



**COUNTY OF LAKE**  
**PUBLIC WORKS DEPARTMENT**  
Courthouse - 255 N. Forbes Street  
Lakeport, California 95453  
Telephone 707/263-2341  
Fax 707/263/7748

**G. R. Shaul**  
Public Works Director

236-A

May 1, 2001

Joe Karkoski  
303(d) List Update Coordinator  
California Regional Water Quality Control Board  
Central Valley Region  
3443 Routier Road, Suite A  
Sacramento, CA 95827 - 3003

**SUBJECT:** Public Solicitation of Water Quality Information

Dear Mr. Karkoski,

Enclosed is a list of pertinent information as per your request for water quality information for Lake County after July 1997.

There is a lot of information that is being collected by other agencies, tribal environmental groups and local CRMP groups. One of the current activities of the Lake County Coordinated Resource Management Committee (RMC) is to compile this information into a centralized GIS data base for water quality activities within Lake County. This is a huge task and will take considerable time and effort.

If you may have any questions I may be reached at (707) 263-2341.

Sincerely,

A handwritten signature of Alex Straessle in black ink.

**Alex Straessle**  
Water Resources Specialist  
alex\_s@co.lake.ca.us

01 MAY -4, PM 12:49  
RECEIVED  
SACRAMENTO  
CVR WQCB

## LIST OF WATER QUALITY RELATED INFORMATION LAKE COUNTY, CA

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X **Name:** Clear Lake Sampling Data

**Description:** Clear Lake water quality parameter and lakebed sediment sampling performed ten times per year by DWR.

**Data:** Physical Water Quality Parameters collected by DWR  
Mineral Data collected by DWR  
Minor Element Data collected by DWR  
Nutrient Data collected by DWR  
Lakebed sediment data (samples collected by DWR, analysis by UC Davis, Hopland Research Station (units are ugP/gr. of sediment)  
Sediment depth in sample (cm) | NH<sub>4</sub>Cl | NaOH | HCl | "Residual" P | Total P | % H<sub>2</sub>O |

**Location:** Clear Lake Sampling site's CL1, CL3, CL4

**Dates:** Ongoing samples taken monthly, partial records begin in 1969.

**Contact 1:** Scott McReynolds  
California Dept. of Water Resources- Red Bluff Office

**Contact 2:** Alex Straessle, Water Resources Specialist  
Lake County Dept. of Public Works- Water Resources Division  
255 North Forbes Street  
Lakeport, CA 95453  
(707) 263-2341

**Comments:** The lakebed sediments collected by DWR have been analyzed by UC Davis, Hopland since 1991. Analysis results are maintained by Lake County Public Works within Microsoft Access.

The entire lakebed sediment data maintained by the County of Lake is included up to the date of last input into the database.

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X **Name:** Creek Water Quality Samples

**Description:** Stream water quality sampling performed by the County of Lake on a flow event basis, sampling locations are correlated with stream gauges.

**Data:** Temperature ( C ) | pH | Stage | Total Dissolved Solids (mg/l) | Total Suspended Solids (mg/l) | Total Solids (mg/l) | PO<sub>4</sub> (mg/l) | Total P (mg/l)

**Location:** Middle Creek, Scotts Creek, Kelsey Creek are currently monitored on a storm event basis. Other retired stream sampling stations are also included (these streams are not correlated with stream gauges)

**Dates:** Stream sampling started in January of 1992 and is continually being performed on a storm event basis.

**Contact:** Alex Straessle, Water Resources Specialist  
Lake County Dept of Public Works- Water Resources Division  
255 North Forbes Street  
Lakeport, CA 95453  
(707) 263-2341

**Comments:** The analysis for total phosphorous is performed by UC Davis at Hopland. All other data is collected by the County of Lake. Analysis results are maintained by Lake County Public Works within Microsoft Access.

The entire water quality database maintained by the County of Lake is included up to the date of last input into the database.

---

X **Name:** Mercury TMDL

**Description:** Clear Lake TMDL for Mercury Numeric Target Report- Preliminary Draft

**Location:** Clear Lake, Lake County, CA

**Dates:** August 2000

**Source:** US EPA, Regional Water Quality Control Board- Central Valley Region

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X **Name:** Clear Lake Basin Watershed Analysis (205j)

**Description:** The objective of this project has been to assess erosion sources and develop management recommendations. Other pertinent products are the establishment of a GIS data base to assist in identifying land uses and sites of high erosion potential, a Quality Assurance Project Plan (QAPP) for sediment and water quality testing, selection of demonstration sites to educate the public and encourage better land management practices and expanding public outreach through workshops and public information materials.

**Data:** Phosphorous loading, total Phosphate and Orthophosphate and suspended solids in tons per year. Raw data is from the creek water quality samples mentioned previously.

**Location:** Clear Lake Basin

**Dates:** Dates covered in this report for water quality information are 1982 through 1998.

**Contact:** Alex Straessle, Water Resources Specialist  
Lake County Dept of Public Works- Water Resources Division  
255 North Forbes Street  
Lakeport, CA 95453  
(707) 263-2341

**Comments:** Report submitted to Joanne Cox, Contract Manager- State Water Resources Control Board on March 24, 1999

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X **Name:** Scotts Creek Watershed Project (319h)

**Description:** The goal of the Scotts Creek Watershed project was to demonstrate that a cooperative erosion control program can help mitigate water quality impacts to Clear Lake. This goal has been met through the completion of each of the project's objectives.

1. Enhancing public understanding of the causes and solutions for erosion of sediments into Clear Lake: This objective has been met through numerous public workshops, extensive information outreach, BMP pamphlets, a video on erosion in the Clear Lake Basin, participation of local schools in the nursery project, and several erosion control demonstration projects.
2. Working with local land owners to develop erosion control demonstration projects: This objective has been met through the inclusion of affected land owners on the technical advisory committee, the BLM stream-crossing project, the Scotts Creek stream bank rehabilitation projects, the vegetated levees, floodplain farming, and Tule Lake Basin demonstration projects.
3. Development of a watershed inventory for watershed-scale analysis of erosion in the Scotts Creek Basin: This objective has been met through the completion of the watershed inventory and erosion modeling program.
4. Demonstrate a watershed-wide management approach for Scotts Creek leading to integrated management of the Clear Lake Basin: The objective has been met through the completion of the upper watershed erosion management plan, the carrying-out of demonstration projects throughout the watershed, and the Scotts Creek long term recovery plan.
5. Monitoring the water quality of Scotts Creek and the effectiveness of erosion control work: This objective has been met through the completion of the Scotts Creek and Clear Lake water monitoring programs, and by the photopoint monitoring and physical monitoring of pre and post project sites.
6. Production of a final report documenting all aspects of the project: This objective has been met through the submittal of the final report.

**Data:** Water quality data results for stream sampling sites:  
Total Solids (ppm) & (Kg/s) | Dissolved Solids (ppm) & (Kg/s) | PO4 (ppm) & (g/s) | Total Phosphorous (ppm) & (g/s) |

**Location:** 15 sampling sites within the Scotts Creek, Kelsey Creek and Middle Creek Watersheds.

**Dates:** Dates of record for the Scotts Creek Watershed Project are 1992 to 1997

**Contact:** Alex Straessle, Water Resources Specialist  
Lake County Dept of Public Works- Water Resources Division  
255 North Forbes Street  
Lakeport, CA 95453  
(707) 263-2341

**Comments:** This report, submitted in fulfillment of SWRCB No. 4-036-255-0 by the Lake County Flood Control and Water Conservation District under the sponsorship of the State Water Resources Control Board, was completed as of June 30, 1997.

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X **Name:** Watershed Analysis Report, Upper Lake Watershed (In cooperation with the Mendocino National Forest)

**Description:** A federal watershed analysis report for the Upper Lake Watershed

**Data:** This report uses the creek water quality sampling results mentioned previously for Middle Creek and correlates this information with flow records dating back to 1962. The resultant water quality data is annual sediment loading (tons/year) in Middle Creek at the Rancheria Road.

**Location:** Middle Creek at Rancheria Road

**Dates:** 1992 through 1997

**Contact 1:** *For requested copies of the report*  
Vickie Stoll  
Mendocino National Forest  
825 N. Humboldt Ave.  
Willows, CA 95988  
(530) 934-7724

**Contact 2:** Alex Straessle, Water Resources Specialist  
Lake County Dept of Public Works- Water Resources Division  
255 North Forbes Street  
Lakeport, CA 95453  
(707) 263-2341

**Comments:** For copies of the report contact the Mendocino National Forest.  
Two copies of the cover page, table of contents and pertinent water quality information is enclosed for your information.

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I have also included some preliminary GIS data that I have been working on. This GIS data is locational information on stream and weather gauges and water quality sampling sites. Its in a rough stage and still needs work (use with caution). See the attached metadata.

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United States  
Department of  
Agriculture

Forest Service

Pacific  
Southwest  
Region

Mendocino  
National  
Forest



State of  
California

County of  
Lake

Water  
Resources  
Division

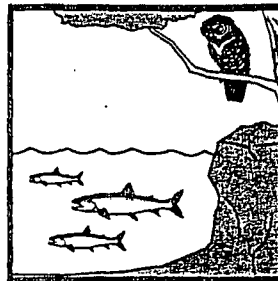
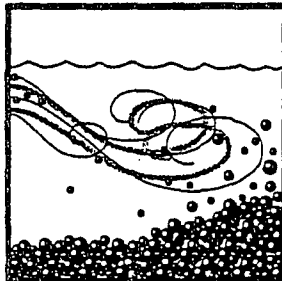
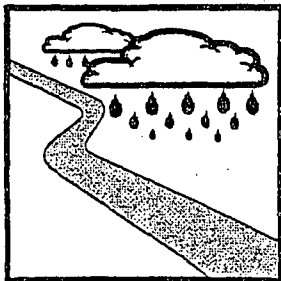
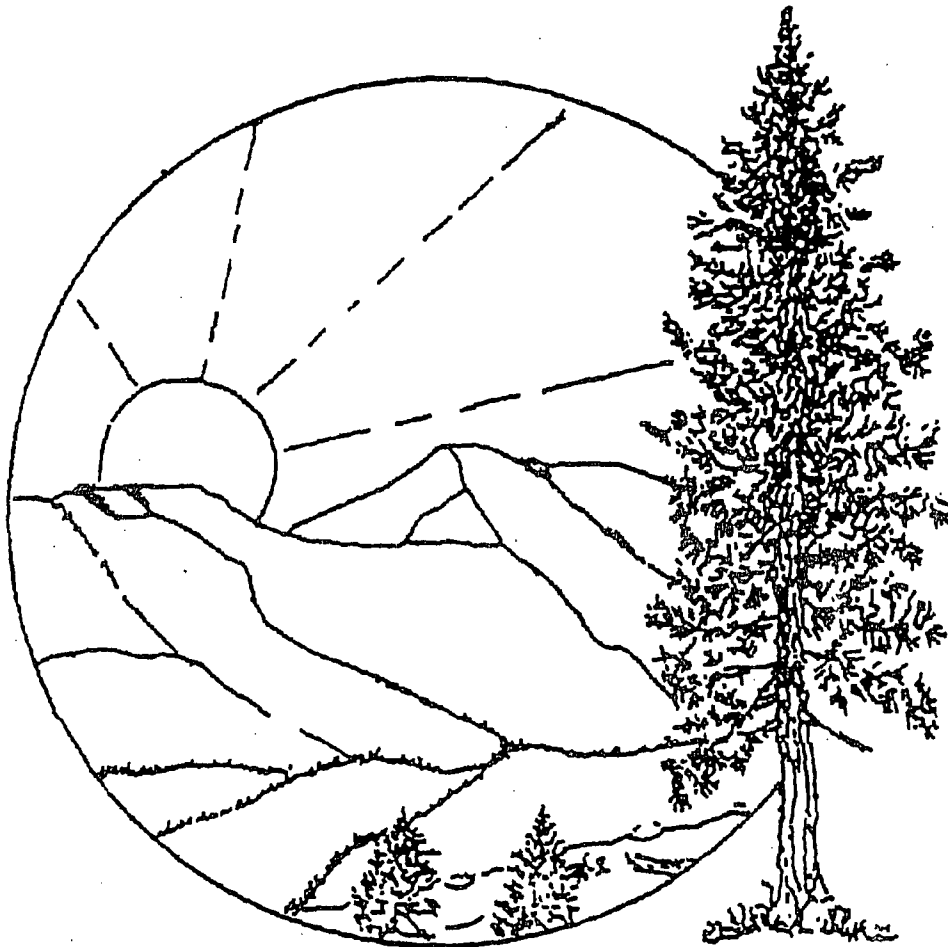


September 1999

# Watershed Analysis Report

## Upper Lake Watershed

R367



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## 5.0 Water Quality in Clear Lake

### 5.1 Issue Statement

The quality of water in Clear Lake, especially the frequent algal blooms in the lake, is a major concern for surrounding communities that depend upon lake water for domestic needs. It also has a negative economic impact on the entire county of Lake, because of its impact on recreation, tourism, and the amenities which draw people to live in the vicinity of Clear Lake. Studies have pointed to increased sedimentation, and the consequent increased phosphorous levels in the lake, as a primary cause for this declining water quality. The Upper Lake watershed is a major source of sedimentation in the lake.

### 5.2 Current Conditions

#### Algal Blooms in Clear Lake

A recent study has determined that the formation of blooms of noxious scum-forming blue-green algae on the surface of Clear Lake is primarily due to high phosphorus levels. The study further found that the main source of this phosphorus is sediments from tributary streams, especially Middle Creek, Scotts Creek, and Kelsey Creek. Together, these three streams account for one third to one half of the total phosphorous input to the lake. According to this study, the risks posed to public health as a result of blue-green algae are negligible. However, algal blooms are a public nuisance with negative impacts on aesthetics. These blooms can make swimming in the lake unpleasant, and when the algae dies, the decaying mats create an odor that can drive people from their homes. Understandably, this has negative economic impacts on tourism and home sales. The USDA Soil Conservation Service estimated that the economic impact of lost tourism revenue alone due to algal blooms in Clear Lake was about \$7,000,000 per year in the early 1990s. (Richerson, et al. 1994.)

#### The Extent to which the Upper Lake Watershed Contributes to Phosphorous in Clear Lake

Figure 5-1 is a chart showing sediment transported down Middle Creek in short (2,000 lb.) tons per year for the years 1967 through 1998. Average sediment load was 13,765 short tons (12,389 metric tons) per year. Measured phosphorous averaged about 3 pounds per ton of sediment, or approximately 19 metric tons per year over this period. As can be observed from the chart, sediment transport (and therefore phosphorous input, which is proportional) varies greatly from year to year.

The gage at Middle Creek does not measure the contribution of Clover or Gilbert Creeks to the total phosphorous input from the Upper Lake watershed into Clear Lake. The Lake County Water Resources Engineer estimates that the Upper Lake watershed as a whole contributes an average of approximately 40 short tons (36 metric tons) of phosphorous per year to Clear Lake, and that this constitutes approximately 25 percent of the total phosphorous load reaching the lake from all of the surrounding watersheds (T. Smyth, pers. comm.)

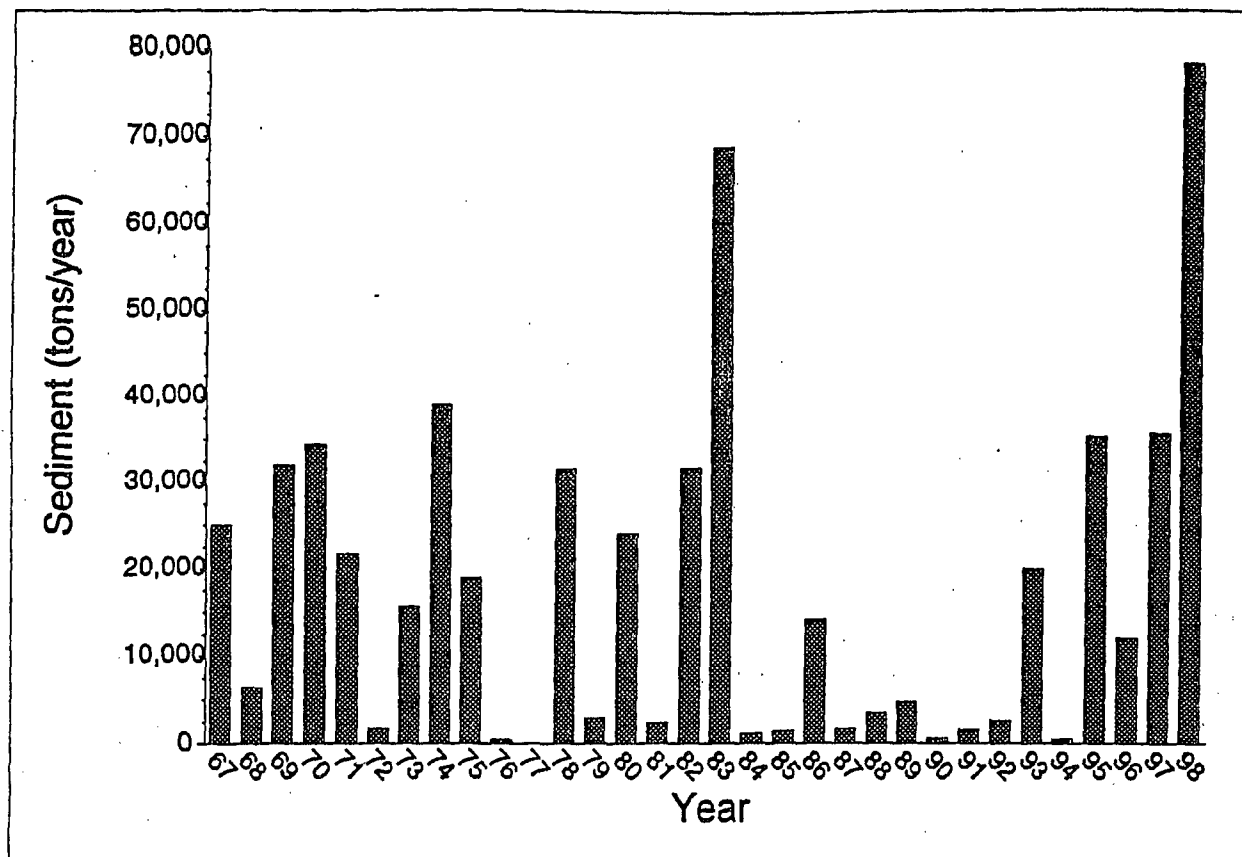


Figure 5-1. Annual sediment load in Middle Creek at the Rancheria Road

#### Factors Contributing to Erosion and Sedimentation from the Upper Lake Watershed

Because algal blooms in Clear Lake are, according to expert opinion, being caused by high phosphorous levels from sedimentation into the lake, the major thrust of this chapter will be aimed at identifying, and wherever possible quantifying, the factors that currently contribute to sedimentation into Clear Lake from the Upper Lake Watershed. The source of sedimentation is, by definition, soil erosion. Therefore, sources of erosion will be identified together with the factors that determine how much of this sedimentation reaches Clear Lake.

#### Precipitation and Soils

Erosion rates are greatly increased by heavy rains, and transport of sediment is greatly increased by high water flows. See Chapter 4.2 for a discussion of water flows in Middle Creek. The nature of the bedrock geology and soils in the watershed has not changed since before the reference period began. To avoid redundancy, the basic erosion and sedimentation potential for the watershed is discussed later in this chapter under reference conditions.



PA

State Water  
Resources  
Control Board

Mailing Address:

Box 100  
Sacramento, CA  
95812-0100

P Street  
Sacramento, CA  
95814  
(916) 657-1033  
(916) 654-8375

OCT 22 1997

Mr. Kurt Stauffacher  
County of Lake  
Public Works Department  
255 N. Forbes Street  
Lakeport, CA 95453

OCT 27 1997  
PUBLIC WORKS DEPT

R 36-2

Dear Mr. Stauffacher:

APPROVAL OF THE QUALITY ASSURANCE (QA) PLAN FOR THE CLEAR  
LAKE BASIN WATERSHED ASSESSMENT 205(j) PROJECT

The QA Plan for the subject project has been approved. I  
have signed the signature page (enclosed) and I am returning  
it to you for the remainder of the signatures. Please have  
this page completed and returned to me for our official  
records. Sampling may proceed.

If you have any questions, please telephone me at  
(916) 657-1033.

Sincerely,

Janet M. Blake, Project Officer  
Water Quality Planning Unit

Enclosure

cc: Carolee Western, DWQ



Pete Wilson  
Governor



**COUNTY OF LAKE**  
**PUBLIC WORKS DEPARTMENT**  
Courthouse - 255 N. Forbes Street  
Lakeport, California 95453  
Telephone 707/263-2341  
Fax 707/263/7748

**G. R. Shaul**  
Public Works Director

November 5, 1997

Janet M. Blake  
State Water Resources Control Board  
Water Quality Planning Unit  
P.O. Box 100  
Sacramento, CA 95812-0100

Dear Ms. Blake,

I have enclosed the signature page with the required signatures for the Quality Assurance Plan for the Clear Lake Basin Watershed Assessment 205(j) Project. I am returning this signature page to you for your official records.

If you have any questions, please telephone me at (707) 263-2731.

Thank You.

Sincerely,

A handwritten signature in black ink, appearing to read "Kurt Stauffacher", is written over a horizontal line.

Kurt Stauffacher  
Water Resources Specialist

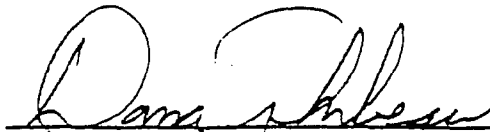
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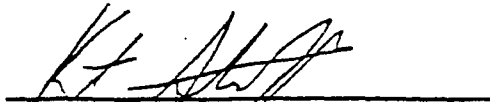
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**QUALITY ASSURANCE PROJECT PLAN  
(CATEGORY III)  
CLEAR LAKE BASIN WATERSHED ASSESSMENT**

**County of Lake  
Public Works Department  
Flood & Lake Management Programs Division**




Prepared by: Dana Thibeau  
Water Resources Technician



Reviewed by: Kurt Stauffacher  
Water Resources Specialist



Submitted by: Sue Arterburn  
Project Director



Approved by: Janet M. Blake  
SWRCB Project Manager (CWA S.205j grant)

Approved by: John Warren  
EPA Quality Assurance Manager

R36-8

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CLEAR LAKE BASIN WATERSHED ASSESSMENT  
QUALITY ASSURANCE PROJECT PLAN

*DISTRIBUTION LIST*

John Warren	EPA
Janet Blake	State Water Resources Control Board
Sue Arterburn	Lake County DPW, Flood & Lake Mgt. Programs
Steve Why	Lake County DPW, Flood & Lake Mgt. Programs
Dana Thibeau	Lake County DPW, Flood & Lake Mgt. Programs
Kurt Stauffacher	Lake County DPW, Flood & Lake Mgt. Programs
Chuck Vaughn	Univ. of Calif. Davis
Peter Richerson	Univ. of Calif. Davis



CLEAR LAKE BASIN WATERSHED ASSESSMENT  
QUALITY ASSURANCE PROJECT PLAN

## PROJECT MANAGEMENT

### ORGANIZATION

#### Project Director

Sue Arterburn, Flood Control Director  
Manager, Flood & Lake Management Programs Division  
County of Lake Department of Public Works  
255 N. Forbes Street, Lakeport, Calif. 95453  
(707)263-2341

---

#### Administrative Representative

Steve Zalusky, Environmental Officer  
Planning Division, Community Development Department  
County of Lake  
(707)263-2221

#### Q. A. Manager (To February 28, 1997)

Steve Why, Water Resources Program Manager  
Flood & Lake Management Programs Division  
(707)263-2341

#### Specialists

Kurt Stauffacher, Water Resources Specialist  
Flood & Lake Management Programs Division  
(707)262-0437

Chuck Vaughn, Chemist  
University of California  
Hopland Research and Extension Center  
4070 University Road  
Hopland, California 95449  
(707)744-1040

#### Consultant

Dr. Peter Richerson  
Division of Environmental Studies  
University of California, Davis  
Davis Calif. 95616  
(916)752-2781

#### Field Technician

Dana Thibeau, Water Resources Technician  
Flood & Lake Management Programs Division  
(707)263-2341

# CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

## **PROBLEM DEFINITION**

Algal blooms in Clear Lake are of concern. The odor and other aesthetic effects of these blooms have a negative impact on tourism, boating, swimming, recreation, and the local economy and quality of life in general. In response to the local community's concern for finding a remedy for the nuisance caused by these blooms, the County of Lake with the University of California, Davis undertook a study completed in 1994. The report, *Causes and Control of Algal Blooms in Clear Lake*, suggests that the single most important method of reducing algal blooms in Clear Lake is the reduction of non-point source sediment loading from the watershed into Clear Lake. The report recommends that this heavy sediment load carried by tributary streams can be reduced significantly by erosion management practices (Best Management Practices, BMPs) that keep sediment out of the lake. The report further recommends that a key element in achieving successful BMPs is monitoring (the regular measuring of key stream and lake water parameters). Measurement of these parameters is needed for several reasons: 1) Analysis of this data is a potential indicator of primary sources of erosion. 2) This data will serve as the basis for choosing BMPs best suited for an identified erosion source. 3) A baseline needs to be established against which to assess the effectiveness of erosion control remedies once they are implemented.

## **PROJECT DESCRIPTION**

**Goal:** Consistent with the above recommendation, a fundamental goal of this study will be the identification and quantification of the sources of sediment loading in general and phosphorous loading in particular. This is accomplished by the regular systematic sampling and analysis of creek water, lake water, lake sediment, and other field measurement parameters. This acquired data will serve as a basis for identifying non-point sediment sources, for choosing the most effective BMPs and for assessing and monitoring their effectiveness.

**Choosing parameters of interest and sample sites:** The creek parameters will be chosen based on the objective of quantifying sediment and phosphorous loading and stream characteristics which may effect this loading. The creek sample sites will be chosen to provide a linear profile of the creek and to potentially detect the impact of various stream characteristics and remedial actions on these parameters. Hence, sample sites will be chosen at such locations as above and below tributary confluences, above and below nutrient retention sections such as Tule Lake, in the vicinity of remedial actions such as the Scotts Creek Riparian Vegetation Rehabilitation Project site, etc.

The Clear Lake parameters will be chosen based upon the two main objectives of quantifying phosphorous loading into Clear Lake and assessing the cycling of phosphorous between the water column and the sediments. Since Clear Lake has a unique shape with three distinct geographical sections or parts, sample sites will be chosen to measure parameters representative of each section and to identify potential differences in measured parameters between them. Sample times for all Clear Lake

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

parameters will be chosen to be on regular monthly intervals to detect potential correlations between seasonal changes in these parameters and the observed seasonal algal bloom cycle.

### **QUALITY OBJECTIVE**

**Scope:** This QA Plan is specific to the geographical area of Clear Lake and the watersheds of its tributaries.

**Time & Resource Constraints:** The resource constraints are given in attachment A.

**Intended Uses Of Data:** The data will be used to identify erosion sources in the Clear Lake tributary watersheds and to quantify the sediment contributed by these tributaries and to Clear Lake by these sources.

### **Decision Standards and Action Levels**

**Creek Sampling and Field Measurements:** Individual rainstorm events will be identified within the winter rainy season. Rainfall during each event will be monitored. Events in which one inch or more of rainfall is received are considered significant events. The time of peak creek flow will be estimated based on weather forecasts, observed measured rainfall, and monitoring creek water level in Scotts Creek and Kelsey Creek. Creeks will be sampled during significant events as close to peak flow as practicable.

**Lake Sampling and Field Measurements:** Lake water and sediment samples and field measurements will be taken monthly and scheduled as close as possible to the same time each month as weather and lake navigation conditions permit. The maximum number of sediment samples per month (28) is determined by the capacity of the contract analytical laboratory (University of California, Hopland Research and Extension Center, 4070 University Road, Hopland, California 95449).

### **Population Parameters of Interest**

#### **Creek water:**

- Sample Time
- Conductivity
- Temperature
- Instantaneous Discharge
- Orthophosphates
- Total Phosphates
- Dissolved Solids
- Total Solids
- Observed weather conditions are noted

# CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

## Lake Water:

- Sample Time
- Water Depth
- Clarity (Secchi Disk)
- Dissolved Oxygen (Column Profile)
- Conductivity
- pH
- Orthophosphates
- Total Phosphates
- Observed weather conditions are noted

## Lake Sediment:

- Total Phosphates —
- Fe/Al Phosphate Fraction
- Ca Phosphate Fraction
- Residual Phosphate

## Precision and Accuracy

**Precision:** The sample standard deviation,  $s$ , is given by

$$s = \sqrt{\frac{n \sum x^2 - (\sum x)^2}{n(n-1)}}$$

where

$n$  = number of analyses

$x$  = individual values of analyses

$s$  = standard deviation of the sample

The analytical precision is expressed in terms of the ratio of the standard deviation to the arithmetic mean:

$$RSD = \left[ \frac{s}{\bar{x}} \right]$$

where

$RSD$  = relative standard deviation

$s$  = standard deviation of the results of replicate analysis

$\bar{x}$  = mean value of the replicate results

A relative standard deviation of 0.10 or less is acceptable; 0.10 to 0.20 is the warning limit, and greater than 0.20 is unacceptable.

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

**Accuracy:** Laboratory accuracy for Orthophosphates, Total Phosphates and Conductivity is assessed by measuring the recovery of known commercial standard reference materials and is expressed in terms of the percent difference between the measured and the nominal value of the known standard:

$$a = \left( \frac{m - n}{n} \right) \cdot 100$$

Where

a = laboratory accuracy

m = measured value

n = nominal value of the known standard

Accuracy, therefore, is simply a quantification of the difference (bias) between the measured value and the true value.

**Completeness:** The completeness of data quality controls relies on how many samples need to be taken to be able to use the information that is collected. For example, if all of the water and sediment samples are taken at each of the four sampling sites on the lake including duplicates, the completeness factor will have been met for that sampling trip. However, if all the water and sediment samples are taken at only two of the four sampling sites on the lake including duplicates, the percent completeness would be only 50%. Percent completeness is the number of planned measurements judged valid divided by the total number of measurements taken multiplied by 100. If the completeness factor is not met, an explanation of the problems or constraints will be provided with the field sheet provided to the project manager for review.

### **PROJECT NARRATIVE**

**Creeks:** The creek population parameters will be monitored to determine sediment load, phosphorous content, and stream discharge. These parameters will be used to estimate the phosphorous load introduced into Clear Lake by the specific creeks and by the watershed in general. This information will be assessed in terms of the hypothesized phosphorous loading contribution to blue-green algae growth in Clear Lake.

**Clear Lake:** The purpose of monitoring the population parameters of Clear Lake is three-fold:

- Monitor seasonal phosphorous exchange between the sediment and the water column.
- Quantify the sediment depth to which the phosphorous exchange takes place.
- Provide a basis for the investigation of possible correlations between phosphorous exchange and other parameters.

# CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

## ***SPECIAL TRAINING / CERTIFICATION REQUIREMENTS***

**Analytical laboratory personnel (U.C.D. contract laboratory):** Masters degree in a field related to natural resources study. Extensive experience in analytical testing of soils and water.

**Field personnel:** At least two years education related to environmental soil and water analysis. At least one year experience in environmental soil and water sampling and analysis. No certification is required.

## ***DOCUMENTATION & RECORDS***

All field data will be logged into field data sheets (attached) and transferred to Microsoft Excel spreadsheets. Laboratory data is logged directly into and computed by Excel spreadsheets. Fractional phosphate and total phosphate analysis will be subcontracted to an outside laboratory. All related data will be Faxed to our office and entered in Excel spreadsheets and converted to MSoft Access Database.

## **DATA ACQUISITION**

### ***SAMPLING PROCESS DESIGN***

The experimental design is based upon the conclusions and recommendations of *Causes and Control of Algal Blooms in Clear Lake* which suggested that the single most important method of reducing algal blooms in Clear Lake is the reduction of non-point source sediment loading from the basin watersheds into Clear Lake. To better understand and quantify this sediment loading, the report recommends improved stream and in-lake monitoring. The monitoring is focused on sediment content and particularly phosphorous, the key constituent of the sediment most directly associated with the blooms.

Accordingly, Scotts Creek and Middle Creek, the two largest volume contributors to Clear Lake, will be monitored as close as practicable to peak flow at six designated sites during significant rain storm events as given in A6, *choosing parameters of interest and sample sites*. Parameter magnitudes will be evaluated against instantaneous discharge where available to quantify sediment and phosphorous load contributed to Clear Lake by these sources. The selection of sample sites allows for monitoring parameter gradient along the course of the creeks and assess the possible effect of sediment retention segments.

The magnitude of Clear Lake sediment and water parameters will be measured monthly and assessed as a function of time to quantify the sediment / water column phosphorous cycle, to monitor seasonal cycles of these parameters, and to identify possible relationships among the parameters.

CLEAR LAKE BASIN WATERSHED ASSESSMENT  
QUALITY ASSURANCE PROJECT PLAN

**SAMPLING METHODS REQUIREMENTS**

**Creek Sampling**

**Creek Surface Water Sampling and Field Testing Procedure:** Attachment J shows creek sample site locations. The parameters of sample time, conductivity, temperature, and surface elevation will be recorded in the field data sheet at the time of sampling. Current weather conditions will be noted and recorded. Creek samples will be collected at or near the horizontal flow center approximately one foot below the surface in a one-pint polyethylene wide mouth sample container triple rinsed with native water to achieve a representative sample. The sample is taken from the upstream side of the sampler to minimize sample bias caused by wading disturbance of the stream water. The sample sites will be land marked and remain constant. The sample will be identified by labeling the sample bottle at the time of sampling with the date, time, location and the sample collector. Field data will be entered in a creek field data sheet (attachment B). A record of the collected sample is made in the field data sheet. The stream water surface level will be measured to a designated constant physical reference with a weighted fiberglass open reel tape. Conductivity and temperature will be measured in the sample bottle immediately upon sampling.

**Clear Lake Sampling**

Clear Lake samples will be collected from four predesignated sites (attachment J) which are representative of the three arms of the lake. They remain constant and are fixed by referencing onshore land marks.

**Clear Lake Water Sampling Procedure:**

**Surface-** Surface samples will be collected approximately eight inches below the surface in a one-pint polyethylene wide mouth sample container which is triple rinsed with native water to achieve a representative sample. The sample will be identified by labeling the sample bottle at the time of sampling with the date, time, location and the sample collector. Field data will be entered in a lake field data sheet (attachment C). A record of the collected sample will be made in the field data sheet. Algal conditions will be noted and recorded.

**Bottom-** Bottom samples will be collected approximately 0.7M from the lake bottom after measuring the water depth. Collection will be made with a 2.2L Van Dorne trip-sealing vertical sampling bottle. The collection depth will be determined by length demarcations on the sample bottle retrieval line. The sample will be decanted into a one-pint polypropylene wide mouth sample container triple rinsed with native water to achieve a representative sample. The sample will be identified by labeling the sample bottle at the time of sampling with the date, time, location and the sample collector. Field data will be entered in a lake field data sheet (attachment C). A record of the collected sample will be made in the field data sheet.

**Clear Lake Sediment Sampling Procedure (Dredge):** Dredge samples will be collected with a 216 cu.in. Ekman Bottom Dredge. The analytical sample (approx. 200ml) will be decanted from the dredge with a 250 ml polypropylene beaker into a one gallon sealed plastic bag. The sample will be identified by labeling the sample bag with

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

the date, time, collection site, collection type (Ekman) and sample collector. The sample bags will be sealed, immediately chilled in an ice chest, and kept refrigerated at 5°C until analyzed. Three independent analytical samples from three independent dredge extractions will be collected from each site.

**Clear Lake Sediment Sampling Procedure (Core):** Two core samples will be collected with a Wildco 2 in. diameter by 18 in length core sampler at each sample site and are designated as "Core A" and "Core B". Eight - one centimeter cross sections will be collected from each core. From Core A, cross sections will be collected representing sediment depth of 1,2,3,4,6,8,10 and 12 cm. From Core B, cross sections are collected representing sediment depths of 1, 4, 8, 12, 16, 20, 24, and 28 cm. These cross sections will be collected from the core sample by incrementally extruding the core sample from the core sampler to a measured distance corresponding to the above values. The measured one cm cross section is then shaved directly into a sample bag. The sample will be identified by labeling the sample bag with the date, time, collection site, core, sediment depth and sample collector. The sample bags will be sealed, immediately chilled in an ice chest, and kept refrigerated at 5°C until analyzed.

Ten percent of the samples will be taken in duplicate. Conductivity, which is an unstable parameter, will be measured in the field. Orthophosphates will be measured in the laboratory no later than two days after the sample is taken. Dissolved solids and total solids will be measured within three days of sampling. Total P will be measured within 30 days of sampling. All samples will be packed in ice for transportation immediately after collection and refrigerated at 5°C until analyzed. On occasions when sample analysis takes place after the standard storage period, deviations will be noted in a lab data book and identified in database comments. Sample custody will be tracked by comparison of field and lab data sheets.

### **SAMPLE CUSTODY REQUIREMENTS**

**Creek Water Samples:** All water samples will be handled only by the technician during field sampling. All sample containers will be labeled with the date, time, and sample location. Samples will be returned by the technician via a County vehicle in use to the Lake County Public Works Lab facility at: 420 2<sup>nd</sup> Street, Lakeport, CA 95453 where the samples will be stored in a refrigerator at 5° C until analysis and transport. This laboratory facility is locked and secure. The field data sheet (attachment B) will be filled out by the technician and provided to the project manager for approval of proper sample retrieval and storage.

Within the time ranges specified in the sampling methods of this report, the samples will be transported by a member of the Lake County Flood and Lake Management Division to the University of California Hopland Research and Extension Center, 4070 University Road, Hopland CA 95449. The project manager will approve the release of a County vehicle to transport the samples. Samples will be transported in a cooler packed with ice and hand delivered to the Hopland Research and Extension Center where the samples will be stored and analyzed following procedures outlined in this



## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

report. Sample results will be faxed from the Hopland Research and Extension Center to the Lake County Flood and Lake Management Division. These results must contain information indicating sample collection date, sample analysis date, and the corresponding parameter reading.

**Lake Water and Sediment Samples:** All water and sediment samples will be handled only by the technician during field sampling. All sample containers will be labeled with the date, time, and sample location. Samples will be stored in a cooler packed with ice during sample collection. Samples will be returned by the technician via a County vehicle in use to the Lake County Public Works Lab facility at: 420 2<sup>nd</sup> Street, Lakeport, CA 95453 where the samples will be stored in a refrigerator at 5° C until analysis and transport. This laboratory facility is locked and secure. The field data sheet (attachment C) will be filled out by the technician and provided to the project manager for approval of proper sample retrieval and storage.

Within the time ranges specified in the sampling methods of this report, the samples will be transported by a member of the Lake County Flood and Lake Management Division to the University of California Hopland Research and Extension Center, 4070 University Road, Hopland CA 95449. The project manager will approve the release of a County vehicle to transport the samples. Samples will be transported in a cooler packed with ice and hand delivered to the Hopland Research and Extension Center where the samples will be stored and analyzed following procedures outlined in this report. Sample results will be faxed from the Hopland Research and Extension Center to the Lake County Flood and Lake Management Division. These results must contain information indicating sample collection date, sample analysis date, and the corresponding parameter reading.

### **ANALYTICAL METHODS REQUIREMENTS**

**Total Solids:** A well-mixed sample is evaporated in a weighed dish and dried to constant weight in an oven at 103°C to 105°C. The increase in weight over that of the empty dish represents the total solids.

A 57mm aluminum weigh dish is labeled and heated at 103°C for one hour. The dish is cooled in a desiccator and weighed immediately before use. Approximately 30ml of well mixed sample is added to the preweighed dish and weighed. The dish is placed in a 103°C to 105°C oven and evaporated to constant weight. The dish with residue is allowed to cool to balance temperature in a desiccator then weighed.

$$\text{mg total solids } L = \frac{(A - B) \times 1000}{\text{sample volume, ml}}$$

where

A = weight of dried residue + dish, mg

B = weight of dish, mg

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

### Total Dissolved Solids

A well-mixed sample is filtered through an ashless filter, and the filtrate is evaporated to dryness in a weighed dish and dried to constant weight at 180°C. The increase in dish weight represents the total dissolved solids.

A 57mm aluminum weigh dish is labeled and heated at 103°C for one hour. The dish is cooled in a desiccator and weighed immediately before use. The sample is centrifuged @ 3600 rpm for one minute. The supernate is gravity filtered through a Whatman 42 ashless cone filter. Approximately 30ml of the filtrate is added to the preweighed dish and weighed. The dish is placed in an oven at 180°C ± 2°C and evaporated to constant weight. The dish with residue is allowed to cool to balance temperature in a desiccator then weighed. —

$$mg \text{ total dissolved solids} / L = \frac{(A - B) \times 1000}{\text{sample volume, ml}}$$

where

A = weight of dried residue + dish, mg

B = weight of dish, mg

**Total P:** Total Phosphorous measurement is conducted using the method of Murphy & Riley 1962; EPA 365.2 (Attachment D): Separate sediment subsamples are analyzed for total P using a perchloric/nitric acid (1/3 v:v) digestion. The nitric acid oxidizes the organic matter in the sediments. The equivalent of about 0.5g of air-dried, sieved (0.5mm) sediments are mixed with 8 ml of the acid in Folin - Wu blood tubes. The mixture is digested at a temperature of a few degrees below the boiling point in an aluminum block until the dark color due to organic matter disappears. The digestion is then continued at a boiling temperature until heavy white fumes of HClO<sub>4</sub> appear and the insolubles turn chalky-white.

**Phosphate Fractions (Fe/Al & Ca):** The Fe/Al and Ca fractions of phosphorous are measured Hieltjes and Lijklema procedure, 1980 (Attachment E). Within 48 hours of sampling, wet sediments containing the equivalent of 0.5g dry sediment are first extracted with 40 ml. of 1M ammonium chloride adjusted to pH 7. These are mechanically shaken for 2 hours, decanted, and an additional 40 ml added for another 2 hours of shaking. This step removes the loosely bound available phosphates. Secondly, samples are extracted by 40 ml. of 0.1 N sodium hydroxide and shaken for 17 hours to remove iron and aluminum-bound phosphates. Finally 40 ml. of 0.4N hydrochloric acid are added and the samples are shaken for 24 hours to remove the calcium - bound phosphates.

### Residual Phosphorous

Residual phosphorous is given by the arithmetic difference between measured total phosphorous and the sum of the measured phosphorous fractions.

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

### **Reactive Phosphorous (Orthophosphate)**

Orthophosphate is measured by the EPA approved Ascorbic Acid method using a Hach DR/1A colorimeter and the Hach Company Portable Colorimeter Procedures Manual Method (Attachment F). Color development time is constant at 4 minutes for all samples. The instrument is calibrated using the Hach Company Portable Colorimeter Procedures Manual Standard Additions Method Check prior to each sample batch run.

### **Field Measurements Requirements (Creeks)**

**Instantaneous Discharge (Creeks):** The main limiting factor is the limited number of mechanically operated stream gages. Instantaneous flows are available from the following stream gauges: DWR Scotts Creek, DWR Middle Creek, DWR Kelsey Creek, and USGS Kelsey Creek. The solution therefore is to tie all calculations of discharge throughout the watershed to the stream gage measurements.

#### **•Flood Insurance Study**

A Flood Insurance Study was performed by the Army Corps of Engineers in cooperation with Lake County which was revised in 1992. This study used the HEC-1 and HEC-2 models to calculate the mean velocity (ft/s) of discharge for a 100 yr. event at a series of points along many of the streams draining into Clear Lake. The associated cross sectional area (ft<sup>2</sup>) was also recorded so that one could calculate a discharge in cfs (velocity \* area) for each point along the streams included in the Flood Insurance study.

For a particular watershed the calculated 100 year discharge from the Flood Insurance Study was recorded for the location of the stream gage. The next step was to record the 100 yr. discharges from the Flood Insurance Study for the location of each sampling site. Finally, the relative 100 yr. discharge compared to 100 yr. discharge at the stream gage was calculated. For example: Assume the calculated 100 year discharge of the south fork of Scotts Creek is 3000 cfs and the calculated 100 yr. discharge at the stream gage at Eickhoff road is 1000 cfs. This would show that the discharge of the south fork of Scotts creek is 3 times the discharge at the stream gage. The rationale used here is that once we obtain the recorded discharge data from the stream gage we can then estimate the instantaneous discharge of the south fork by simply multiplying the discharge of the stream gage by a factor of 3.

This method was used to obtain relative discharges to stream gages for each of our sampling sites occurring within the Flood Insurance study. The Department of Water Resources supplies 15 minute interval discharge data for their stream gages. Therefore, using the exact time our grab sample was taken we could obtain a fairly accurate estimate of the discharge at the associated stream gage. Finally, using the relative discharge factor, we could estimate the instantaneous discharges at each sampling site.

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

### Creek Surface Elevation

For sites sampled from a bridge or overpass, the distance from a fixed point on the bridge to the water level was recorded in meters. This information is useful in a qualitative sense, allowing us to know which events caused a higher runoff (lower bridge height).

This surface elevation data was combined with the instantaneous flow data described above to explore the possibility of creating rating curves for each bridge. This would allow a simple bridge height measurement to determine the approximate discharge in cfs. These rating curves were created by plotting the calculated instantaneous discharges vs. the measured bridge height and a curve was fit to the data.

### **Field Measurements Requirements (Clear Lake)**

**Clarity (Clear Lake):** Water clarity will be measured at each sample site with a Secchi disk. The disk is lowered over the shady side of the water craft to minimize surface glare. The disk is lowered to a depth just past the threshold of visibility. It is then raised slowly to the visibility threshold. The depth reading is then taken from demarcations on the disk line.

**Water Depth: (Clear Lake):** A single measurement of water depth will be taken at each sample site with a weighted fiberglass open reel tape.

**Dissolved Oxygen (Clear Lake):** A Yellow Springs Instrument 51B dissolved oxygen meter will be used for this measurement. The concentration of dissolved oxygen in lake water will be measured in situ at each sample site to construct a water column D.O. profile from the lake bottom to the surface. The probe is placed in the lake to the desired depth per the probe cable demarcations. D.O. is measured at the surface (one meter) and at 0.5 meters from the bottom after measuring water depth. Measurements will be then taken at successive ascending one meter increments. The D.O. measurement, along with its associated meter temperature value, will be immediately entered into the lake field data sheet (attachment C).

**pH (Clear Lake):** The pH of all water samples will be measured in the sample bottle immediately upon sample collection with a Fisher Scientific Accumet pH meter Model 955. The meter is calibrated using commercial pH buffers of 7.0 and 10.0. The meter is internally compensated for temperature. The field standardization procedure will begin with inspecting the meter and probe for damage. The electrode is rinsed with pH 7 buffer, then the instrument is calibrated to pH 7. The electrode is double rinsed with distilled water, rinsed with pH 10 buffer, then calibrated by slope adjustment to pH 10. The electrode is then rinsed in native water and the sample pH is measured and read when the meter stabilizes and the value will be immediately recorded in the field data sheet.

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

**Conductivity (Creeks and Clear Lake):** Conductivity will be measured in the field immediately upon sample collection using a Corning model Check Mate 90 conductivity / temperature meter. This meter is internally temperature compensated to 25° C. The meter and electrode will be inspected for damage immediately prior to each sample batch run. The instrument will be then standardized using a calibration sequence which is internally programmed into the instrument. In the sequence, it is standardized to zero in air, then to 1314  $\mu\text{S}$  using Corning commercial 1413  $\mu\text{S}$  standard. The electrode is then triple rinsed in native water, the sample conductivity value is taken after the meter has stabilized, and the value will be entered into the field data sheet.

**Temperature (Creeks and Clear Lake):** Temperature of all water samples will be measured in the sample bottle immediately upon sample collection with a Corning conductivity / temperature meter. The meter will be standardized with ice water prior to each measurement run.

### **QUALITY CONTROL REQUIREMENTS**

**Instruments:** Instrument calibration against standard reference and blank samples will be an integral part of routine analytical procedure.

**Blank Samples:** Distilled water samples will be processed in a identical manner with field samples to confirm the absence of contamination via sample processing. If such blanks exceed detection limits, subsamples will be taken from blanks between processing stages to determine the specific contamination source. The contamination source will be rectified before further analysis is conducted. Data obtained subsequent to the most recent previous blank will be reexamined for contamination error.

**Replicate Samples:** At least 10 percent of the samples will be duplicated at the sample source. Parameter measurement value spread between replicate samples will be evaluated against identified precision limits (see page 6, **Precision**). If these limits are exceeded, the source of the spread will be rectified before further analysis is conducted. Increased sample holding times resulting from interrupted analysis will be identified with the corresponding data.

**Sample holding times:** On occasions when sample analysis takes place after the standard storage period, deviations will be noted in a lab data book and identified in database comments.

### **INSTRUMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS**

All instruments and measuring equipment used to measure water quality parameters will be maintained and operated according to manufacturer's manual instructions and procedures. All instruments will be inspected and calibrated prior to each sample run with standard solutions. Each calibration will be logged with the respective data.

### **INSTRUMENT CALIBRATION**

**Dissolved oxygen:** A Yellow Springs Instrument 51B dissolved oxygen meter will be used for this measurement. Calibration procedures will begin by determining the

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

condition of the probe and meter. If the probe membrane appears damaged, or if bubbles are observed, the membrane and electrolyte solution will be replaced. The meter is turned on at least one hour prior to use in order to allow stabilization of the probe. After stabilization, the zero and maximum settings are adjusted. The or calibration chamber is dipped in the water source and removed. The barometric pressure and water temperature are used to determine the value for DO saturation. The meter is then adjusted to this value. The probe is then placed in the lake to the desired depth per the probe demarcations. Manual stirring is affected by continuous reciprocation of the probe. The reading is taken after the meter indication has stabilized.

**pH:** A Fisher Scientific Model 955 Accumet pH meter will be used for pH measurements. Two commercial buffers, pH 7 and pH 10, will be used to calibrate the meter. The meter is internally temperature-compensated. The standard field procedure will be to initially inspect the meter and electrode for damage. The electrode must be clean and properly maintained. The electrode is rinsed with deionized water. The electrodes is rinsed with pH 7 buffer, then placed in pH 7 buffer. The instrument is then calibrated to pH 7.

**Analytical Balance:** Analytical weight measurements will be taken using an Ohaus Model AP110S analytical balance. The balance will be inspected for level and calibrated before each usage using the balance's internal calibration procedure (attachment G).

**Conductivity Meter:** The conductivity meter will be calibrated before each sample run and will be standardized using a calibration sequence which is internally programmed into the instrument. In the sequence, it is standardized to zero in air, then to 1314  $\mu\text{S}$  using Coming commercial 1413  $\mu\text{S}$  standard. This will be performed prior to each sample run.

**Colorimeter:** Orthophosphates will be measured with a Model Hach Colorimeter

### ***DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)***

Historical climatological data for the Clear Lake Basin region will be obtained from the University of California, Davis, Division of Agriculture and Natural Resources Statewide Integrated Pest Management Project computer data base (see Attachment I). It is certified as an official publication of the National Oceanic and Atmospheric Administration (NOAA). It will be compiled using information from weather observing sites supervised by NOAA/National Weather Service and received at the National Climatic Data Center (NCDC), Ashville, North Carolina 28801. Further information regarding data quality and reliability may be directed to Joyce Strand of UCDIPM at (916)707-752-8350 or via e-mail at [ipmig@ucdavis.edu](mailto:ipmig@ucdavis.edu).

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

### **DATA MANAGEMENT**

The status of all data will be maintained and tracked using a *Data Library Index* (attachment H) which will be evaluated at least monthly or more frequently as required. Random sample checks will be made from original measurements to final data to check the accuracy of data processing.

**Clear Lake:** Core total P and P fractions, Ekman total P and P fractions, lake water total P and Ortho-P, water column D.O. and Temp. profiles will be graphed and trends evaluated monthly. Anomalies and apparent spurious readings will be reexamined for possible sources of error. Unexpected trends will be examined for possible causes.

**Creeks:** Total solids, total dissolved solids, total P, Ortho-P, conductivity, and temperature will be graphed and trends evaluated monthly. Anomalies and apparent spurious readings will be examined for possible sources of error.

### **ASSESSMENT / OVERSIGHT**

#### **ASSESSMENTS and RESPONSE ACTIONS**

The Technical Review Committee will conduct periodic reviews of the status and progress of the project and the Project Director will implement TAC recommendations as appropriate.

#### **REPORTS to MANAGEMENT**

**Quarterly progress reports:** Q.P.R.'s will be submitted to the Contract Manager by the 10th of the month following the end of each calendar quarter. The report will describe activities undertaken and accomplishments of each task during the quarter, milestones achieved, and problems encountered in the performance of the contract work. The report will describe the progress of each task in sufficient detail to provide a basis for payment of invoices and to determine task completion percentage.

**Submission of data to STORET:** A report of all water quality related data will be submitted to the State Water Board for input into the STORET system prior to the submission of the Final Project Report. Data will be submitted on computer diskette. A copy of this data report which has been retrieved from STORET after submission will be compared to original data to verify correctness.

**Watershed inventory list:** An inventory of the subwatershed groups. Complete one subwatershed group each quarter over the first year and report on progress in each quarterly report. Include for each milestone or inventory a list and description of: priority erosion sources, landowner/stakeholder information, potential BMP prescriptions, and erosion and BMP improvement estimates.

**Draft action plan:** Make recommendations for the use of BMP's and the restoration work required to reduce erosion from high priority areas and practices. Draft action plans with stakeholders and partners for implementing the recommendations, including cost estimates and cost share opportunities, stakeholder responsibilities and incentives, financial and institutional responsibilities, together with a time line.

## CLEAR LAKE BASIN WATERSHED ASSESSMENT QUALITY ASSURANCE PROJECT PLAN

**Implementation plan:** An institutional and financial plan for implementation of actions recommended by the project. This report will identify the affected agencies, stakeholders, estimated costs, and funding sources for development and management of the actions recommended by the project. It identifies institutional constraints and outlines a proposed schedule for the implementation of recommended actions. It includes a list of stakeholder actions necessary for restoring priority creek banks, incorporating BMP's in the management and development of land, roads and creeks, public outreach and monitoring resultant water quality improvements.

**Implementation checklist:** A brief checklist to allow annual post-project assessment by the State Water Board. The checklist will identify key milestones in conformance with the implementation schedule prepared for the management/implementation plan. This will be submitted to the contract manager with the project final report.

**Draft report:** The draft project report will include the results of the task work completed by the project including the watershed inventories, sediment modeling and water quality monitoring, the review of the stakeholder practices and policies, the recommended management strategies, the stakeholder plans, and the final implementation plan. The report will include:

- A report abstract.
- An introduction including a discussion of the purpose and scope.
- A discussion of the data collection and sampling methods and the rationale for applying those methods; a discussion, evaluation, and interpretation of the collected data for each section of the report as appropriate.
- A list of references to the literature cited.
- Any additional information that is deemed appropriate by the Project Director.

Copies of the draft report will be distributed to the TAC team members, affected agencies, interested parties, and the Contract Manager.

**Final report:** The final report will incorporate changes resulting from suggestions and comments made by the Contract Manager, the TAC, and the public. Copies will be distributed the Contract Manager, the TAC, and the Contract Manager.

## DATA VALIDATION and USABILITY

### DATA REVIEW, VALIDATION AND VERIFICATION REQUIREMENTS

The status of all data will be maintained and tracked using a *Data Library Index* (attachment H) which will be evaluated at least monthly or more frequently as required. Random sample checks will be made from original measurements to final data to check the accuracy of data processing.



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QUALITY ASSURANCE PROJECT PLAN

***RECONCILIATION WITH DATA QUALITY OBJECTIVES***

The Project Director will reconcile data with quality objectives and direct any necessary modifications of procedure to assure reconciliation.

CLEAR LAKE BASIN WATERSHED ASSESSMENT  
QUALITY ASSURANCE PROJECT PLAN

# **APPENDIX**

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Attachment A  
Quality Assurance Project Plan

EXHIBIT C - BUDGET

<u>TASK</u>	<u>STATE BOARD</u>	<u>CONTRACTOR'S MATCH</u>	<u>TOTAL</u>
1.1 Administration	\$ 0	\$ 0	\$ 0
1.2 Quarterly Reports	8,000	2,640	10,640
2.1 TAC	0	0	0
2.2 Responsiveness Summaries	1,690	558	2,248
3.1 QA Plan	932	308	1,240
3.2 Data Submission	2,148	709	2,857
4.0 Consultant	0	0	0
5.0 Inventories	37,580	12,401	49,981
6.0 Quantification	9,575	3,160	12,735
7.0 Interim Report	5,155	1,701	6,856
8.0 Recommendations	14,007	4,622	18,629
9.1 Implementation Plan	4,600	1,518	6,118
9.2 Checklist	500	165	665
10.1 Draft Report	5,000	1,650	6,650
10.2 Final Report	<u>8,813</u>	<u>2,908</u>	<u>11,721</u>
TOTAL	\$98,000	\$32,340	\$130,340

SAI DATE:

# COUNTY LAKE

FLOOD LAKE MANAGEMENT DIV

FIELD DATA (CREEKS)

1F

SITE	DATA					
	LOCATION	TIME	COND	TEMP (C)	pH	BR. HEIGHT (meters)
S.C. S. Fork						N/A
S.C. N. Fork						N/A
S.C. Confl.						N/A
S.C. Sc Vall Rd						
S.C. Eickhoff Rd						
S.C. Blue Lakes						
S.C. Hwy 20						N/A
S.C. T L Bypass						N/A
S.C. Below Tule L.						N/A
S.C. Hwy 29						
M.C. E. Fork						N/A
M.C. W. Fork						
M.C. Hunter Br						
M.C. Rancheria						
Clover @ Elk Mt						
M.C. Hwy 20						
Robinson (Br. Arb.)						
Lyons (Hospital)						
Alder above Kel						N/A
K.C. Rainbow Br.						N/A
K.C. Robinson Br.						N/A
K.C. Bottlerock Br.						N/A
K.C. Main Street						
K.C. Soda Bay Br.						
Adobe Finley						
Other						
Other						

Attachment B  
Quality Assurance Project Plan

NOTES

File name

rev Feb 99

Date entered

# COUNTY OF LAKE

## CLEAR LAKE SAMPLE DATA

DATE \_\_\_\_\_

LOCATION	TIME	DEPTH (M)	SECCI DISC (M)	DISSOLVED OXYGEN			CONDUCTIVITY	pH	COMMENTS
				DEPTH (M)	TEMP (°C)	PPM			
UA									
RATT									
LAW									
LAE									

Attachment C  
Quality Assurance Project Plan

oxidation of the electrode. This effect is also only noticeable at low concentrations. The  $\pm 2$  sources of error tend to cancel each other so that reasonably accurate results can be obtained even at concentrations of a few microns. At concentrations below this level the wave for electrode oxidation becomes relatively large and distorts the uranium(V) oxidation wave to the point where transition times can no longer be accurately measured.

Any substance which is present in, or can be reduced to, an oxidation state which is oxidized before or with the uranium(IV) will interfere with this procedure — e.g., iron, iodide, or titanium. Table II lists several other possible interfering substances which were tested.

It is evident from examination of Table II that nitrate and acetate ions cause serious errors in this determination, but even chromium and vanadium do not interfere. Apparently any chromium or vanadium reduced in the reductor is oxidized again by the passage of air.

#### ACKNOWLEDGMENT

Gratitude is expressed to DAVID CHURTON who did part of the experimental work and to the National Science Foundation for its support.

#### SUMMARY

The chronopotentiometry of uranium at platinum electrodes has been investigated. A determination of uranium has been devised based on the conversion of the uranium to uranium(IV) and the oxidation of the uranium(IV). The effect of several possible interfering substances has been checked.

#### RÉSUMÉ

Le dosage de l'uranium par chronopotentiométrie a été examiné, en utilisant des électrodes de platine et en procédant à l'oxydation de l'uranium, puis de l'uranium(IV). L'influence de diverses substances organiques possibles a été examinée.

#### ZUSAMMENFASSUNG

Bestimmung einer chronopotentiometrischen Methode zur Bestimmung von Uran unter Auswertung von Platinelektroden.

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*Anal. Chim. Acta*, **17** (1964) 46-50

## A MODIFIED SINGLE SOLUTION METHOD FOR THE DETERMINATION OF PHOSPHATE IN NATURAL WATERS

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In a recent communication<sup>1</sup> the authors described a molybdenum blue method for the determination of soluble phosphate in sea water, in which a single reagent solution is used. This procedure, in which the formation and reduction of phosphomolybdic acid is brought about by an acidic molybdate solution containing ascorbic acid, has a number of advantages over methods using stannous chloride<sup>2</sup>. In particular, the molybdenum blue colour is stable for long periods and the salt error correction is much smaller.

STUCKEAS<sup>3</sup> *et al.*<sup>2</sup> consider that the reproducibility of the ascorbic acid method is superior to that of the stannous chloride process, but has found that some sea waters tend to give higher results with the former reagent. He has attributed this effect to the hydrolysis of organic phosphorus compounds to phosphate during the long period required for the development of the molybdenum blue colour. We have recently carried out phosphate determinations by the ascorbic acid method on sea water enriched with dissolved organic phosphorus compounds (*viz.* sodium glycerophosphate, inositol hexaphosphoric acid, diphenylamino phosphate and leucine), and in no case were the results higher than those obtained by the stannous chloride procedure. Determinations made by both methods on sea water inoculated with either living or dead and partially decomposed cultures of *Phaeodactylum tricornutum*, gave identical results. It seems probable that generally no appreciable hydrolysis of organic phosphorus compounds occurs with the ascorbic acid reagent. It is possible, however, that very labile phosphorus compounds might lead to high results such as those found by STUCKEAS<sup>3</sup> *et al.*<sup>2</sup>

This paper describes a single solution reagent which has most of the advantages of the original procedure, but in which the colour develops rapidly. It is based on the finding that if antimony (as potassium antimonyl tartrate solution) is added to a phosphate solution containing the original single solution reagent, an intense bluish purple colour forms rapidly.

JEAN<sup>4</sup> has described a method for the determination of phosphate in steel, in which phosphomolybdic acid is reduced by ascorbic acid in the presence of bismuth. A blue-coloured complex is formed, which reaches its maximum intensity in about 30 min; this is extracted with amyl alcohol. We have found that the aqueous solution becomes turbid owing to the hydrolysis of bismuth to a basic salt, and that the method, if used without extraction, has a sensitivity only about half that attainable by the use of ascorbic acid alone.

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Experiments made by adding various amounts of antimony to the single solution reagent showed that the optimum antimony concentration was 0.4 mg per 50 ml final volume. At this concentration the colour attained its maximum intensity in both distilled water and sea water in about 10 min and remained constant for at least 24 h. Greater concentrations of antimony did not lead to more rapid colour development. At concentrations of above ca. 4 mg of antimony per 50 ml of solution, a turbidity of basic antimony salt was formed.

The absorption maximum of the phosphomolybdenum blue formed in the presence of antimony is at 882 m $\mu$ . The phosphomolybdenum blue yielded by either the stannous chloride or the ascorbic acid method has its absorption maxima at lower wavelengths (Fig. 1). This suggested that antimony might be a component of the

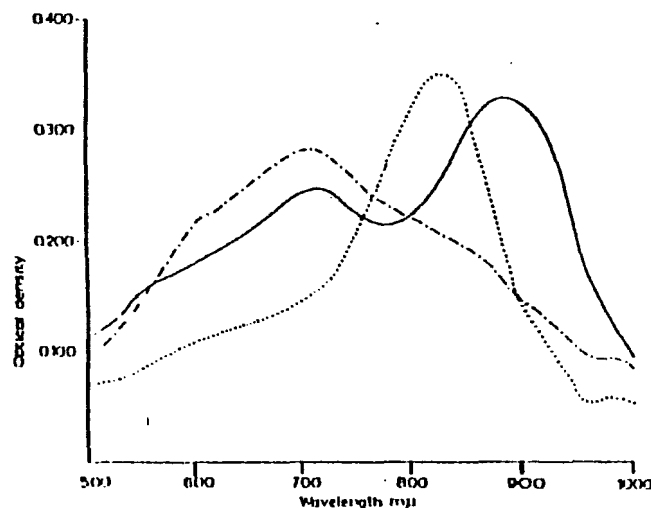


Fig. 1. Absorption curves for molybdenum blue formed with various reducing agents (1.0  $\mu$ g P as  $P_2O_5$  in 50 ml flask; 7.62 cm cell): — reduced with stannous chloride; ..... reduced with ascorbic acid; ..... reduced with ascorbic acid + antimony.

molybdenum blue compound absorbing at 882 m $\mu$ . In order to determine the atomic ratio of antimony to phosphorus in the complex, the complex formed from 10  $\mu$ g of phosphate phosphorus was quantitatively extracted with iso-butyl methyl ketone. The solvent was evaporated and the residue was treated with 0.1 M hydrochloric acid and zinc. The stibine and hydrogen formed were passed into 0.2% w/v mercuric chloride solution. After the gas evolution had continued for 30 min, the antimony absorbed in the mercuric chloride solution was determined photometrically using methyl fluorone. Duplicate experiments gave antimony: phosphorus atomic ratios of 1:0.47 and 1:0.94 for the complex.

#### EXPERIMENTAL

All measurements of optical density were made with a Unicam S.P. 500 spectropho-

meter, modified to use 7.62 and 15.24 cm cells (1 and 6 inch respectively). Distilled water was used in the compensating cell.

#### Reagents

- (1) *Sulphuric acid (5 N)*. Dilute 70 ml of concentrated sulphuric acid to 500 ml.
- (2) *Ammonium molybdate*. Dissolve 20 g of A.R. ammonium molybdate in water and dilute to 500 ml. Store the solution in a Pyrex glass bottle.
- (3) *Ascorbic acid (0.1 M)*. Dissolve 1.12 g of ascorbic acid in 75 ml of water. This solution should, if possible, be prepared on the day it is required as the ascorbic acid easily becomes oxidised. If it is necessary to keep the solution it can probably be stabilised by addition of 25 mg of ethylenediaminetetraacetic acid (disodium salt) and 0.5 ml of formic acid per 75 ml of solution.
- (4) *Potassium antimonyl tartrate (1 mg Sb/ml)*. Dissolve 0.2743 g of potassium antimonyl tartrate in distilled water and dilute to 100 ml.
- (5) *Mixed reagent*. Mix thoroughly 125 ml of 5 N sulphuric acid and 37.5 ml of ammonium molybdate. Add 75 ml of ascorbic acid solution and 12.5 ml of potassium antimonyl tartrate solution. This reagent should be prepared as required as it does not keep for more than 24 h.

#### Standard phosphate solutions

*Stock phosphate solution*. Prepare a solution containing 0.1757 g of potassium dihydrogen phosphate per l. This solution contains 40 mg P (as phosphate)/l. Prepare, as required, a solution containing 0.2  $\mu$ g P (as phosphate)/ml by dilution of the stock phosphate solution.

#### Treatment of apparatus

Fill the calibrated flasks, which are to be used for the determination, with concentrated sulphuric acid, allow them to stand overnight, and then rinse thoroughly. It is preferable to keep a set of flasks to be used only for the determination of phosphate, and after use to wash them and to keep them filled with water until required again. If this is done the treatment with sulphuric acid is only required occasionally.

#### Procedure

Pipette 40 ml of the sea water sample into a 50 ml calibrated flask, add 8 ml of the mixed reagent from a tilt measure, dilute to volume with water, and mix well. After not less than 10 min measure the optical density of the solution at 882 m $\mu$  using cells of an appropriate length. Determine the reagent blank in the same manner using freshly distilled water. Calibrate the method using 1, 2 and 4  $\mu$ g phosphorus as phosphate (these amounts are appropriate for a 15 cm cell), and make up to approximately 40 ml with distilled water before adding the reagent. The calibration curve only needs occasional checking as it remains constant and appears to be independent of changes in the batches of reagents. For normal purposes the salt error is negligible (less than 1%).

#### Beer's law and reproducibility

Replicate calibration runs were made using 1-10  $\mu$ g of phosphorus (as phosphate) in 40 ml of distilled water. The optical densities of the resulting molybdenum blue

complexes were measured at 882 m $\mu$  in 7.62-cm cells. The results (Table I) show that Beer's law is obeyed over this concentration range, and that the method gives an excellent reproducibility.

As a further test of the reproducibility of the method with sea water, seven replicate analyses were made on a natural sea water, poor in phosphate. The average optical density (measured in a 15.24-cm cell), less reagent blank, was 0.164  $\pm$  0.0007, corresponding to a concentration of 18.6  $\pm$  0.1  $\mu$ g P (as phosphate)/l in the sea water.

TABLE I  
CALIBRATION OF METHOD

$\mu$ g PO <sub>4</sub> -P	Optical density*			Mean*	Optical density less reagent blank
1	0.110	0.110	0.110	0.110	0.1100
2	0.220	0.219	0.221	0.220	0.1100
3	0.331	0.331	0.331	0.331	0.1103
4	0.442	0.442	0.441	0.442	0.1105
5	0.553	0.553	0.553	0.553	0.1108
8	0.884	0.884	0.885	0.884	0.1105
10	1.100 <sup>b</sup>	1.100 <sup>b</sup>	1.101 <sup>b</sup>	1.100 <sup>b</sup>	0.1100

\* Measured at 882 m $\mu$  in 7.62-cm cells (less reagent blank 0.021).

<sup>b</sup> Measured in 4-cm cell calculated for 7.62-cm cell.

TABLE II  
DETERMINATION OF SALT ERROR OF METHOD

Conc. of element ( $\mu$ g/l)	$\mu$ g PO <sub>4</sub> -P added	Optical density*		Salt error (%)
		Mean	Less Blank <sup>b</sup>	
0.00	0.0	0.012	—	—
0.00	1.0	0.264	0.220	—
10.64	0.0	0.045	0.003	—
1.00	1.0	0.262	0.219	-0.5
9.50	1.0	0.263	0.219	1.05
91.70	1.0	0.266	0.222	1.09
19.64	1.0	0.267	0.222	1.09
0.00	4.0	0.217	0.185	—
1.00	1.0	0.216	0.184	-0.1
9.80	1.0	0.212	0.179	-0.7
91.70	1.0	0.212	0.179	-0.7
19.64	1.0	0.210	0.181	-0.1

\* Measured in 15.24-cm cells at 882 m $\mu$ .

<sup>b</sup> Blank reckoned proportional to chlorinity.

#### Salt error

In most molybdenum blue methods for the determination of silicon and phosphorus, less intense colours are developed with the same amount of silicon or phosphorus, in the presence of sea water salts, than in distilled water. The effect is particularly pronounced when the stannous chloride method is used for the determination of phosphate in oceanic waters; in this case the salt error amounts to ca. 15%.

The salt error of the rapid single solution method was studied. Filtered sea water,

which had been stored in polyethylene bottles to remove phosphate<sup>7</sup>, was diluted with distilled water to give waters having chlorinities ranging between 4.00 and 19.64‰. Duplicate phosphate determinations were made on 40-ml portions of distilled water and of the original sea water, and on 40-ml aliquots of the diluted sea waters enriched with 1  $\mu$ g and 4  $\mu$ g of phosphorus as phosphate. The results (Table II) show that at both levels of phosphate concentration the salt error was below 1%. The rate of colour development in sea water was similar to that in distilled water, and the colour once formed, was stable for at least 24 h.

#### Interferences

The interference of several ions, which are known to interfere in molybdenum blue methods for the determination of phosphate, was investigated. Determinations were made using 40-ml aliquots of distilled water containing these ions, both alone and in the presence of 10  $\mu$ g of phosphate - P. The results are shown in Table III; they indicate that no interference is caused by copper, iron or silicate at concentrations many times greater than their greatest reported concentration in sea water. Arsenate produces a similar colour to phosphate, but since according to recent work<sup>8</sup> its concentration in sea water is only ca. 2.5  $\mu$ g As (as arsenate)/l, it will not interfere seriously in the determination (a sea water containing this amount of arsenic will give an optical density in a 15-cm cell only 0.003 greater than the reagent blank).

TABLE III  
EFFECT OF OTHER IONS ON DETERMINATION OF PHOSPHATE

Ion	Concentration of element ( $\mu$ g/40 ml)	Optical density at 882 m $\mu$ (4-cm cells)		
		No added PO <sub>4</sub> -P	4 to 40 $\mu$ g PO <sub>4</sub> -P	Difference
Copper(II)	500	0.012	0.593	0.581
Iron(III)	2500	0.018	0.585	0.567
Silicate	500	0.014	0.594	0.580
Arsenate	50	1.141 <sup>a</sup>	1.754 <sup>a</sup>	0.613
Asenate	1	0.010	0.614	0.594

\* Measured in 4-cm cell calculated for 15-cm cells.

#### SUMMARY

A single solution reagent is described for the determination of phosphorus in sea water. It consists of an acidified solution of ammonium molybdate containing ascorbic acid and a small amount of antimony. This reagent reacts rapidly with phosphate ion yielding a blue-violet compound which contains antimony and phosphorus in a 1:1 atomic ratio. The complex is very stable and obeys Beer's law up to a phosphate concentration of at least 1  $\mu$ g/ml. The sensitivity of the procedure is comparable with that of the stannous chloride method. The salt error is less than 1%.

#### RÉSUMÉ

Une méthode spectrophotométrique est décrite pour le dosage du phosphate dans l'eau de mer au moyen de molybdate d'ammonium, en présence d'acide ascorbique et d'antimoine. Il se forme rapidement un composé violet bleu, contenant antimoine et phosphore dans un rapport atomique de 1:1.

#### ZUSAMMENFASSUNG

Beschreibung einer Methode zur Bestimmung von Phosphat in Meerwasser mit Hilfe von Ammoniummolybdat in Gegenwart von Ascorbinsäure und Antimon. Der gebildete blau-violette Komplex wird spektrophotometrisch gemessen.



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## CÉRIMÉTRIE EN MILIEU NITRIQUE. APPLICATION AU DOSAGE DU FER, DE L'URANIUM ET DU PLUTONIUM

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(Reçu le 21 Octobre, 1961)

La volumétrie par le sulfate cérique, après réduction à la colonne de Jones, est une des méthodes les plus précises parmi les méthodes rapides de détermination du fer, de l'uranium et du plutonium. Mais en milieu nitrique, elle devient impraticable à moins d'effectuer préalablement un changement de milieu par évaporation en présence d'acide sulfurique concentré. Ceci complique les manipulations et en augmente la durée, surtout dans le cas du plutonium, où il est nécessaire d'effectuer ces opérations en boîte à gants, et, à plus forte raison, pour l'uranium irradié qui nécessite une protection *zirc*.

En pratique, les solutions d'uranium et de plutonium dont on doit contrôler la teneur se trouvent le plus souvent en milieu nitrique. L'acide nitrique est en effet l'acide le plus employé industriellement, que ce soit pour la tenue de l'appareillage à la corrosion, ou pour le procédé chimique proprement dit.

Dans le but d'effectuer un contrôle à la fois précis, rapide, et compatible avec les contraintes imposées par les protections contre les rayonnements  $\alpha$  et  $\beta\gamma$ , une nouvelle méthode a été développée, permettant d'effectuer directement la cérimétrie en milieu nitrique. Cette méthode est applicable au dosage du fer, de l'uranium et du plutonium dans le même domaine que celui de la volumétrie classique.

### PRINCIPE DE LA MÉTHODE

L'action gênante des ions nitrates dans une cérimétrie classique s'exerce de deux

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spontanément par réaction avec les ions  $\text{NO}_2^-$  et accélération par  $\text{NO}_2^-$ .

Pour éviter la présence des ions  $\text{NO}_2^-$  susceptibles soit de réagir directement avec la forme réduite de l'élément à doser, soit de réagir avec la solution titrante, on ajoute de l'acide sulfamique qui, avec les nitrates, donne une réaction du type:



La fin du dosage est ensuite effectuée de la façon habituelle au moyen d'une solution titrée de cérium(IV), en présence d'orthophénanthroline ferreuse comme indicateur d'oxydo-réduction.

### RÉACTIFS

- Solution constituée d'un mélange d'acides nitrique et sulfurique, tel que la normalité de chaque acide soit égale à l'unité ( $\text{HNO}_3$  N,  $\text{H}_2\text{SO}_4$  N).
- Solution de chlorure titanéux R. P. à 15% environ de  $\text{TiCl}_3$ .
- Solution titrée de cérium(IV) environ  $10^{-2}$  N, en milieu sulfurique N.

### MATÉRIEL

Diluer la prise d'essai avec la solution  $\text{HNO}_3$  N,  $\text{H}_2\text{SO}_4$  N de façon à obtenir un volume voisin de 50 ml.

Ajouter en agitant 0,5 g environ d'acide sulfamique en poudre et 1 ml de la solution concentrée de titane(III). Attendre 5 min, en maintenant l'agitation, la destruction complète de l'excès de titane(III).

Ajouter 1 ml d'orthophénanthroline ferreuse  $2,5 \cdot 10^{-2}$  M, quelques gouttes de chlorure ferrique dans le cas de l'uranium pour catalyser l'oxydation, et effectuer la volumétrie.

### RÉSULTATS - DISCUSSION

#### Acidité du milieu

Des essais préliminaires ont été effectués en milieu nitrique pour examiner les conditions les plus favorables à la destruction de l'excès de titane(III) en un temps de 5 min. Les résultats sont rassemblés dans le tableau I; ils montrent que les conditions les plus favorables correspondent à une concentration d'ions  $\text{NO}_2^-$  comprise entre 0,2 et 1 N. En dessous de 0,1 N, l'observation visuelle montre la présence d'un excès de titane(III) non détruit; au-dessus d'une acidité comprise entre 1 N et 2 N, la réduction du corps à doser est incomplète et les résultats sont trop faibles.

Mais, d'une part, il faut conserver un milieu suffisamment acide pour effectuer la volumétrie et il n'est donc pas possible d'opérer à des acidités aussi faibles que 0,1 N; d'autre part, à des concentrations comprises aux environs de 1 N, l'oxydation du titane(III) par les ions nitrates est presque instantanée et l'on peut craindre une réduction

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## Attachment E Quality Assurance Project Plan

### Fractionation of Inorganic Phosphates in Calcareous Sediments<sup>1</sup>

ARNOLD H. M. HIELTJES AND LAMBERTUS LIJKLEMA<sup>2</sup>

#### ABSTRACT

The selectivity of current fractionation schemes for inorganic phosphates in sediments has been tested on pure compounds. Results indicate that effective removal of calcium carbonate through ammonium chloride extraction is necessary in order to achieve satisfactory discrimination between iron- or aluminum-bound phosphates and calcium phosphates. A simple extraction procedure based on this information has been applied to the sediments of Lake Brielle.

**Additional Index Words:** sediment phosphate, phosphate extraction, sorption on calcium carbonate.

Hieltjes, A. H. M., and L. Lijklema. 1980 Fractionation of inorganic phosphates in calcareous sediments. J. Environ. Qual. 9:405-407.

Physical and chemical characterization of sediments is important for the comprehension of the phosphate exchange processes between bottom sediments and overlying waters. In many lakes a significant fraction of the annual phosphate loading accumulates in the sediments. Depending upon environmental conditions partial release of these phosphates may occur. Solubility of phosphate in the interstitial water of a sediment under prevailing conditions of pH, redox potential, and ionic strength is controlled by the chemical composition of the phosphates present and their interactions with other minerals or amorphous materials. The association of phosphate with iron, aluminum, and calcium, and the adsorptive properties of carbonates and clays are of especial interest.

Several extraction schemes have been developed for the elucidation of the chemical nature of soil and sedi-

ment phosphates. The shortcomings of Chang and Jackson's (1957) original procedure were demonstrated by Williams et al. (1967, 1971a, 1971b). These authors proposed a fractionation scheme (1971a) that allows distinction between iron- and aluminum-bound phosphates vs. calcium phosphates in calcareous lake sediments. Their method is widely used for the characterization of inorganic phosphates.

The research reported here is an investigation into the feasibility of Williams' scheme and a method proposed by Kummies (1972) for the characterization of inorganic phosphates. Natural sediments used in this project were obtained from Lake Brielle, a shallow eutrophic hard water lake southwest of Rotterdam, the Netherlands.

#### MATERIALS AND METHODS

Sediments from Lake Brielle were collected with an improved Jenkin mud sampler. The water depth at the sampling sites varied between 4 and 10 m. After division into 2-cm layers and partial dewatering by application of N<sub>2</sub> pressures up to 6 atm, the sediment samples were stored at 4°C. Water content was estimated by drying duplicate samples at 110°C and establishing the loss of weight. In all extractions of natural sediments wet samples were used. Results presented here were obtained with the top layer of the sediment. Synthetic materials used were hydroxy-apatite: Ca<sub>5</sub>(PO<sub>4</sub>)<sub>3</sub>OH (Riedel-de Haen A.G.; chem. pure); calcium phosphate: Ca<sub>3</sub>(PO<sub>4</sub>)<sub>2</sub> (Merck; chem. pure); aluminum orthophosphate: AlPO<sub>4</sub>·H<sub>2</sub>O (BDH; chem. pure); and a suspension of freshly precipitated ironhydroxy-phosphate, aged by standing or moderate heating. The fractionation schemes used are summarized in Table 1. Unless stated otherwise the extraction temperature is 20°C. Our modification of Kummies' procedure consists of the use of NH<sub>4</sub>Cl/ethanol mixture instead of an alcoholic solution of KCl. Filtration (0.45-µm membrane) after each extraction was preceded by centrifugation.

The Murphy and Riley method (1962) was used for determination of inorganic P in the clear extracts. Strongly alkaline or acid solutions were neutralized prior to analysis. Calcium was determined by atomic absorption spectrophotometry with a Varian Techtron 1100. The carbonate content of sediments was measured through volumetric determination of the CO<sub>2</sub> liberated by acid digestion.

<sup>1</sup>Contribution of the Dept. of Chemical Engineering, Twente Univ. of Technology, P.O. Box 217, Enschede, The Netherlands. Received 19 Nov. 1979.

<sup>2</sup>Research Assistant and Assoc. Prof. of Environmental Engineering, respectively.

Table 1—Fractionation schemes compared in this research. Wet samples containing 50 mg of dry sediment were extracted in each procedure.

Form of phosphate extracted	Method		
	(1) Williams et al. (1971a)	(2) Kurmies (1972, modified)	(3) Hietjes, Lijklema
Loosely bound		Two consecutive extractions, 2 hours, with a mixture of 20 ml 1M NH <sub>4</sub> Cl and 30 ml ethanol; pH of extractant adjusted at 7	Two consecutive extractions, 2 hours, with 50 ml 1M NH <sub>4</sub> Cl; pH of extractant adjusted at 7
Fe - Al	17 hours with 50 ml 0.1N NaOH/1M NaCl; 15 min at 80°C with 50 ml of a mixture of 0.1M Na-citrate, 1 g Na-dithionite, and 1M NaHCO <sub>3</sub> (CDB)	17 hours with 50 ml 0.1N NaOH	17 hours with 50 ml 0.1N NaOH
Ca	1 hour with 50 ml 0.5N HCl	24 hours with 50 ml 0.5N HCl	24 hours with 50 ml 0.5N HCl

## RESULTS AND DISCUSSION

Phosphate solubility of some representative pure compounds in the major extractants is shown in Table 2.

The main conclusion from these experiments is the unsuitability of the NaOH/CDB combination for the separation of calcium-bound phosphates and iron-aluminum-phosphates as outlined in Williams' scheme (Table 1, method 1). The CDB extraction aims at solubilization of the phosphate adsorbed on calcium carbonate during the NaOH treatment and of phosphates occluded in iron-hydroxides. However, apparently substantial amounts of calcium-bound phosphate is solubilized by the CDB-reagent, for which the strongly complexing citrate ion is responsible. Williams et al. (1976) demonstrated that the solubility of naturally occurring apatite in this reagent is much less. However, X-ray analysis did not reveal the presence of this mineral in our sediments. Actually calcite and dolomite were the only calcium-containing minerals that could be determined. Hence, we cannot be sure that any calcium-bound P present in our sediments will be insoluble in the CDB-reagent. Especially in sediments low in calcium-bound P, this will cause serious underestimation of this fraction. Prevention of phosphate adsorption on the carbonates in calcareous lake sediments during the NaOH extraction can be achieved by complete removal of the carbonates prior to the alkaline treatment.

Neutralized ammonium chloride solutions of 1.0 or 0.5M as used in the original procedure of Chang and Jackson (1957) and in Williams' et al. (1967) first modification of this method are very effective in the removal of carbonates and loosely bound calcium ions. However, this reagent also dissolves some phosphate from the compounds shown in Table 2.

Table 2—Percent of orthophosphate extracted from dry, powdered synthetic phosphate compounds by various reagents.

Extractant?	Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ·OH	Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>	Fe-P	AlPO <sub>4</sub> ·H <sub>2</sub> O
	% of P extracted			
1M NH <sub>4</sub> Cl (pH = 7)	3-4	4-6	5-7	4-6
0.1N NaOH	<1.0	<1.0	98.9	91.0
CDB	31.2	33.8	99.2	12.9
0.5N HCl	100.8	98.9	98.6	100.0

† Total amounts of P in samples varied between 0.4 and 2.5 mg for the Ca-compounds and was about 2 to 4 mg for the iron- and aluminum phosphates. Fifty ml of reagent in each extraction. CDB = citrate-dithionite-bicarbonate (see Table 1).

Although the percentages fluctuate around the fairly insignificant value of about 5% for the compounds tested, somewhat higher values can be expected when smaller amounts of P-containing compounds are present in the natural lake sediment samples (about 50 mg) upon extraction with the same volume (50 ml) reagent. However, increasing the extractant/sediment ratio revealed only slight increases in the percentages solubilized unless insignificantly small amounts were tested.

The solubility of the iron-phosphate material with an Fe/P molar ratio of 5:1 was hardly changed by prolonged heating of the suspension; upon drying at 110°C the solubility in NH<sub>4</sub>Cl decreased to about 2% of the phosphate present in the sample.

Kurmies (1972) suggested the use of an alcoholic KCl solution for the elimination of soluble and loosely bound calcium. This method proved to be inappropriate for the removal of carbonates from calcareous sediments. Hence we tried to compromise by application of a mixture of ethanol and ammonium chloride as indicated in Table 1.

Results of the extraction procedure (method 2) and the procedure with 1M NH<sub>4</sub>Cl (method 3) as obtained with some sediments from Lake Brielle are presented in

Table 3—Orthophosphate and calcium extraction from Lake Brielle sediment samples.

Method?	Extractant	Sample				
		1	2	3	4	5
		μg/g dry sediment				
2	Alcoholic NH <sub>4</sub> Cl-P	134	268	24	7	70
3	NH <sub>4</sub> Cl-P	321	236	53	97	845
4	-	-	-	-	-	-
2	Alcoholic NH <sub>4</sub> Cl-Ca	25,500	20,500	13,700	21,500	23,100
3	NH <sub>4</sub> Cl-Ca	53,700	48,500	58,500	32,000	70,800
4	-	-	-	-	-	-
2	NaOH-P	2,429	1,085	321	322	2,815
3	NaOH-P	3,099	1,175	396	297	2,300
4	NaOH-P	2,546	1,293	359	207	1,382
2	HCl-P	1,334	601	401	984	1,473
3	HCl-P	521	528	314	914	1,010
4	HCl-P	1,141	672	423	1,094	2,492
2	Total P	3,387	1,964	746	1,313	4,158
3	Total P	3,941	1,937	783	1,208	4,158
4	Total P	3,987	1,966	772	1,302	4,074
Sampling depth, m		9.0	9.0	9.0	4.0	10.0
% CaCO <sub>3</sub> in sample		13.6	14.8	15.3	8.5	18.2

† Method 2: modified Kurmies (1972); Method 3: Hietjes and Lijklema; Method 4: same as above with omission of NH<sub>4</sub>Cl extraction. Mean values of duplicate samples.

Table 4. Comparison of orthophosphate extracted by two procedures.

Extraction procedure	Sample			
	3	6	7	8
	µg P/g dry sediment			
NaOH-P	780	1,960	987	
NH <sub>4</sub> Cl-P	287	542	396	
Subtotal	1,167	2,592	1,285	
NH <sub>4</sub> Cl-P	117	632	280	
NaOH-P	997	1,974	1,025	
Subtotal	1,014	2,506	1,235	
NH <sub>4</sub> Cl-P	441	438	315	
NaOH-P	571	474	350	
Subtotal	1,508	1,030	1,700	
NaOH-P	1,588	2,980	1,835	
Subtotal	1,700	3,440	1,900	
	µg Ca/g sediment			
Subtotal	29,300	62,100	74,100	

Williams (1971a) (2) proposed method.

The CaCO<sub>3</sub> content of these sediments ranged from 10 to 18% by wt, the total P content is in the range 0.75 to 4.0 mg per g dry wt. Also, results of NaOH and HCl extractions without previous NH<sub>4</sub>Cl extraction are presented (method 4).

Results with Kurmies' modified extraction scheme indicate incomplete removal of calcium carbonate from the sediment, hence part of the phosphate liberated in the NaOH step can be resorbed by the remaining carbonate. Indeed the cumulative extraction of phosphate in the first two steps is lower in method 2 as compared to method 3. This results in overestimation of the CaCO<sub>3</sub> phosphate in the HCl extraction; the same is true when no carbonate removal with NH<sub>4</sub>Cl is applied.

In samples 2, 3, and 4 the partial carbonate removal gives intermediate results for the HCl extraction. In sample 1 apparently the remaining carbonate in method 2 liberates more phosphate than the unchanged sediment during the NaOH extraction. Although the NaOH extraction in the proposed method may remove carbonate-bound phosphate, as suggested by the results shown in Table 2, the quantities dissolved in NH<sub>4</sub>Cl are relatively unimportant and it is felt that prevention of reaction on carbonates is more significant.

In order to compare overall results of our method with Williams' NaOH-CDB-HCl extraction procedure, samples have been analyzed in both ways. The results are summarized in Table 1, the results are shown in Table 4. Although the differences are small, the tendency is that Williams' method yields a lower phosphate fraction. This can be attributed to some dissolution of calcium compounds in the CDB step. As mentioned, phosphate could be detected in our sample, hence the nature of the calcium-P compound is not clear.

Another explanation for the difference is the presence of some occluded iron phosphates in the samples which are dissolved in CDB, but will not be removed until the HCl extraction step in the proposed scheme. This would also explain the small differences in total P extracted. In fact, the characterization of the phosphates is defined by the analytical procedure. An advantage of the NH<sub>4</sub>Cl-NaOH-HCl method is the analytical simplicity; the estimation of phosphate through Murphy and Riley's method requires a rather cumbersome destruction (Wildung et al., 1977) of CDB extractant prior to analysis.

Sediment samples from the deeper parts of Lake Brielle have carbonate contents up to 25% by wt. The phosphate content in these samples is about 4 to 6 mg per g dry wt.

Anaerobic conditions at the sediment-water interface prevail in the deeper parts of the lake; hence an accurate estimation of the iron-associated phosphates for these carbonate-rich sediments is of paramount importance. The absence of significant amounts of aluminum in NaOH extracts and the solubilization of considerable amounts of phosphate in oxygen-free suspensions of sediment upon prolonged standing indicate that iron compounds are largely responsible for the phosphate in the NaOH-fraction.

## ACKNOWLEDGMENTS

The authors wish to thank J. Koggei who participated in the analysis and P. J. Gellings and W. Poeman for their valuable suggestions. We gratefully acknowledge the assistance of the Environmental Section of the Delta Service Rijkswaterstaat on various phases of the study.

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# DATA LIBRARY INDEX

COUNTY OF LAKE  
FLOOD/LAKE MGMT. DIV.

Attachment 4  
Quality Assurance Project Plan

1996																
		Dec-95	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NOTES	
LAKE																
CORE DATA (UA)																
Total-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
FeAl-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Ca-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Resid.-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
EKMAN (UA, RATT, LAW, LAE)																
Total-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
FeAl-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Ca-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Resid.-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Avail.-P					2	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
LAKE WATER (SAMPLES)																
Field Data		1	1	1	1	n/a	1	1	1	1	1	1	1	n/a		
D.O. / Temp. Profiles					2	3a	3a	3a	3a	n/a	1	1	n/a	n/a		
Cytha-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	2	n/a		
Total-P		3a	3a	3a	3a	n/a	3a	3a	3a	3a	3a	3a	1	n/a		
Deuterium (for Calpine)		1	1	1	n/a	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
COPPER (UA, RATT, LAW, LAE)																
Sed.-Cu				3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
Water-Cu				3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a		
CREEKS																
Field Data		3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	2		
Dissolved Solids		3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	2		
Total Solids		3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	2		
Ortho-P		3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	2		
Total-P		3	3	3	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	2	0		
GROUNDWATER																
MONTHLY		2	2	2	2	2	3	2	2	2	2	2	2	2		
BIANNUAL		n/a	n/a	n/a	3	n/a	n/a	n/a	n/a	n/a	n/a	3	n/a	n/a		
CITY WELLS (S.V.)		0	0	0	0	0	0	0	0	0	0	0	0	0		
STREAMBANK EROSION																
Site 1		3a	n/a	n/a	n/a	n/a	n/a	3a	n/a	n/a	n/a	1	n/a	n/a		
Site 2		3a	n/a	n/a	n/a	n/a	n/a	3a	n/a	n/a	n/a	1	n/a	n/a		
Site 3		3a	n/a	n/a	n/a	n/a	n/a	3a	n/a	n/a	n/a	1	n/a	n/a		
Site 4		3a	n/a	n/a	n/a	n/a	n/a	3a	n/a	n/a	n/a	1	n/a	n/a		
Site 5		3a	n/a	n/a	n/a	n/a	n/a	3a	n/a	n/a	n/a	1	n/a	n/a		
RAINFALL & TEMP (IPM)																
LAKEPORT		2	2	2	2	2	2	2	2	2	2	2	2	2		
CLEARLAKE		2	2	2	2	2	2	2	2	2	2	2	2	2		

KEY 0 Still to obtain  
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2 Entered in Database  
3 Hard copy printed (3a indicates printed graph)

Rev. 1/16/97

# DATA LIBRARY INDEX

COUNTY OF LAKE  
FLOOD/LAKE MGMT. DIV.

1997														
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	NOTES
<b>LAKE</b>														
<b>CORE DATA (UA)</b>														
Total-P		3a	1											
FeAl-P		3a	1											
Ca-P		3a	1											
Resid.-P		3a	1											
<b>EKMAN (UA, RATT, LAW, LAE)</b>														
Total-P		3a	1											
FeAl-P		3a	1											
Ca-P		3a	1											
Resid.-P		3a	1											
Avail.-P		3a	1											
<b>LAKE WATER (SAMPLES)</b>														
Field Data		1	1											
D.O. / Temp. Profiles		n/a	n/a											
Ortho-P		3a	3a											
Total-P		1	1											
Deuterium (for Cal		n/a	n/a											
<b>COPPER (UA, RATT, LAW, LA)</b>														
Sed.-Cu		n/a	n/a											
Water-Cu		n/a	n/a											
<b>CREEKS</b>														
Field Data		2	n/a											
Dissolved Solids		2	n/a											
Total Solids		2	n/a											
Ortho-P		2	n/a											
Total-P		0	n/a											
<b>GROUNDWATER</b>														
MONTHLY		2	2											
BIANNUAL		n/a	n/a	0										
CITY WELLS (S.V.)		0	0											
<b>STREAMBANK ERC</b>														
Site 1		n/a	n/a					0						
Site 2		n/a	n/a					0						
Site 3		n/a	n/a					0						
Site 4		n/a	n/a					0						
Site 5		n/a	n/a					0						
<b>RAINFALL &amp; TEMP</b>														
LAKEPORT		2	2											
CLEARLAKE		2	2											

KEY 0 Still to obtain  
1 Collected and filed  
2 Entered in Database  
3 Hard copy printed (3a indicates printed on air)

Rev. 1/18/97

**University of California  
Statewide Integrated Pest Management Project****Acknowledgments**Attachment I  
Quality Assurance Project Plan

Developing a content-rich Web site requires a host of talents and many hours of work. UC IPM staff have participated in multiple aspects of development of this site, but the list that follows names individuals and their primary involvement. Without each one, this site would not be possible.

**Site design and development**

Joyce Strand, Buz Dreyer, and Donna Seaver

**Programming**

Buz Dreyer, Pest Management Guidelines, Weather, and Degree-days  
Ed Morgan and Buz Dreyer, Pesticide Use Database

**Documentation**

Donna Seaver, Writer

**Production**

Donna Seaver, Writer  
Alfred Nichols, Student Assistant  
Craig Anderson, Student Assistant  
Ricky Wong, Student Assistant

**Photos**

Jack Kelly Clark, Principal Photographer  
Larry Strand, Photo Librarian

**Pest Management Guidelines**

Barbara Ohlendorf, Coordinator  
Mary Louise Flint, Technical Editor  
Margaret Brush, Production  
Christine Joshel, Pesticide registration verification  
Steve Dreistadt, Larry Strand, Cheryl Weber, Partie Gouveia, Barbara Ohlendorf, and Mary Louise Flint, Web enhancement through Hypertext  
UC Division of Agriculture and Natural Resources scientists, content

**California Weather Database**

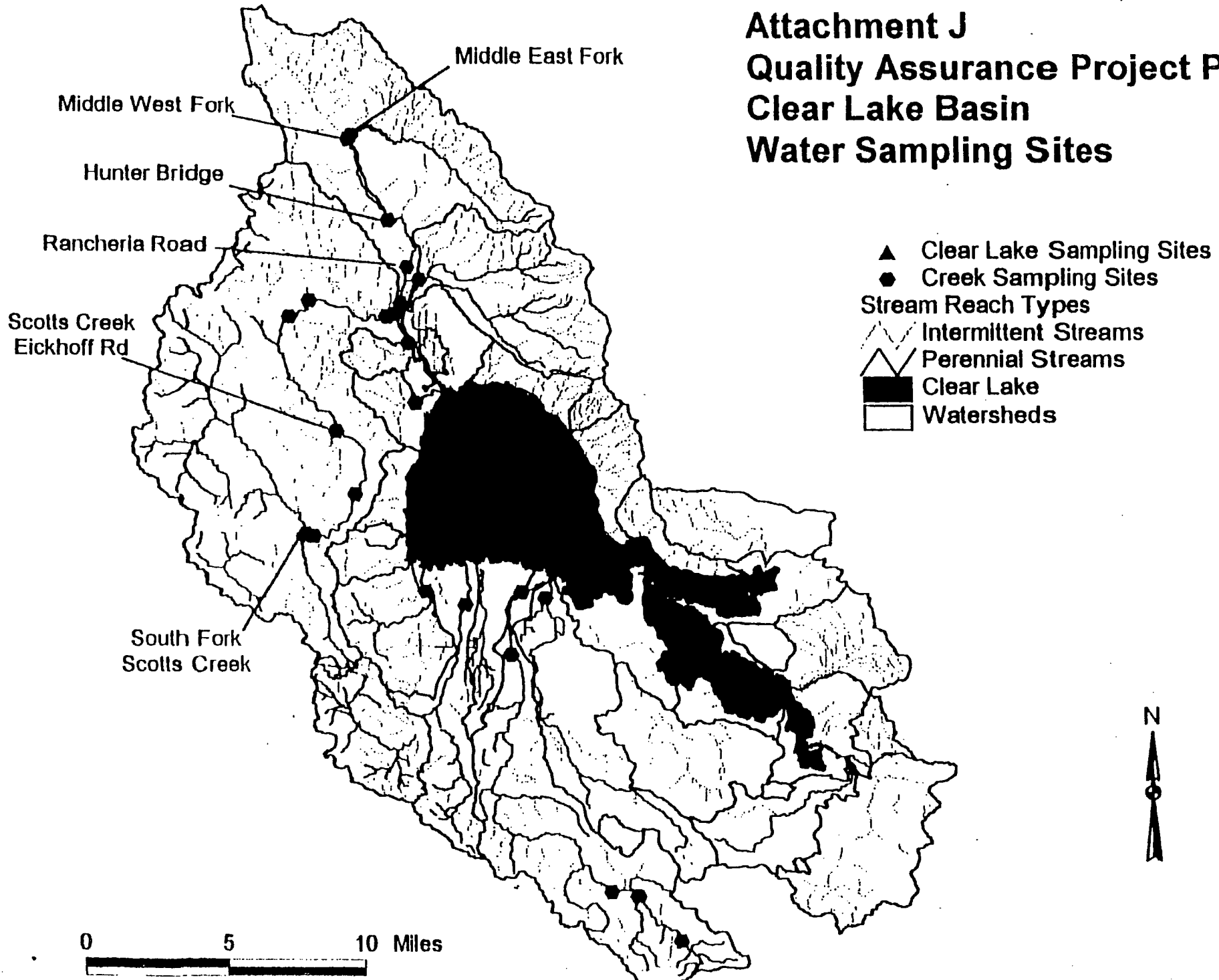
Marty Martino, Meteorology Assistant for acquisition and quality control

# Attachment J

## Quality Assurance Project Plan

### Clear Lake Basin

### Water Sampling Sites





## Methods and Information about the County Clear Lake Database

*File Location:* D:\water\lakedata\lakedata.mdb Access '97

R32-f

### Tables:

- "Clear Lake Core Data" - Includes averages of Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g for each core section for data compiled from 1995 to present. Upper Arm data was compiled from Upper Arm Core Data table to be incorporated with the present and future DWR collected cores at their 3 sites.
- "Ekman Dredge Sediment Data" - Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements for samples collected from 1991 to present. Includes data incorporated from the Clean Lake Report STORET data and the County's collection.
- "Lake Levels" - Lake levels for samples dates used in Lake Volume calculations. Data obtained from DPW records of Lake Levels.
- "Lake Volume Conversion Table" - Conversion factors used in conversion of concentration measurements to metric tons. Source of data: Clean Lakes Report Chapter 6 Methods.
- "Orthophosphate Data" - Orthophosphate measurements in [ppm] for lake water samples. Includes data incorporated from the Clean Lake Report STORET data and the County's collection.
- "Sampling Site Summary" - Summary of sampling dates from 1991 - present.
- "Sampling Site Codes" - Sites codes and names of sampling sites used in the Clean Lakes Report
- "Total Phosphorus Data" - Total Phosphorus measurements in [ppm] for lake water samples. Includes data incorporated from the Clean Lake Report STORET data and the County's collection.
- "Upper Arm Core Data" - Includes individual measurements and averages of Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g for each core section for data compiled from 1995 to present in the Upper Arm.

### Queries/Methods of Calculations

**Ekman Dredge Summary:** Averages multiple measurements of samples by date.

Source Data: Ekman Dredge Sediment Data table

Grouped by Location and Date. Then average of Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements. Location = "UA", "HOS", "NAR", "RATT", "LAE", "LAW".

**Ekman Dredge Lake Arm Summary:** Averages measurements by Lake Arm for each date.

Source Data: Ekman Dredge Lake Arm Summary query linked to Sampling Site table by Location;

Sampling Site table linked to Lake Volume Conversion Table by Lake Arm.

Grouped by Date and Lake Arm. Then average of average of Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements.

**Ekman Dredge Lake Bed Area Conversion:** Weighted measurements by % lake area.

Source Data: Ekman Dredge Lake Arm Summary query linked to Lake Volume Conversion Table by Lake Arm. Conversions calculated by taking Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements and multiplying by Proportion of Lake Bed area of given Lake Arm.

**Ekman Dredge Average Results:** Summarizes measurements over entire lake.

Source Data: Ekman Dredge Lake Bed Area Conversion query. Grouped by date and sum of Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements.

Wednesday, October 01, 1997

D:\Water\Methods and Information about the County Clear Lake Database.doc

**Ekman Dredge Phosphorus Metric Tons:** Calculates metric tons of measurements in lake.

Source Data: Ekman Dredge Average Results query. Grouped by date. Tons of sediment calculated by taking Fe/Al-P(NaOH) ug/g, Ca-P(HCL) ug/g, Res-P ug/g, Total P ug/g measurements and plugging into following equation:

Tons of [parameter] in sediment = [Sum of parameter in Lake]\*D\*E\*F\*G\*H

D = 1.25 g/cm<sup>3</sup> (Assumed density)

E = 0.13 (Assuming 13% Sediment)

F = 10 cm (Assumed thickness of Layer)

G = 1.37 x 10<sup>12</sup> cm<sup>2</sup> (Area of Lake Bottom)

H = 1 x 10<sup>-12</sup> Metric Tons/Micro gram

Refer to Clean Lakes Report Chapter 6 Methods

**Lake Volume Calculations:** Calculates volume of lake for a given Lake Level

Source data: Lake Level Table

Lake Volume (acre feet) = ([Lake Level] / 6) \* (39551 + 4 \* 39551 \* exp(0.0133 \* [Lake Level] / 2) + 39551 \* exp(0.0133 \* [Lake Level] )) + 841800

*Source of equation: Tom Smythe*

**Total Phosphorus Summary:** Total Phosphorus Data for surface measurements

Source data: Total Phosphorus Data Table

Group by Date, Location (Where = "Surface"), and Site. Average of Total Phosphorus Measurement.

**Total Phosphorus Lake Arm Summary:** Averages measurements by Lake Arm for each date.

Source Data: Total Phosphorus Summary query linked to Sampling Site table by Site.

Grouped by Date and Lake Arm and then Average of Total Phosphorus (ppm).

**Total Phosphorus Lake Volume Conversion:** Weighted measurements by % lake volume

Source Data: Total Phosphorus Lake Arm Summary query linked to Lake Volume Conversion table by Lake Arm.

Converted Total Phosphorus = Total Phosphorus \* Proportion of Total Lake Volume

**Total Phosphorus Average Results:** Summarizes measurements over entire lake.

Source Data: Total Phosphorus Lake Volume Conversion query

Group by Date and sum of converted Total Phosphorus

**Total Phosphorus Metric Tons:** Calculates metric tons of measurements in lake.

Source of Data: Total Phosphorus Average Results Query linked to Lake Volume Calculations by date.

Metric Tons of phosphorus = Sum of Converted Total Phosphorus \* Lake Volume (Acre - feet) then convert units to metric tons.

**Pete Total Phosphorus Summary:** All phosphorus data by date for Pete's graphs.

### Forms:

**Core Entry Data Form:** Form to enter results from cores taken by DWR and analyzed by Hopland Field station at 3 DWR sampling sites. Data entered goes into Clear Lake Core data table.

**Notes about Data file structure:**

**D:\water\lakedata\**

**~\Archive**

Dana Thibeu's original files of the County's lake data. All of this data has been incorporated into the LakeData database in Access '97.

**~\CLR Data**

Text files of data that were submitted to the EPA STORET system. This data was generated in the Clean Lakes report. All of this data has been incorporated into the LakeData database in Access '97.

**~\DWR Lake Data**

Text files of data obtained from the DWR containing data from their monthly sampling program.

**~\Charts For Pete**

Data used to generate figures for Dr. Pete Richerson for the First Annual Clear Lake symposium. This data was exported from the LakeData database into Excel. Contains data from 1991 to June of 1997 for Phosphorus and UA core data. Power Point presentation contains figures used for report.

**Future data**

Ekman dredge samples are currently not being taken anymore at the present time, therefore the database and charts for the symposium report contain all the data for the Ekman dredge samples

The County is no longer (as of August 1997) performing monthly lake sampling. The DWR is continuing their monthly sampling regime at their 3 designated sites (since 1960's). These sites closely coincide with the County's sites. The DWR samples for all of the parameters (and more) that the County's program did. Therefore all of the future water quality results will be available from the DWR. We have already set up communication to receive the data periodically and this data will be set up in a separate database. Any additions to the symposium charts will need to be done specifying the new sample sites and merging final data from both databases because of differences in file formats and data. This can simply be done by extracting final values from the DWR database and running them through the same calculations listed above.

Core samples are now being taken by the DWR at the 3 sites. This data is analyzed by Chuck Vaughn at the Hopland field station and entered into the LakeData database as described above.