability for the public park costs $2000
- The costs for election and periodic audits
- Payroll for the district's secretary
- Fees for legal counsel
- Office supplies and telephone

With the passage of this levy, the district board can continue working toward bettering the district and keeping Milfoil at bay. Please consider the work that has already been done and support our weed control efforts by voting for this levy.

Sacheen Betterment Association

Submitted by Diane Wear, President

The millenium summer was a glorious one and fall is proving to be just as spectacular. If you haven't been out for a couple of weeks you will be amazed by the colorful changes!

The *!# beavers continue to gnaw their way through trees, block the flow, and the 'crew' is just plain tired, soooo, the board designated an annual late fall clean-out, deciding to pay the crew members for their time & wetsuit rentals, in order to help future spring lake levels be lower. We hired a trapper, but there are just so many critters. He stated on departure that one of the beavers slapped his tail at him...an "I'll show you!" **Clothing sales** were outstanding (thanks to Joannie Suttle's efforts) and the AED unit for the Sacheen Fire Station was donated from those sales. **We received approximately $750 in donations, in memory of Charles Peters** (and proposed a memorial idea for his family to consider). **The boat parade was superb**...KUDOS to all who participated, *BUT, we can't let the Pargman/Harrison crews win a 3rd year in a row*...so get those ideas/plans going early! **Ice cream melts fast in August,** but about 40 people had all they could eat *& enjoyed each other's company.* **The state fisheries biologists have done their survey,** but results are not yet in...we will keep you posted as to the date/s of any decisions/hearings as a result. **Thanks, also, to the Adopt-A-Highway crews of May & August** and to Nancy & Roger Moore for keeping us organized.

The board will meet early next spring, review priorities, and survey the membership once again, as to the direction we need to be working. Some new, as well as old concerns keep surfacing and need to be addressed. Of course, you can't expect the board to do it all...it takes YOU to step up and offer your help, too, if you have something you wish to have done. In the meantime, have blessed holidays and see you at the lake!

The website is not yet complete...no 'real' excuse, I like to play outside when I'm off!
If you are not already on the e-mail list & wish to be added, please contact – bdwear@povn.com

FIRE HOUSE NEWS

erry Pearman, Captain

We at the Sacheen Station
wish to express our thanks for many items
but three things stand out...

:s for the great response for new firefighter volunteers. Our station has seen some-
:hat we haven't had in years, a full roster. Six people from our area answered the
ıd joined our department. They are: Joannie Suttle, Gary Wilkey, Paul James, Jeff
s, Starla Schaaf & Jessica Schaaf (daughters of Lieutenant Rick Schaaf). Paul and
'e out at sea right now and will begin training next summer (their occupations have
ly prepared them well). The others are spending long hours in the new recruit train-
ssions being conducted this fall.

ew Automatic External Defibrillator has been purchased with the donation from the
:en Betterment Association and will be put in our Rescue truck as soon as we all are
d in its' use (this fall).

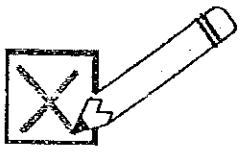
***est of the west* caught fire this year...WE DID NOT.** We were fortunate and made
f our own luck by being vigilant. Thank you to all of you that held off on burning *and*
ded your neighbors to do the same.

heen Ladies of the Lake Invitation

le having fun, getting to know one another, and raising money for charity, the Sacheen
Lake organization combines idealism and friendship. If you haven't been aware of this
up, we invite you to join us. We meet once a month, usually in our homes, although
e step-out to gather in a restaurant or to take a field trip.

is to promote friendship among the women of the lake and to serve the Pend Oreille
y donating time, money, or items to selected causes. We have helped with seniors' holi-
schools, food banks, care centers, hospice, and our fire stations just to name a few.

ou would enjoy joining us, our next meeting will be Wednesday, October 25, noon,
h's - 8512 Fertile Valley Road. Halloween costumes strongly suggested (or you'll look
Dues are just $1 per year plus a penny for each year you have lived collected each birth-
re information call Karen Averitt, President, (509) 447-0934



DON'T FORGET TO VOTE!

MEMBERSHIP FORM

NAME: _____

_____

ADDRESS:

_____

_____

PHONE:

_____

E-mail address:

_____

*Are you the
property owner of record?

_____Yes _____No

MEMBERSHIP DUES:
$10 ANNUALLY
Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
1638 E Providence Ave Spokane WA 99207

SACHEEN BETTERMENT ASSOCIATION
BOARD MEMBERS:

resident:	Diane Wear	lake/home 447-4030 bdwear@povn.com
Secretary:	Gordon Young	Cheney 235-2216 cell 993-2402 syoung1138@aol.com
Treasurer:	Barb Floyd	Spokane 489-2016 lake 447-2006 floydb@omnicast.net
Board Members:	Kent Dyekman	Richland 509-943-1333 blue1jay@gte.net
	John Pargman	Spokane 928-0256 lake 447-0735
	Julie Vervair	lake/home 447-0171 vervair@povn.com
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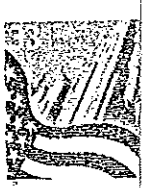


SacheenSCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

Spring 2001

SACHEENSCOPE

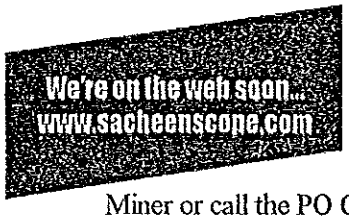
Sacheen Betterment Association

Submitted by Di Wear, President

Another Sacheen season has arrived, along with the snowbirds…
summer must not be far off!

SBA Board seeks change!
We hope to see a change in the makeup of the Betterment Board. If the members approve, we are proposing the board have a representative from each of the seven areas we used during our neighborhood sewer discussions, three 'at-large' members, and the immediate past president. Hopefully, this will keep everyone up to date, communication more open, and encourage neighborly get-togethers, too. We hope to break into groups at the general meeting for some short preliminary discussions & to meet one-another, then, at the end of summer, hear reports back from each section...*what do you think?*

Pend Oreille County Boating Ordinance
This spring a county committee reviewed the (very old) county boating ordinance. That committee has now submitted its' recommendations to the Sheriff and County Commissioners. We did use the SCOPE e-mail list to solicit feedback as we worked through the ordinance and your comments were very helpful, whether they came in by e-mail or phone! The public hearing/s should be held in early June. I will try to get an e-mail out ahead of time, but, please check the Newport



Miner or call the PO County Commissioner's Office, to see when it is on the schedule, if you wish to attend. They hope to have two open hearings, both in the evening, to allow working folks to have input. **Highlights of the revised ordinance will be available at the general meeting, if approved by then.**

Once the ordinance is approved, we will see a new sign installed at the public boat launch. It will feature ordinance highlights, a map of the lake with prominent rock outcroppings marked, and no wake zones. The SBA Board agreed to donate up to $500 to help pay for this sign. There will also be WA State Boating pamphlets, with the ordinance highlights on the back. The SBA will also provide a paper map for visiting boaters. The booklets/maps will be available at the general meeting, if approved.

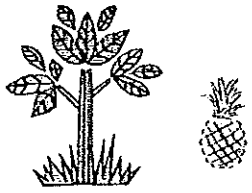
cont'd p 2

2001 SUMMER CALENDAR

Adopt-A-Highway
June 3 & September 9
8:00 am
(meet at Old Cedar Creek Resort)

SBA General Meeting
Saturday, June 23
9:00 am
@Fire District #7 Station
Fertile Valley & Jermain RD

Tropical Fever



4th of July? Boat Parade
Saturday, June 30
1:00 pm
Line up at public launch

Ladies of the Lake
have a slate full of fun
& Garage Sale-July 14
Call for info...
Karen Averitt 447-0934

SBA cont'd...

Additionally, Sgt. Thad Schultz, from the sheriff's office, will attend the general meeting to speak and address any questions/concerns re: ordinance, marine patrol, safety, etc.

The Marine Patrol Boat should be much more visible this year, BUT, **they need volunteers to ride it when it is at Sacheen.** You would assist the sheriff's deputy,mainly in handling the boat, assisting with safety inspections, etc. You will not be expected to do any enforcement. *We've stated that we want to see the boat here and they need our help in order to do it.*
If you can go out, even if occasionally (2 – 4 hours), please call me (447-4030) or sign up at the meeting.

FYI on PWC's!
Personal Watercraft concerns were discussed by board members at their April meeting. This issue is/was was/is a hot one, but we agree that enforcement and giving the new ordinance an opportunity to succeed at Sacheen is the best solution. The opinions received, during the course of the ordinance review, were very equally split among those who wish to ban/those who are opposed to banning.

Fish Survey

The survey report (by the state) is not yet complete, so...the lake was planted in the usual numbers this spring. They expect the report to be complete sometime this summer. Look for the results in the fall issue of the SCOPE...and if it comes any sooner, we will post it on the web site and send an e-mail.

Want to...<u>Take a Walk In the Woods</u>
with a Forester & Wildlife Biologist? This DNR sponsored program is available, if we have enough people interested. Our thoughts were to visit the infamous state land south of the lake. A signup sheet will be available at the general meeting.

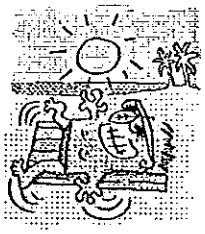
Charles Peters Memorial
The family of Mr. Peters has agreed to the installation of a memorial bench, on Rock Island, off the south shore. If you would like to assist on the project/installation, please give Di Wear a phone call/e-mail or sign up at the meeting. A formal dedication will take place next spring.

Ugly cars are gone!

Thank you John Pargman, Brad Wear, and the Sacheen Fire Fighters for their diligent efforts in getting the eyesores removed from our Adopt-A-Highway section of Hwy 211!

Don't forget the Adopt-A-Highway litter pickup Saturday, June 3...the more the merrier & the faster it gets done!!!
& thanks once again, Nancy & Roger Moore, for organizing!

THANKS, BARB!



In closing, we'd like to thank Barbara Floyd for her service as the Sacheen Betterment Association Treasurer & Board member *since 1993*! **We will miss her** and *appreciate all she has done to keep us solvent...*
now she can relax & enjoy her beautiful new lake home and the grandkids!

?IMPARTIAL?
JUDGES NEEDED FOR BOAT PARADE
SIGN UP AT THE MEETING

Congratulations, Perry Pearman
Pend Oreille County Firefighter of the Year!

DON'T MISS THE GENERAL MEETING
JUNE 23...GET A PREVIEW OF THE TYPE OF FIRE STATION/COMMUNITY FACILITY WE COULD HAVE ...
ALSO, DON'T MISS OUT ON THOSE INFAMOUS PRIZES
ALL NEW 'DUCKY' CLOTHING
AND
SACHEEN COFFEE MUGS – AGAIN!

ewer & Water District

ubmitted by: Sheila Pearman, Commissioner

HANK YOU, THANK YOU, THANK YOU!
/e would like to thank the District members for continuing support our efforts with the passage of last fall's Maintnance & Operation Levy. With this support, we will conue our efforts toward maintaining Sacheen's water qualy.

econdly, **"Thank you" to Julia Vervair,** for stepping up id volunteering to fill our vacant seat on the Board. Julia is lived on the Terrace for a couple of years now and is so a Sacheen Betterment Association Board member. We ppreciate her desire to serve our community!

inally, **a big "Thank You *and* Goodbye" to David amb.** David recently left the employ of Resource Mangement and has taken a position with the Coeur d'Alene ribe as a Wetland Habitat Biologist. David has worked ith us for over ten years on our lake projects. His expertse and sincere concern for Sacheen Lake will truly be issed. We thank him for all he has done and wish him ell in his new endeavor.

his season will see us developing an integrated aquatic lant management plan. Once we have a plan in hand, we an use it to apply for implementation grants. This can fiancially help support our continued milfoil efforts, too. Ve will again be conducting milfoil surveys/hand pulling, sing divers this summer, and if conditions warrant, we ill again use the herbicide 2,4D.

Ve hope all had a good winter and that veryone is looking forward to another acheen Summer.

IREHOUSE NEWS!
ubmitted by Joanie Suttle

have been coming to Sacheen Lake for over 20 years, ave been a property owner for 10 years, serve on the Saheen Betterment Association Board, and last August I oined the Sacheen Lake Volunteer Fire Department, as a irefighter-EMT. Until joining the Fire Department, all I new was that we had a fire station and if I needed help, ither with a fire or a medical emergency I could call them. never gave much thought to how they were funded and ist how much work went into keeping our station up and unning.

Fire District #3 includes the Sacheen Lake, Diamond Lake, and Deer Valley stations, covers 100 sq. miles, and a population of 3,566. We are responsible for ALL 911 fire and medical calls. Additionally, the WA State Patrol, through the PO County Sheriff, has requested our assistance with the methamphetamine lab busts. They have asked us to be on-scene in case of fire or medical emergencies. We have currently assisted in six of these busts so far this year.

Our main source of revenue comes through property tax assessment, generating $80,000 per year. We also receive a grant from the Dept. of Health ($1,200), a grant from PUD ($2,700), and a timber grant ($8,000), which gives us a woefully inadequate annual budget of $91, 900. Our annual income is enough to keep up with general maintenance and supplies, BUT, when we have to use the money for bigger equipment needs, it takes it all!

I have written two grants, one to the Gates Foundation (which was turned down) and one to Paul Allen's foundation (pending), to try to replace the fire engine at the Sacheen Station. Our engine is a 1965 model and this past winter we were forced to leave it in the station because the defroster/heater wasn't working properly and we couldn't keep the windshield from icing up.

Many of your very dedicated neighbors volunteer their free time to provide fire and medical services to the families in our district. Their quality of care is directly related to the ability to respond quickly, with the equipment and supplies necessary to give adequate support.

Here's where we need your help! We need to replace equipment that is either worn out or broken. Some of the equipment needs are, fire hoses, fire spray nozzles, turn-out gear, gloves, radios, tanks, flash lights and medical supplies. *Any donation that you are able to give would be greatly appreciated!* Even a small amount, when added with that of others, will provide us with the equipment we need (AND you get a head start on your tax deductions for the year 2001 :-) You may send a check directly to me, made out to Pend Oreille Fire District #3, or send it directly to the Fire District (addresses below).
Thank you for any support that you may be able to give!
If you have any questions, please feel free to call me!

Joanie Suttle
32 Kohles Beach DR
Newport WA 99156
447-2579

Pend Oreille Fire District #3
PO Box 870
Newport WA 99156-0870

MEMBERSHIP FORM

NAME: _____

_____

ADDRESS:

_____

_____

PHONE:

_____

E-mail address:

_____

*Are you the
property owner on record? Yes No

MEMBERSHIP DUES:
$10 ANNUALLY
Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
161 Viewpoint Rd
Newport WA 99156

SACHEEN BETTERMENT ASSOCIATION
BOARD MEMBERS:

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Secretary:	Gordon Young	Cheney 235-2216 cell 993-2402 syoung1138@aol.com
Treasurer:	Julia Vervair	lake/home 447-0171 vervair@surf1.ws
Board Members:	Kent Dyekman	cell 509-943-1333 blue1jay@gte.net
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	Mike Pielli	Spokane 484-3759 lake 447-3586
	Bill Storms	Spokane 747-7629 lake 447-5404 islndmvr@aol.com
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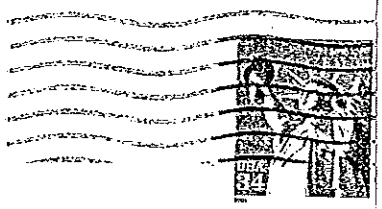


SacheenSCOPE
7512 N FERTILE VALLEY RD
NEWPORT WA 99156

PERRY & SHEILA PEARMAN
8272 FERTILE VALLEY RD
NEWPORT, WA 99156

FALL 2001

SACHEENSCOPE

Sacheen Betterment Association

ɔmitted by Di Wear .

ɔther Sacheen season has passed and the ›w flew before the snowbirds left...chasing ın early & quickly south for the winter!

me **follow up reports for 2001:**
A Board sought change & you agreed!
th member approval, we have a represen-
.ve from each of the seven identified areas
l three 'at-large' members. The immediate
ɜt president will also serve a two year term.

nd **Oreille County Boating Ordinance**
ɘ updated ordinance was adopted in
gust, much later than hoped for.
ghlights for Sacheen included:
Retention of the 35 MPH speed limit
NO PWC's may operate after sunset & before sunrise
Skiing ends 1/2 hour after sunset until 1/2 before sunrise
NO WAKE language replaces the 5 MPH in the entire county, which at Sacheen is at the west end of the lake. This means not only can there be no wake, but by definition, speed can not exceed 5 MPH.
Copies of the ordinance are available from the County Commissioners and we will have boating booklets with highlights on the back available next spring, as well as a nice new sign at the public launch.

Check us out on the web...
www.novn.com/sacheenscope

The Marine Patrol Boat should have been more visible this year, but with an increasing Meth problem and personnel losses, the sheriff's department had to redirect their attention. Hopefully, next season will see them on the county waters again.

Fish Survey
I have asked for the report on several occasions, to no avail. The last word was that Sacheen will continue to be managed/ planted as it has been in recent years.

<u>Take a Walk In the Woods</u>
<u>with a Forester & Wildlife Biologist</u>. We have many people interested in this program and I requested a tour of the state land. Of course, it will be next season, since no response has come back yet.

cont'd p.3

Adopt-A-Highway

was held September 9

Thanks to everyone who helped & especially to Nancy & Roger Moore...

AGAIN, our ever faithful coordinators!

Congrats, 2001

Tropical Fever

Boat Parade

winners

Pawgmans,

Garretts,

& Hawkins...

Island Dreamers!

Holiday gift ideas!

Sacheen Lake shirts & coffee mugs...

Call Di Wear 447-4030

Check out the SacheenSCOPE web site...it is up & running. We will try to keep it current & to make it appear more *sophisticated* with time.

www.povn.com/sacheenscope

DON'T FORGET TO VOTE NOVEMBER 6

SACHEEN SEWER & WATER DISTRICT
MAINTENANCE & OPERATION LEVY
&
COMMISSIONER

FIREHOUSE NEWS!
Submitted by Perry Pearman

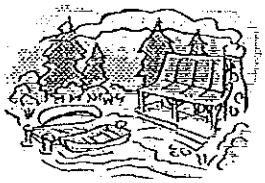
It has been fairly busy for the Fire District. We have had approximately 150 calls so far this year with 70% of those being medical assistance. We now have eight members at the Sacheen Station. Mike Pielli is going through the Fire Fundamentals course. Mike and Gary Wilkey are planning to take the EMT course this winter. That will give us four EMT's and one Medical First Responder at the Sacheen Station alone!

I checked the times on one of our recent calls and Leanord Pielli arrived at a Sacheen Terrace residence with the rescue truck in seven minutes. This sort of time is what we aim for!

Some things you can do to help us:
1) *label your mail box well with large reflective numbers*
2) *send someone out to the main road to lead us in*
3) *keep your driveway clear so we can get in*

One more thing! This is our normal chimney fire season. Please take the time to clean your chimney before burning. Hope you all have a safe fall and winter and *remember, we are just a 911 phone call away!*

Perry Pearman, Captain
Sacheen Lake Station



Thanks for the Memories!

I can't believe it has been 9 1/2 years since I began working for the Sacheen Lake Sewer and Water District. You just never know what your husband will get you into! First, it was just taking the notes at meetings, but before I knew it, I was writing grants and managing thousands of dollars in grant money! Heck, I was even elected as a commissioner! And then along came son Joey...see what husbands get us into!

Thank you for all the support you have shown over the years. Your words of encouragement and gratitude have made me feel a part of this wonderful Sacheen Lake community. I know it is because of my work with the board that I have been able to meet so many of you. But with Joey now involved in school activities and husband Perry with the local fire department, I feel it is time for me to step back and focus my energies in other directions.

So, with the expiration of my term as a Commissioner in December, I will also be leaving the position of Managing Secretary. I feel the work that has been accomplished by the SLSWD has been very important to Sacheen Lake and the Sacheen Community and I hope you will continue to actively support the district and the board, and the work they do for Sacheen Lake.

Sincerely,
Sheila Pearman

Sheila has always comically referred to herself as a sewer queen...
Her 'crown' is now available for a new head!

SACHEEN 'DUCKY' CLOTHING
AND
COFFEE MUGS
MAKE GREAT HOLIDAY GIFTS
CALL DI WEAR 447 - 4030
& ARRANGE TO PICK SOME UP!

efinite chill in the air and a hearty snowfall two ks ago must mean winter is on the way?

nks to all of you who attended the public hearing in ember, regarding the Integrated Aquatic Vegetation nagement Plan (IAVMP). David Lamb has worked up n to submit to the Department of Ecology (DOE) that out a strategy for the management of our aquatic ts. For those of you who submitted surveys, thank you aking the time to do so. It's invaluable!

week we will be submitting a grant application to the atic Weeds Management Fund, which we hope will us with our ongoing efforts to keep Milfoil at bay. If rded, it could help us offset up to 75% of our cost for foil work for the next three years. We hope that by ng a good track record with DOE and an IAVMP, we score well and be awarded a grant. We should know etime after the first of the year!

l now, a blast from the past! In 1992 District voters ed a General Obligation Bond in the amount of 0,000. This money was to be used toward the purchase roperty, development of a lakeside park, as well as to t our share of $190,000 toward a Centennial Clean er Fund Grant, to get rid of the Eurasian Milfoil (60 s) in Sacheen Lake. This 20-year bond payment, along n any maintenance and operation levy, is what you see n you read the sewer and water portion of your tax ement.

r passage of the bond, the district received a $75,000 t from the Aquatic Lands Enhancement Account, for purchase and development of the Myers/Harter Sanc- y. Due to the award of this grant, we have residual ls that we are now able to use to buy back the last four s of the General Obligation Bond. By doing so, the rict will be saving approximately $7,000 per year in rest charges and reducing the bond term by four years! e Ormsby, the district's attorney, has advised the board we can do this with the payment due December 1.

Those of you registered to vote in the District should have received your ballots by now.

SLSWD has two issues on the ballot:
1. The election of a new commissioner. Julia Vervair and Ken Zarko are running for a 4-year unexpired term.

2. A Maintenance and Operation Levy in the amount of $.25 per $1,000 of the assessed valuation. This money will be used in 2002 to pay for district operation expenses and continued Milfoil control. Please consider the work that has already been done and continue to support those efforts to keep Milfoil at a manageable level.

Above all, please make sure to cast your vote!

In closing, we hope those who travel in the winter do so safely and those who stay close by have a wonderful winter season. We look forward to seeing you all next summer.

The Board,
Ron Schmidt, Julia Vervair, & Sheila Pearman

Thank You, Sheila!

On behalf of the Sacheen Betterment Association, as a property owner, and as a friend, it is with somewhat of a heavy heart that we say goodbye to Sheila Pearman, in her role as a sewer commissioner. Her efforts have always been sincere and most commendable, her presentations clear, and concise!

I am confident that I speak for many folks around Sacheen when I say *"Thank You, Sheila"...*
Di Wear

Happy Holidays, Everyone!

MEMBERSHIP FORM

NAME: _____

_____

ADDRESS:

_____

_____

PHONE:

_____

E-mail address:

_____

*Are you the
property owner on record? Yes No

MEMBERSHIP DUES:
$10 ANNUALLY
Please make checks payable to:
SACHEEN BETTERMENT ASSOCIATION
mail to:
161 Viewpoint Rd
Newport WA 99156

SacheenSCOPE
c/o 7512 N FERTILE VALLEY RD
NEWPORT WA 99156-9500

SACHEEN BETTERMENT ASSOCIATION
BOARD MEMBERS:

President:	Di Wear	lake/home 447-4030 bdwear@povn.com
Secretary:	Gordon Young (@large)	
Treasurer:	Julia Vervair (Terrace)	

Board Members:

Sacheen Shores	Kent Dyekman
@large	Gary Garrett
Mt View	Anne James
East Shore	John Pargman
@large	Mike Pielli
Shaffer's Beach	Bill Storms
Kohles Beach	Joanie Suttle
Narrows	Brad Wear

Board members represent the 'identified' areas of Sacheen Lake

APPENDIX E

Other Agency Information

1. WDNR Natural Heritage Program letter
2. WDOE initial IAVMP comments
3. WDOE second draft IAVMP comments
4. POCNWCD IAVMP comments
5. WDFW Priority Habitats and species information

November 8, 2001

Ms. Sheila Pearman
Sacheen Lake Sewer and Water District
8272 Fertile Valley Road
Sacheen Lake
Newport, WA 99156

RE: Sacheen Lake Integrated Aquatic Vegetation Management Plan comments.

Dear Ms. Pearman:

Thank you for submitting the Sacheen Lake Integrated Vegetation Management Plan to Ecology for our review. This plan is very well written, but needs some extra information before it will meet the minimum grant guideline standards. I use the minimum standards as a checklist to try to be consistent in evaluating plans from lake to lake. I am confident that this additional information can be easily added to this draft and you will soon have an approved plan. I am also providing a copy of the plan to Nancy Weller of the Eastern Regional Office for her review and comment.

Here are my comments. SEE REFERENCED PAGES IN IAVMP FOR RESPONSES

1. Do you know how long milfoil has been in Sacheen Lake? If so, please add this information to the plan. See pp 1-2
2. Pest management plans should set action limits. I assume that the action limit for milfoil in Sacheen Lake is set at zero milfoil plants. See p 16
3. Can you provide a beneficial use map with varying zones of control intensity or is the plan to remove milfoil where ever it is found? See p 16 You do mention removing all plants from swimming areas and these areas should be shown on a beneficial use map. = all developed areas
4. Provide more information about land use activities. You allude to logging, ranching, single family homes. Could you make this more definitive? At a minimum the number of homes around the lake and also number of homes with lake access should be included in this plan. See p 8
5. Could you provide more information about the wetlands? What class are they? What were the Sonar treatment impacts? Do you expect any impacts from the proposed treatment? If

no, what leads you to this conclusion? (Actually I do know the answers to some of these questions, I just want a naïve reader to have all their concerns answered in the plan) See p 8

6. Are there any endangered species (plants or animals) in the area? Ask the DNR heritage program for a printout of endangered species information for Lake Sacheen. See p 15 What are the fish species in the streams? Are there any native trout or just stocked fish in the lakes and streams? Are there any bull trout in the area? See p 15
7. I'd like a list of bird and animal species in the area to be included with this plan. See p 14
8. Do Fish and Wildlife consider Sacheen to be a good fishery? What is their opinion of the 2,4-D treatments? See p 14
9. The sediment types need to be included. See p 10
10. Who identified the aquatic plants for this plan? See p 17
11. I would like you to provide some information about why the Sonar treatment did not result in eradication. Also discuss in detail where and when 2,4-D has been applied and your strategy for application. I assume that you surveyed the lake, mapped out the problem sites, and then came back and applied the herbicide based on the plant distribution. How did you deal with water right issues with these applications? Discuss in more detail why, even with the 2,4-D treatments, milfoil has been increasing in Sacheen. Have you observed dying plants in the treated sites or are the treatments ineffective in some areas? See pp 3 & 4
12. When you discuss each control option, please follow-up with why each control option would or would not be an applicable control option for Sacheen. For instance with hand pulling you might indicate that each lake resident could patrol in front of their home and hand remove the milfoil plants (with appropriate Fish and Wildlife brochure) and then describe the pulling technique and the importance of fragment collection. Or you may prefer that the lake residents leave it to the professionals. In any event, I think that you need to spell out why or why not each method may or may not be an applicable one for milfoil control in Sacheen Lake. See each control option section
13. Diver dredging. We need to come up with another name for this. According to Terry you don't actually remove any sediment, but instead hand pull the plant and then use the suction device to dispose of the plant. This action really isn't dredging. Diver dredging actions may need coverage under the Corps. The type of work that I think that you are proposing does not. Maybe call it suction disposal or something. I also would like you to discuss this control method in much more detail as it relates to Sacheen, especially as it is identified as a potential control method. This is where knowing the sediment type is important to identify in a plan. Obviously flocculent sediments will interfere with visibility and very hard rocky sediments may cause more problems in removing the roots. See pp 29 - 31
14. In biocontrol (and in some other areas of the plan), you talk about coontail and elodea. I assume that this language was taken from another plan. You need to change this to milfoil. I think that grass carp are now more typically stocked at 9 fish per acre. Another thing that happens to water quality with grass carp stocking is that water turbidity increases. Also please discuss the milfoil weevil. You could discuss it here or discuss it under emerging techniques. At one point before treatment, Sacheen actually had weevils. See p 31
15. Endothall is now "owned" by Cerexagri and diquat by Syngentia. Those companies change names so fast that it's hard to keep up. See pp 35 & 36
16. Dow Agrisciences has registered a liquid 2,4-D product now. It is an amine formulation and it is approved for use in Washington so there are potentially two 2,4-D products that could be used for milfoil control in Sacheen. Since 2,4-D treatment is identified in the plan as being

the herbicide of choice, I would like you to include the labels in the appendix (you can download sample labels from the internet). See Appendix C Also provide more information about the toxicity of this chemical. See p 37 I assume that the Lake Sacheen folks are comfortable with its use, but it would be good to have this information in the plan. How are you going to deal with water use issues and 2,4-D use? There are conflicts with the label. I assume that you have resolved this issue since you have been using 2,4-D in the lake with no complaints.

17. Need to change the registration year for triclopyr. I assume that it won't be registered this year. Also discuss this herbicide in more detail. It might make sense to do some follow-up treatment with triclopyr. I was just reading a paper out of Minnesota which indicates that repeated 2,4-D treatment ultimately fails. Maybe having another herbicide to use may help beat those odds. I also don't think that Minnesota folks used hand pulling as a follow-up so it is obviously very important not to rely just on 2,4-D use. See p 39
18. How are you going to remove the milfoil in Moon Creek inlets? Discuss this. This control activity should be the top priority even before tackling the in-lake milfoil. See p 42
19. What factors in addition to the fact that milfoil is increasing in the lake, led you to conclude that larger areas need to be treated with 2,4-D? By the way, my supervisor has indicated that permit fees are not grant eligible. No other factors
20. Are you assuming that individual homeowners have no interest in taking steps to control plants in front of their residences? You might want to set out some options for homeowners to use if they desire to control nuisance weeds. For instance you may advise homeowners to not use the cutting tool because it would produce fragments. See p 42
21. Do you have minutes from the public meeting? If so, please include them. See Appendix A
22. Do you have copies of the newsletters from the last couple of years? This serves as evidence of public input and buyoff on the management methods. We want the plan reader to understand that lake residents are well informed and are in support of these methods. See Appendix D
23. Have Fish and Wildlife and other interested parties been given a chance to review the plan? That's part of the process too. The second draft of the Plan was submitted to WDFW (John Whalen) and the POCNWCB (Sharon Sorby for review 4/24/02. A response from Sharon Sorby was received 5/15/02. No response was received from WDFW through 7/10/02 in spite of several follow-up communications.

When you have revised the plan, please provide me with a copy for my review. I fully expect that the next draft will meet our minimum requirements and the plan can be finalized.

If you have any questions, please call me at (360) 407-6562 or by e-mail kham461@ecy.wa.gov.

Sincerely,

Kathy Hamel

KSH:ksh

December 7, 2001

David Lamb, Aquatic Biologist
Sacheen Lake Sewer & Water Distric
c/o 151 View Point Road
Newport, WA 99156

SUBJECT:

We've searched the Natural Heritage Information System for information on significant natural features in your project area (vicinity of Sacheen Lake Township 31 N., Range 43 E). Currently, we have no records for rare plants or high quality ecosystems in the vicinity of your project.

The information provided by the Washington Natural Heritage Program is based solely on existing information in the database. In the absence of field inventories, we cannot state whether or not a given site contains high quality ecosystems or rare species; there may be significant natural features in your study area of which we are not aware.

The Washington Natural Heritage Program is responsible for information on the state's endangered, threatened, and sensitive plants as well as high quality ecosystems. We have begun to add information to our database on selected groups of animals of conservation concern, such as freshwater mussels, butterflies and bats. We now make this information available in our reports along with information on rare plants and high quality ecosystems.

The authority for protection of animal species in Washington rests with the Department of Fish and Wildlife who manages and interprets data on wildlife species of concern in the state. To ensure that you receive information on all animal species of concern, please contact Priority Habitats and Species, Washington Department of Fish and Wildlife, 600 Capitol Way N, Olympia, WA 98501-1091, or by phone (360) 902-2543.

If you have the opportunity, visit our website at http:// www.wa.gov/dnr and click on *Programs & Topics* to locate the Natural Heritage Program. Please do not hesitate to call me at (360) 902-1667 if you have any questions, or by E-Mail: sandra.moody@wadnr.gov.

Sincerely,

Sandy Swope Moody, Environmental Coordinator
Washington Natural Heritage Program
PO Box 47014
Olympia WA 98504-7014

From: Hamel, Kathy [mailto:kham461@ECY.WA.GOV]
Sent: Thursday, April 25, 2002 9:45 AM
To: Dave Lamb
Cc: Weller, Nancy C.
Subject: Sacheen lake

Hi Dave, As usual you have done an excellent job! I have just a few comments on the revised plan. Sorry this is all different fonts and colors. I have cobbled this together from several sources.

SEE REFERENCED PAGES IN IAVMP FOR RESPONSES

1. Information on rare, threatened or endangered animal species was not solicited due to the expected absence of effects that chosen Milfoil control techniques will have on animal (including fish) species. I know its a pain, but I would like you to check on this. If I am going to use this as an example of a good plan on our web site, I would feel better about it. See page 16

2. You need to take out references to short term mods. We no longer issue them. Everything is covered under an NPDES permit. We have one permit for noxious weeds and another one for Nusiance weeds and algae. See page 22 Copper is no longer allowed under either NPDES permit so you should take that out too. See page 39

3. I think that the Ohio company sells their weevils for about a dollar each. See page 42

4. Cerexagri now market AquaKleen which is the same formulation as Navigate. You need to include that in your 2,4-D discussion. http://www.cerexagri.com/usa/Markets/Aqua_Kleen.html. See page 38

5. There is no swimming restriction for 2,4-D. Ecology recommends " that due to risk of dermal contact, a swimming advisory shall be posted advising swimmers to wait 24 hours before reentering directly treated areas to allow time for granules to disperse. " (from FEIS) This is advisory only and there is no requirement for even a swimming advisory in the draft permit. See page 38

6. Does the label allow for turkey feeder type application for 2,4-D? If not can we get a special needs exemption? I know that they have done some turkey feeder work in Florida. You need to get this checked out before including it in the plan. See page 44

7. Some 2,4-D monitoring needs to be built in to this plan to satisfy the NPDES monitoring requirements. See page 46 Here is what Skagit is doing for Erie Lake.

A. The RECIPIENT will collect four composite samples from Lake Erie following treatment with a DEPARTMENT approved herbicide. Samples one and two will be collected one day after treatment. Sample one will be collected from outside the

treatment area. Sample two will be collected from inside the treatment area. If more than one area is treated, the RECIPIENT will collect the sample from the largest area of treatment. Samples three and four will be taken within three to five days of the treatment application, in the same areas of the first two samples (one outside and one inside the treatment area).

B. Samples will be composited and placed in pre-preserved sample containers supplied by an environmental laboratory which is accredited by the DEPARTMENT. Samples will be taken from a variety of depths in the water column, and will be taken from at least four discrete locations and field mixed in the same sample containers. Samples will be collected by qualified Skagit County personnel.

Sampling and analytical methods used will conform to the latest revision of the *Guidelines Establishing Test Procedures for the Analysis of Pollutants* contained in 40 CFR Part 136 or to the latest revision of the *Standard Methods for Examining Water and Wastewater* (APHA). In order to be acceptable for NPDES permit monitoring compliance requirements, all monitoring/laboratory requirements as set out in the general noxious

We are hoping that Mike will allow us to use the ELISA assay that has been developed for 2,4-D. This will probably be cheaper with a quicker turn around time.

8. I am assuming that nobody has expressed any concerns about water rights when using 2,4-D at Lake Sacheen . I just got the latest label language (AquaKleen) off the web. The main thing will be if anybody is using lake water to drink or to irrigate, they will have to wait for a few days. This needs to be in the plan. See page 45

"Unless an approved assay indicates the 2,4-D concentration is 100 ppb (0.1 ppm) or less, or, only growing crops and noncrop areas labeled for direct treatment with 2,4-D will be affected, do not use water from treated areas for irrigating plants or mixing sprays for agriculture or ornamental plants."

"Unless an approved assay indicates the 2,4-D concentration is 70 ppb (0.07 ppm) or less, do not use water from treated areas for potable water (drinking water)."

I am looking forward to getting copies of the final plan. I would appreciate an electronic copy so that I can post it as another example of a good plan on the web.

Good work as always Dave. Thanks so much.

Kathy

From: Sharon L Sorby <ssorby@coopext.cahe.wsu.edu>
To: Dave Lamb <aqualamb@mindspring.com>
Date: Wednesday, May 15, 2002 4:28 PM
Subject: Sacheen Lake IAVMP

Hi Dave,

Sorry I waited to the last minute, I would have written last night, but my email program decided to lock-up my inbox and so I couldn't even get into it to send a message. I had to reformat my hard-drive and start over. Sigh.

Anyway, enough with excuses. The only 2 things that came to mind were:

1. The appropriateness of Diquat (I believe). With the work done in Kootenai County on Hayden Lake, they had a diver apply (with a modified back-pack, I believe, for underwater use) to the bottom third of each plant's stem. Obviously this is highly labor intensive, but not as much product is needed and the results were impressive as the method seemed to kill the entire plant as a systemic would. It may function similar to the Milfoil weevil in that it causes the plants to collapse, pulling the mat down and stopping the flow of nutrients to the roots for storage. You might want to talk further with Doug Freeland or Sandy Daniel about it. (see page 37 in IAVMP)

2. You were looking for a cost on the Milfoil weevils. The project costs (which we could never get from the consulting firm) were very high. I do not believe it would be necessary to run the same level of project (in terms of quantification). Weevil augmentation would only be appropriate if the S&WD or SLBA decided some level of Milfoil infestation is acceptable. It requires a diver 1 to 2 times a month, late May through early August to collect brood stock, and once a week for release unless the production tanks heat up, then releases need to made twice a week. Volunteers could take care of the production work, separating out the stems ready for release and keeping the tanks stocked with Milfoil and lake water. Tanks can be set-up rather inexpensively, PUD used the clear plastic serving tanks from a restaurant supply store. Tanks were fitted with air pumps and heaters in a tent outside. I'd guess $25-$50 per tank. The volunteer crew and my employee who oversaw the project were run ragged during the hot weather to keep up with 6 tanks. Although several thousand weevils were produced, they could only supply a small area for release. We still don't have biomass analysis, so we really don't know the impact. Although spendy, it's a great educational and awareness program though, getting residents involved and taking ownership of the Milfoil problem. (see page 41 in IAVMP)

So there's my 2 points. Good luck and let me know if there's anything else I can give you a hand with -- I will try to be more timely in the future.

Sharon

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE - HABITATS AND SPECIES REPORT
IN THE VICINITY OF T31R43E SECTION 25
Report Date: June 03, 2002

This map contains the following species and/or habitat locations that are deemed sensitive by the Washington Department of Fish and Wildlife Sensitive Fish and Wildlife Policy.

PHS CODE/ SPPCODE	COMMON NAME	USE CODE	USE DESCRIPTION
ACGE	NORTHERN GOSHAWK	B	BREEDING OCCURRENCE

PHS POLYGON FORM LIST - CROSS REFERENCE REPORT
IN THE VICINITY OF T31R43E SECTION 25

PHSPOLY#	FORM NUMBER/ PHS CODE*USE CODE
2	900000 *-
3	900227 RIPAR*-
4	900000 *-

PHS POLYGON - SPECIES AND HABITAT LIST

PHS FORM#	PRIORITY	PHS CODE	COMMON NAME	USE CODE	USE DESCRIPTION
900,000					
900,227	YES	RIPAR	RIPARIAN ZONES		

Form number 900000 indicates presence of PHS is unknown or the area was not mapped. Form numbers 909998, 909997, or 909996 indicate compilation errors.

YES under the "PRIORITY" column indicates that the species or habitat is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List.

WILDLIFE HERITAGE POINT - SPECIES LIST AND REPORT
IN THE VICINITY OF T31R43E SECTION 25

QUADPT	PRIORITY	SPPCODE	COMMON NAME	USE CODE	USE DESCRIPTION
4811723008	NO	PAHA	OSPREY	B	BREEDING OCCURRENCE
4811723009	YES	ACGE	NORTHERN GOSHAWK	B	BREEDING OCCURRENCE
4811723010	YES	POGR	RED-NECKED GREBE	B	BREEDING OCCURRENCE
4811723017	NO	PAHA	OSPREY	B	BREEDING OCCURRENCE

YES under the "PRIORITY" column indicates that the species or habitat is considered a priority and is on the Priority Habitats and Species List and/or the Species of Concern List.

quadpt: 4811723008 sppcode: PAHA use: B name: OSPREY
year: 1989 class: SA accuracy: C state status: SM fed status:
township - range - section: T31N R43E S25 SWOFSE occur#: 544 seqno: 1
general description:
SACHEEN LAKE OSPREY TERR. NEST IN FIR SNAG WEST SIDE OF SE BAY. NEST ACTIVE FOR YEARS MOVED FROM TREE TO TREE.

quadpt: 4811723009 sppcode: ACGE use: B name: NORTHERN GOSHAWK
year: 1989 class: SA accuracy: C state status: SC fed status: FCo
township - range - section: T31N R43E S24 SEOFNW occur#: 138 seqno: 1
general description:
NORTHERN GOSHAWK NEST JUST NORTH OF SACHEEN LAKE. NO ACTIVITY 1992.

quadpt: 4811723010 sppcode: POGR use: B name: RED-NECKED GREBE
year: 1991 class: SA accuracy: C state status: SM fed status:
township - range - section: T31N R43E S35 NWOFNE occur#: 31 seqno: 1
general description:
RED-NECKED GREBE. PAIR SEEN IN THE S BAY-91;

quadpt: 4811723017 sppcode: PAHA use: B name: OSPREY
year: 1996 class: SA accuracy: C state status: SM fed status:
township - range - section: T31N R43E S25 SWOFSE occur#: 544 seqno: 2
general description:
OSPREY NEST IN VERY LARGE P-PINE NEAR SHORE.

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE - PHS POLYGON REPORT
Report Date: 06/03/2002

form: 900,227 species/habitat: RIPAR species use: season: accuracy: 1
sitename: SACHEEN MARSH
general description:
OUTLET FROM SACHEEN LAKE - RIPARIAN AREA BEAVER DAMS, NONGAME USE BY HERONS, DUC KS, GEESE AND FURBEARS, MINK, MUSKRAT

source: PALMANTEER, ALLEN, WDW, SPOKANE REGIONAL OFFICE
date: 88 code: PROF
synopsis:
ON SITE OBSERVATIONS DURING ROUTINE HPA REVIEWS

source: COBURN, GEORGE, WDW, SPOKANE REGIONAL OFFICE
date: 89 code: PROF
synopsis:
PERIODIC SITE VISITS DURING NORMAL BEAVER CONTROL ACTIVITIES

source: WHALEN JOHN, ZENDER STEVE WDFW
date: 102594 code: PROF
synopsis:
PROF. KNOWLEDGE AND FIELD OBSERVATION 1974 TO PRESENT.
POLYGON CHANGE TO EDIT ORIGINAL MAPPING

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
PRIORITY ANADROMOUS AND RESIDENT FISH PRESENCE REPORT FROM THE STREAMNET DATABASE
IN THE VICINITY OF T31R43E SECTION 25
Report Date: June 03, 2002

PRIORITY ANADROMOUS FISH PRESENCE

CODE	COMMON NAME	STREAM NAME	STREAM LLID	RECORD DATE	SOURCE

PRIORITY RESIDENT FISH PRESENCE

CODE	COMMON NAME	STREAM NAME	STREAM LLID	RECORD DATE	SOURCE
RBT	Rainbow Trout	Moon Creek	1173105481548	02/28/90	WDFW Staff
RBT	Rainbow Trout	Stream name(s) not in database	1172918481971	11/24/93	WDFW Staff
RBT	Rainbow Trout	West Branch Little Spokane Riv	1173285479827	02/28/90	WDFW Staff

The fish information in this report only includes information that Washington Department of Fish and Wildlife (WDFW) maintains in a central computer database. This information only documents the location of important fish resources to the best of our knowledge. It is not a complete inventory of the fish species in the state. Fish are identified as priority by WDFW if they meet one of three criterion as listed in the Priority Habitats and Species List. The list is available by contacting WDFW Priority Habitats and Species section at (360)902-2543 or it is available on our web site at http://www.wa.gov/wdfw/hab/phspage.htm. To insure appropriate use of this information users are encouraged to consult with WDFW biologists.