CITY OF WASILLA
290 E. HERNING AVE.
WASILLA, ALASKA 99654-7091
PHONE: (907) 373-9050
FAX: (907) 373-0788

COUNCIL MEMORANDUM NO. 92-102

From: Mayor Stein

Date: September 9, 1992

Subject: Lake Lucille Water Study

Last year Dr. Joe Eilers proposed a $12,000 paleoliminology study of Lake Lucille. The Work was to be added to his existing contract and be financed by an $8,400 E.P.A. grant and $3,600 City appropriation.

Council approved CM92-05 on January 13, 1992 authorizing a proposal to E.P.A. E.P.A. failed to fund the project at that time.

A new grant cycle is now open. Dr. Eilers asks if the City wishes to make application again for work to be done next summer. Cost will remain the same.

Does Council wish to re-authorize a proposal and commit $3,600 to the study?

General Fund Fund Bal

John C. Stein, Mayor

JCS/sbh

APPROVED
DATE: 9-14-92
BY: PS

CITY OF WASILLA

290 E. HERNING AVE.
WASILLA, ALASKA 99687
PHONE: (907) 373-9050
FAX: (907) 373-0788

COUNCIL MEMORANDUM NO. 92-05

FROM: Deputy Administrator

DATE: December 20, 1991

RE: Lake Lucille Study Project

We have contracted with Joe Eilers of E & S Engineering who, along with Gilfilian, are performing a two-year study of Lake Lucille. The purpose is to determine the best method of lake restoration and/or maintenance.

The attached documents were forwarded to the City from Mr. Eilers. He proposes to add a paleolimnology study to the existing contract. The work would cost about $12,000 total; the City share would be $3,600. He proposes to do the work while conducting the other lake work this summer. If Council wishes to add the work to the existing project we could authorize Mr. Eilers to make the proposal to EPA with the understanding that Council will appropriate the $3,600 for the City share.

Request Council guidance.

Robert E. Harris
Deputy Administrator

Approved by Council
Jan 13, 1992

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To Peter Curtis	From Joe Ellers
Co. Gilfilian	Co. E&S
Dept.	Phone #
Fax # 907-373-5686	Fax #

E&S Environmental Chemistry, Inc.

Post Office Box 609
1325 NW 9th Street
Corvallis, Oregon 97339
503-758-5[illegible]
Fax: 758-7319

December 13, 1991

Peter Curtis
Gilfillan Engineering
P.O. Box 871868
Wasilla, AK 99687

Dear Peter:

EPA, Region 10, announced that they are accepting proposals from the States for the Clean Lakes Program. I would like to submit a supplemental funding proposal to EPA to collect and analyze a sediment core from Lake Lucille. I am currently using paleoliimnological approaches on three other lakes; the results have been extremely useful in reconstructing recent changes in water quality.

It would cost about $12,000 to do the work, which means the City would need to come up with about $3,600 for cost-sharing. I could do the coring this summer and incorporate the results into the existing diagnostic study.

Could you or Bob check with the City to see if they'd be interested in a project addition of this nature. I'd be glad to provide a short pre-proposal if they need more information to make a decision. However, before I go to that trouble, I'd like to know if they are receptive to this idea. Meanwhile, I'll check with Doug Redburn to see if the State would process the proposal.

The time-frame for the proposal is extremely tight. I probably have to have the application to the State by mid-January. Consequently, I'd need an indication from the City fairly quickly. Thanks for your help.

Sincerely,

Joe

Joseph M. Ellers

/jc

FAX TRANSMITTAL | # of pages 1

To: Bob Harris	From: Peter
Co. City of Wasilla	Co. Gilfillan Engineering, Inc.
Dept.	Phone #
Fax # 373-0788	Fax #

PALEOLIMNOLOGY
(the study of lake history)

Q. Why do we want to know the past history of the lake?

A. The key to understanding the future of the lake is to understand how it has behaved in the past. Studying the lake sediments tells us how the lake processes operated before any alterations by man.

Q. Why would we want to know the history of the lake? Is this just an "academic" exercise?

A. No, it is not just another research project. The results from paleolimnology are extremely useful from a management standpoint because they tell us how far the lake has deviated (if at all) from natural conditions and what land use activities have contributed to a water quality decline. The results also tell us about rates of change so that management has an idea how fast it needs to respond.

Q. How is the work done?

A. A sediment core (usually less than 3 feet long) is collected from the lake bottom. A lead isotope is used to determine the age of the sediments. Diatom remains (algae "shells") are identified and counted. The algae tell us about past water quality. Other measurements of the sediment can also be made including nutrients, plant pigments, and pollen.

Q. What do we learn from paleolimnology that we don't learn from current watershed/lake studies?

A. The traditional diagnostic and feasibility studies tell us a lot about the current conditions in the lake. However, they tell us little about how the lake has changed, the type of the change, or the rate of change. Paleolimnology is the only highly accurate method of quantitatively telling us about the lake history beyond the period where data may have been collected. Paleolimnology compliments current water quality studies by removing uncertainty regarding past events and providing data for making more accurate future predictions.

E&S
Environmental
Chemistry, Inc.

Post Office Box 609
1325 N.W. 9th Street
Corvallis, Oregon 97339
503·758·5777
Fax: 758·7319

January 14, 1992

Mr. Doug Redburn
Department of Environmental Conservation
410 Willoughby Street, Suite 105
Juneau, AK 99801-1795

Dear Doug:

Enclosed are two copies of a proposal entitled, "Paleolimnological Reconstruction of Water Quality Changes in Lake Lucille, Wasilla, Alaska." The proposal is being submitted to you in hopes that your department will forward the proposal to:

Ms. Judith Leckrone
Clean Lakes Coordinator
Environmental Protection Agency
1200 6th Avenue
Seattle, WA 98101

The grant request from EPA is $10,500, with $4,500 in cost share provided by the City of Wasilla and E&S. The proposals are due to Ms. Leckrone no later than February 1. I'm sorry that I could not have provided you with more time to process the supplemental grant request, but EPA didn't give official notification on the Clean Lakes Program funding until mid-December. Also, I had to hold off sending the proposal to you until the City of Wasilla acted on the request for cost share (which occurred last night).

I appreciate your efforts in submitting this proposal to EPA. I believe that the paleolimnological work will dramatically improve our understanding of Lake Lucille and help us in developing a rational restoration program.

Sincerely,

Joseph M. Eilers

/jc

cc: Mr. Bob Harris, City of Wasilla
Mr. Peter Curtis, Gilfilian Engineering

PALEOLIMNOLOGICAL RECONSTRUCTION OF WATER QUALITY CHANGES IN LAKE LUCILLE, WASILLA, ALASKA

A PHASE I CLEAN LAKES *SUPPLEMENTAL* GRANT APPLICATION

A Proposal Prepared by

E&S Environmental Chemistry, Inc.
and
Gilfilian Engineering, Inc.,

for the City of Wasilla, AK

and submitted to the

Alaska Department of Environmental Conservation

for submission to

U.S. Environmental Protection Agency
Region 10, Clean Lakes Program

January 13, 1992

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PROPOSAL SYNOPSIS

Title: Paleolimnological Reconstruction of Water Quality in Lake Lucille, AK

Type: Phase I, supplemental grant request to augment the existing diagnostic and feasibility study

Problem: Lake Lucille is experiencing several symptoms of eutrophication, including severe dissolved oxygen depletion and extensive macrophyte growth. There are competing hypotheses to explain the current status of the lake: (1) increased nutrient loading and (2) hydrologic manipulation of lake stage and groundwater inputs. There is a great need to reduce the uncertainty in the cause(s) associated with the current problems in the lake by developing a better understanding recent lake history.

Approach: A sediment core will be collected from Lake Lucille and analyzed for sedimentation rate (using lead-210 dating), nutrients (N & P), and diatom species. The changes in diatom communities and sediment nutrient concentrations will be used to infer changes in water quality in the lake during the last century. The inferred changes in lake chemistry will be compared with known changes in the watershed to determine what effect(s) land use has had on lake water quality. The results of the study will be incorporated into the final report of the on-going diagnostic and feasibility study.

Cost:		
	Total cost	$15,000
	Cost Share	$ 4,500 (30%)
	Requested Funds	$10,500 (70%)

I. INTRODUCTION

Lake Lucille is a highly productive lake in the City of Wasilla, Alaska. The lake is presently under investigation as part of EPA's Clean Lakes Program. The current diagnostic and feasibility study was initiated in June 1991 and is scheduled for completion in May 1993. Standard water quality monitoring and watershed characterization activities are being conducted that will provide a thorough evaluation of existing water quality problems in the lake. The monitoring data will provide a basis for developing model estimates of nutrient loading and major nutrient sources for analysis of feasible restoration programs.

However, the standard monitoring activities tell us little regarding the past water quality in the lake, when the water quality changed, or the rate of change. The current Clean Lakes Program project on Lake Lucille is operating under the *assumption* that the perceived deterioration of water quality was associated with gradual shoreline development, which is believed to have increased the nutrient loading to the lake. An alternate hypothesis is that the increase in macrophyte growth is associated, in part, with an increase in lake level caused by installation of a weir on the outlet. These competing hypotheses to explain an increase in lake macrophyte growth have radically different solutions to address the problem. Therefore, it is critical that we have an assessment of the recent changes in lake history.

In the absence of direct measures of historical water quality, the most accurate method of reconstructing lake history is through examination of lake sediments. Lake sediments provide a record of changes in lake productivity, nutrient content, watershed vegetation, and its acid-base chemistry. Through selective analyses of the sediments, we can determine the rate of sedimentation, the age of the sediments, and the historical water quality inferred from sediment chemistry and diatom fossil remains.

II. METHODS

A 90-cm core will be collected from the deepest portion of Lake Lucille (Figure 1). The core will be collected using a 5 or 10-cm diameter piston corer. The sediment core will be transported to shore where it will be extruded into 1 cm sections for the first 25 cm and into 2 cm sections thereafter. Sediment samples will be placed in Whirl-pac® bags and refrigerated until transport and analysis at the various laboratories.

Selected sediment samples will be analyzed for the following (the methods references are shown in parentheses):

- wet weight
- percent water/percent dry sediment
- sediment accumulation rate (Appleby and Oldfield 1978; Binford 1990)
- loss on ignition (@ 550° C)
- lead-210 activity (Eakins and Morrison 1978)
- total Kjeldahl Nitrogen (Nelson and Summers 1972)
- total phosphorus (APHA 1975)
- diatom species composition (Whiting et al. 1989)

Based on previous experience with these types of reconstructions, about 12 to 16 sediment sections will be selected from each core for analysis. The remaining samples will be retained in the event that additional examination of the sediments is desired. Duplicate analyses will be run on selected subsamples to evaluate precision of the measurements. Diatom species identification will be verified by checking specimens with the diatom reference collection available at the Academy of Natural Sciences, Philadelphia.

III. DATA ANALYSIS

Data will be entered into computer files and plotted to reveal temporal patterns. Examples of the types of analyses expected from this project are presented from E&S projects currently being

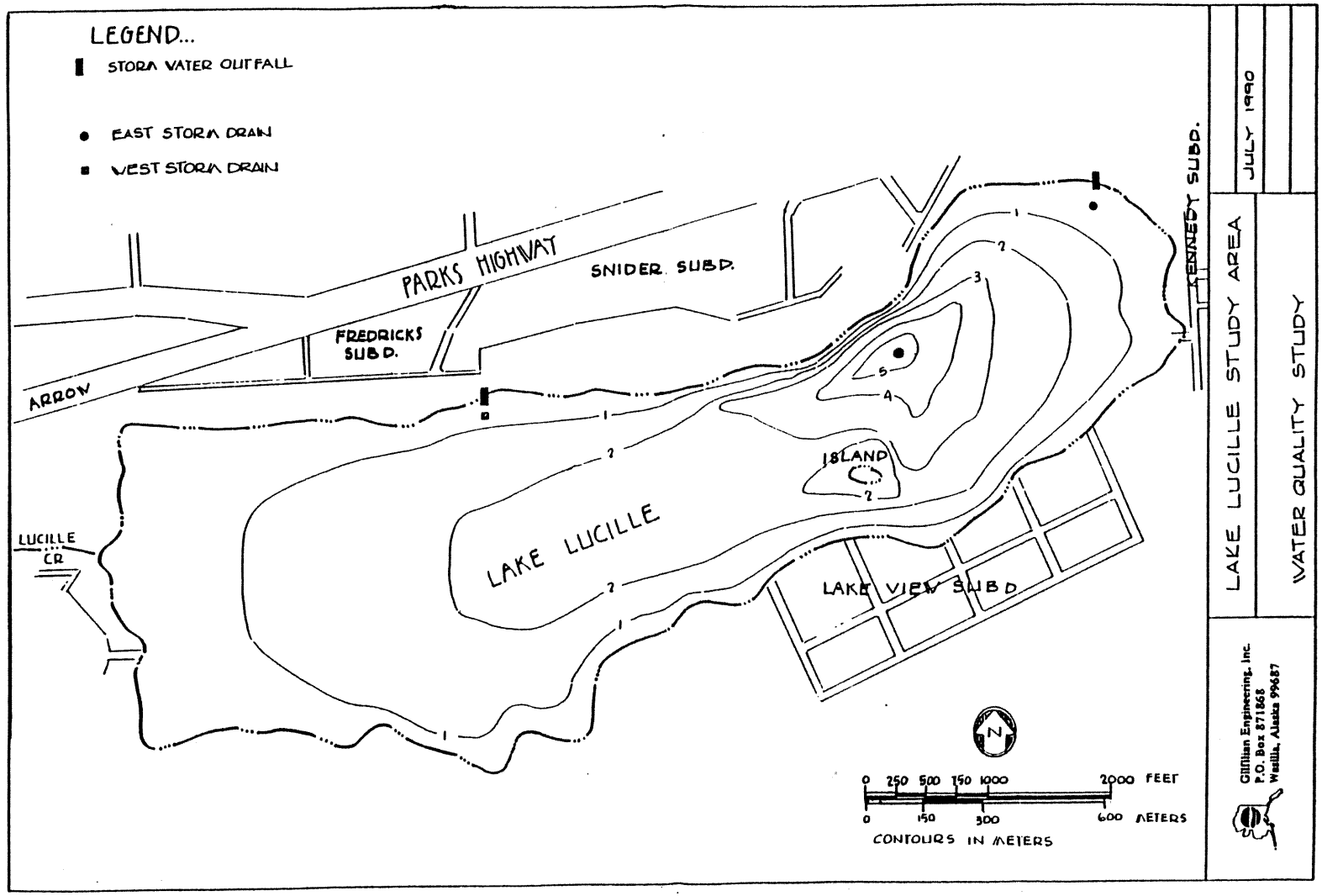

Figure 1. Bathymetric map of Lake Lucille, Wasilla, AK. Source: Gilfilian Engineering, Inc.

conducted on lakes in Wisconsin and Oregon. Pickerel Lake in Wisconsin is a productive, macrophyte-dominated lakes similar in many respects to Lake Lucille. The sedimentation rate and sediment characteristics in Pickerel Lake are expected to be similar to those in Lake Lucille (Figure 2). In contrast, Lake Notasha is an ultra-oligotrophic lake in Oregon that shows an extremely low sedimentation rate (0.06 mm/yr compared to 4.4 mm/yr in Pickerel Lake; Figure 3). Although the sediments and water quality in Lake Notasha are unlike those in Lake Lucille, these examples illustrate the range of water quality reconstructions that can be achieved using paleolimnological techniques.

IV. RELATIONSHIP TO EXISTING PROJECT

The current project design for Lake Lucille is typical of many other Clean Lakes projects in which water quality and watershed analyses are combined to provide a rather complete understanding of the current condition of the lake. Monthly lake and water quality monitoring provide information on temporal variability and nutrient loading to the lake. These data will be used to develop simulation models of the watershed to better understand what mechanisms influence the lake chemistry and biology.

The present design, although adequate according to existing Clean Lake criteria for evaluation of project suitability, does not address the need to better understand how lake shoreline development and hydrologic manipulations have contributed to the current conditions in the lake. By collecting the specified information on sediment history, we not only gain valuable insight into the historical conditions in the lake, but we also resolve questions regarding *why* the lake may have changed (i.e., was it only an increase in nutrient loading or did increasing the lake stage play a role as well?). In addition, the changes in sedimentation rate provide an idea of erosion disturbance in the watershed. Lastly, the data on sediment chemistry assists us in developing a more realistic lake water quality model by providing information on model parameters that, in the absence of the paleolimnological data, would have to be estimated.

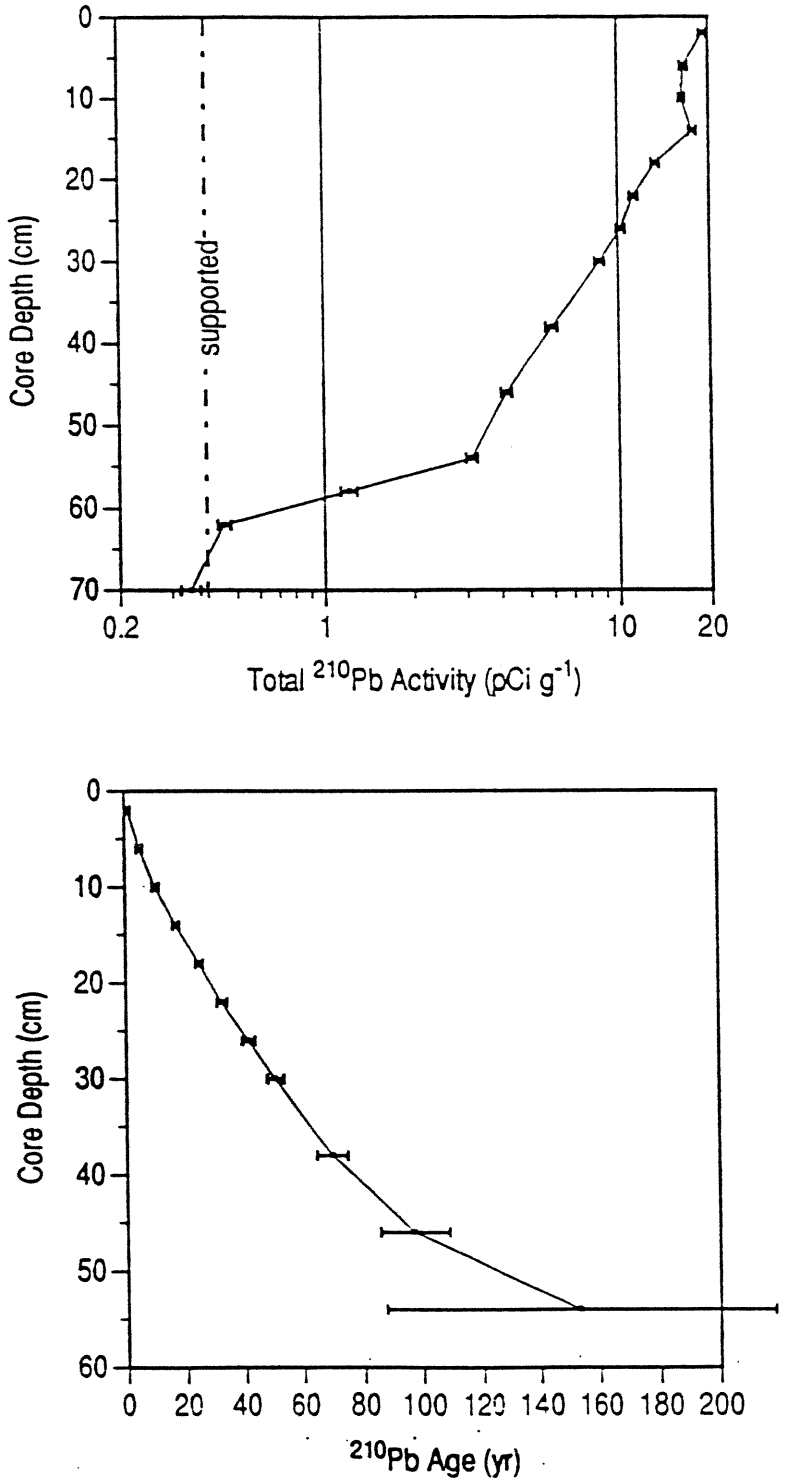

Figure 2. Core depth vs ^{210}Pb activity (top) for Pickerel Lake, WI; shown on the bottom is core depth vs estimated age of the sediments.

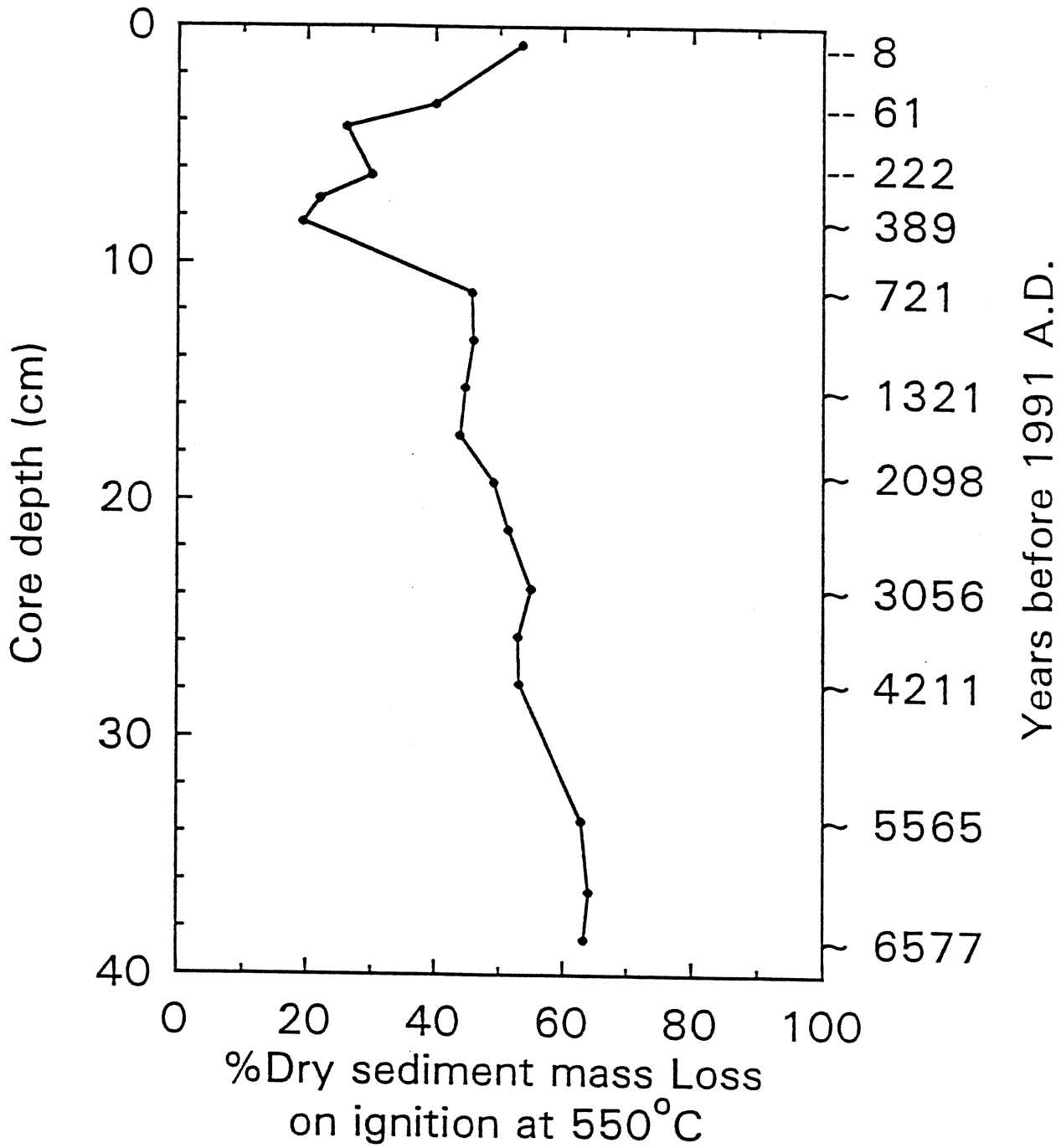

Figure 3. Core depth vs age of sediments and loss on ignition for Lake Notasha, OR.

V. SCHEDULE

The schedule for the proposed supplemental work coincides well with the existing project. The existing project period runs from June 1991 to May 1993. The proposed supplemental work would commence in June 1992 and also would be completed in May 1993. All of the information collected in the supplemental project would be incorporated into the final diagnostic and feasibility project report in May 1993. A proposed schedule is shown in Table 1.

Table 1. Schedule of major activities for the Lake Lucille Paleolimnological Project.

June 1.	Notification of Award
July 15.	Collect Sediment Core
September 1.	Quarterly Report
November 1.	Complete ^{210}Pb dating
December 1.	Quarterly Report
December 15.	Complete Sediment analysis on N & P
March 30	Complete diatom analyses
April 1.	Quarterly Report
May 30.	Final Report

VI. BUDGET

The total cost of the supplemental paleolimnology project is $15,000. The City of Wasilla will provide $3,600 cost share and E&S will waive its fee of $900, leaving a grant request to EPA of $10,500. The proposed project costs have been allocated as shown in Table 2.

VII. PUBLIC PARTICIPATION

The Lake Lucille diagnostic and feasibility study has a substantial public participation component, including collection of data by lakeshore residents, a mid-project meeting with local residents to review progress on the study, and development of oral histories on the lake by long-time residents. We will build on this active participation by encouraging lakeshore owners to assist in collection of the sediment core. The City of Wasilla will be kept informed regarding progress on the sediment analyses and the relevance of the findings to the report.

VIII. PERSONNEL

The proposed staff for the supplemental study is the same as that for the primary project, with the addition of two scientists for the paleolimnological analyses. The principal investigator for the proposed supplemental project is Joseph Eilers. Mr. Eilers is the current principal investigator for paleolimnological studies on Pickerel and Crane Lakes, WI (due to be completed in February 1992) and Lake Notasha, OR (due to be completed in June 1992). Mr. Eilers will supervise collection of the core, distribution of the sediment samples for analyses, review of the quality assurance data, and interpretation of the data and incorporation into the overall study. He will be assisted in the field by Mr. Joseph Bernert who also collected the Lake Notasha sediment core and Mr. Bill Queitszch who is responsible for collection of field data on the diagnostic and feasibility study.

Table 2. Budget for Supplemental Clean Lakes Grant Request, Lake Lucille, AK.

Labor	
E&S	
J. Eilers (70 hrs @ $57/hr)	$ 3,990
J. Bernert (40 hrs @ $37/hr)	1,600
Gilfilian Engineering (20 hrs @ $50/hr)	1,000
	6,590
Sediment Analyses	
^{210}Pb dating, wet/dry weight	1,600
TKN, TP (12 sections @ $100/section)	1,200
Diatom analyses (12 sections @ $250/section)	3,000
	5,800
Coring equipment (1 m, acrylic, 5 cm or 10 cm corer w/push rods)	1,200
Shipping and supplies	410
Travel	1,000
TOTAL PROJECT COST	$15,000
Cost Share (30%)	
City of Wasilla	3,600
E&S profit waived (6% of $15,000)	900
	4,500
GRANT REQUEST (70%)	$10,500

The lead-210 dating and chemical analyses on the sediments will be supervised by Dr. Daniel Engstrom, University of Minnesota. Dr. Engstrom directs a number of paleolimnological studies throughout North America and has published his results extensively.

Diatom identification will be conducted by Dr. Mark Whiting, University of Maine. Dr. Whiting has participated in a number of paleolimnological studies throughout North America, including studies in the Sierra Nevada, New England, and Oregon. Dr. Whiting will have access to the diatom reference collection at the Philadelphia Academy of Sciences.

Resumes for the principals involved in the study are provided in Appendix A.

IX. LITERATURE CITED

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