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DEPARTMENT OF ECOLOGY

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M E M O R A N D U M
March 1, 1984

To: John Bernhardt
From: Lynn Singleton *LS*
Subject: Lake Sequalitchew

A request was made of the Water Quality Investigations Section staff to look into the aquatic plant problem in Lake Sequalitchew. I visited the lake on September 21, 1983. Dean Wood, Washington State Department of Fisheries (WDF) and Jim Stevenson, Fish and Wildlife Service of Fort Lewis, were in attendance as were other members of their staffs.

An algae sample and one near-shore water sample were collected at the boat launch located on the northwest side of the lake, for identification and laboratory analysis. One sample actually tells you little about the seasonal occurrences prior to a survey; however, it can be an indication of some general events. The attached sample results are indicative of other lakes in the geographical area. The nutrients indicate that nitrogen forms have been depleted. The low chlorophyll a and higher pheophyton a levels are what could be expected from a senescent algal population. The decline of the algae could have resulted from nitrogen depletion and/or light limitation.

Lake Sequalitchew is a shallow, undeveloped lake which does not apparently stratify (Table 1). It is located in Pierce County on the Fort Lewis Military Reservation, and access is controlled by Fort Lewis. The lake is presently managed to provide a rainbow trout fishery for military personnel. It has generally been stocked on a yearly basis as needed since the early 1960s. Plants have ranged in size from 3,500 to 56,000 fish (Stevenson, 1983).

Table 1. Physical data for Lake Sequalitchew
(source: Washington, 1976).

Drainage Area	34.2 square miles
Altitude	206 feet
Lake Area	91 acres
Lake Volume	470 acre-feet
Mean Depth	5 feet
Maximum Depth	11 feet
Shoreline Length	2.5 miles
Shoreline Configuration	1.9
Development of Volume	0.47
Bottom Slope	0.49%
Basin Geology	Sed./Meta.
Inflow	Intermittent
Outflow Channel	Present

In 1976, Fort Lewis and WDF made a non-written agreement whereby lake access would be granted to WDF so the lake could be used as a coho salmon-rearing facility (Stevenson, 1983). Lake Sequalitchew has been one of the most productive rearing areas in the state. Fish are generally placed in the lake in August or September and released in April of the following year. WDF has placed up to 2,900,000 fish in the lake during a growing season (Peck, 1980); however, the recent norm appears to be less than 2,000,000 (Wood, 1983). Being shallow, Lake Sequalitchew inherently has aquatic weed growth. A 1973 survey (Washington, 1976) noted that 26 to 50 percent of the shoreline and 1 to 10 percent of the lake surface was covered by emerged plants. Stevenson (1983) has indicated that since the fish-rearing program began, the aquatic plant problem has appeared to worsen to the point where the entire lake surface has been covered by mats of algae. The first occurrence was in 1979 with the latest being the summer of 1983 (Stevenson, 1983). I identified the algae in the sample as Hydrodictyon reticulatum. Prior to 1981, Elodea and Myriophyllum sp. were the predominant problem plants. The Fort began an aquatic weed control program in 1981, and has applied Diquot and/or copper sulfate to parts of the lake. Short-term results have had limited success; however, the problem continues to persist from year to year (Stevenson, 1983).

The species composition shift from rooted-type aquatic weeds to floating-type is interesting and may indicate that different herbicides may have to be varied from season to season to treat a changing problem. The aquatic weed problem will probably continue to persist and may worsen if the lake is used as a rearing facility.

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While the WDF program provides several economic benefits, it provides a substantial nutrient load to the lake. For example, during the period December 1980 to March 1981, 74,000 pounds of fish feed were applied to the lake. This corresponded to a rate equivalent to 1 percent of the body weight of the 2.3 million Coho present (Wood, 1983). If broken down into the elemental concentrations (CH₂M-Hill, 1978), this feed equates to: 5,100 pounds phosphate as P; 870 pounds KJN-N; less than 37 pounds of nitrate + nitrite-N; and 230 pounds of ammonia-N. It is understood that some of these nutrients are incorporated into fish which leave the system; however, much of it remains behind in the sediments or as increased plant biomass.

It has been shown that hatcheries can be a significant source of pollutants (FWQA, 1970). Loading rates to receiving waters have been determined from the average of 114 hatcheries as:

<u>Parameter</u>	<u>lbs/100 lbs fish/day</u>
COD	2.0
TP	0.036
OP	0.015
TKN	0.20
NH ₃ -N	0.058 (FWQA, 1970)

I would suspect loads to the lake might be higher as no facility cleaning is possible in the lake.

The lake is downgradient from American Lake and receives its outflow. Additional nutrients may be entering Lake Sequalitchew in this manner.

In summary, the lake is a perturbed system which is going to continue to require yearly efforts and manipulation to provide a system amenable to its user's needs. This task will require planning, coordination, and additional study.

LRS:cp

cc: Darrell Anderson
Jim Stevenson
Dean Wood
Files

REFERENCES

- CH₂M-Hill, 1978. Water Quality in Capitol Lake, Olympia, WA. 79 pp. and appendices.
- FWQA, 1970. An Evaluation of Salmonid Hatchery Wastes. U.S. Dept. of Interior, Portland, OR. 51 pp.
- Peck, L., 1980. Washington Dept. of Fisheries, memorandum to J. Oberlander, WDOE, Olympia, WA.
- Stevenson, J., 1983. Forestry Fish and Wildlife Section, Fort Lewis, WA. personal communication.
- Washington, 1976. Reconnaissance Data on Lakes in Washington, Vol. 3. Kitsap, Mason and Pierce counties. Water Supply Bul. 43. Vol 3. 259 pp.
- Wood, D., 1983. Washington Department of Fisheries, Olympia, WA. personal communication.



DATA SUMMARY

ORIGINAL TO: LAB FILES

COPIES TO: Lynn Singleton

SOURCE

Sequalitchew Lake, Pierce County

DATE COLLECTED

9-21-83

COLLECTED BY

L. Singleton

Sample (Log) Number	13 5006																					
Station:	#1																					
pH (units)	7.1																					
Turbidity (NTU)																						
Sp. Conductivity (umhos/cm)	118																					
COD																						
BOD (5 day)																						
Fecal Coliform (Col./100 ml)	1 est																					
NO3-N	<0.01																					
NO2-N	<0.01																					
NH3-N	<0.01																					
T. Kjeldahl-N																						
O-P04-P	0.01																					
Total Phos.-P	0.06																					
Total Solids																						
Total Non Vol. Solids																						
Total Suspended Solids																						
Total Non Vol. Sus. Solids																						
Total Hardness as CaCO3	56																					
Chlorophyll a	0.5																					
Pheophytin a	8.8																					

NOTE: All results are in mg/L (ppm) unless otherwise specified. ND is "None Detected"
 "<" is "Less Than" and ">" is "Greater Than"

SUMMARIZED BY S. Freeman DATE 10-19-83
 REVIEWED BY A. Pett DATE 10-21-83