CONTRACT

THIS CONTRACT is entered into between the STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION, whose address is 2600 Blair Stone Road, Tallahassee, Florida 32399-2400 (hereinafter referred to as the "Department") and the ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, INC. whose address is 10545 Mackall Road, St. Leonard, Maryland 20685 (hereinafter referred to as the "Contractor"), a Pennsylvania non-profit corporation authorized to transact business in Florida, to provide services for the biogeochemical control of mercury methylation in the Florida Everglades.

In consideration of the mutual benefits to be derived herefrom, the Department and Contractor do hereby agree as follows:

1. The Department does hereby retain the Contractor to perform the services for the biogeochemical control of mercury methylation in the Florida Everglades as defined herein and the Contractor does hereby agree to perform such services upon the terms and conditions set forth in this Contract, Attachment A (Scope of Services), and all attachments and exhibits named herein which are attached hereto and incorporated by reference.

2. The Contractor shall perform the services in a proper and satisfactory manner as determined by the Department. Any and all equipment, products or materials necessary to perform this Contract shall be supplied by the Contractor, unless otherwise specified herein.

3. The Contractor shall perform as an independent contractor and not as an agent, representative, or employee of the Department.

4. As consideration for the services rendered by the Contractor under the terms of this Contract, the Department shall pay the Contractor on a cost reimbursement basis not to exceed $225,000 for the term of this Contract. The initial funding increment for the period of service commencing with execution of this Contract and ending June 30, 1998, is set at $75,000. Based upon continued satisfactory performance and annual appropriations by the Legislature, the Department reserves the right to provide increments of funding on an "as needed" basis up to $225,000. The Contractor shall be notified, by certified letter from the Department's Mercury Coordinator, Division of Administrative and Technical Services, of additional funding increments. All bills for amounts due under this Contract shall be submitted in detail sufficient for a proper pre-audit and post-audit thereof.

   The Contractor shall submit quarterly progress reports. Quarterly progress reports shall be submitted in conjunction with invoices, if applicable, along with a summary of all expenditures which shall include details of the current quarter expenditures for each funding source, as well as the funding period to date. It is understood and agreed that manuscripts developed under this Contract shall be viewed as final deliverables for each funding period. A detailed final report which shall include a compilation of all manuscripts prepared under this Contract is due no later than thirty (30) days prior to the completion date of the Contract.

The State Comptroller requires detailed supporting documentation of all costs under a cost reimbursement Contract. In accordance with Comptroller's Memorandum No. 10, issued December 18, 1991 (attached hereto and made a part hereof as Attachment B), the Contractor shall comply with the minimum requirements set forth therein. Invoices shall be accompanied by supporting documentation and other requirements as follows:

A. Salaries/Wages - List personnel involved, salary rates and hours/time spent on project.

B. Overhead/Indirect/General and Administrative Costs - All multipliers used (i.e. fringe benefits, overhead, and/or general and administrative rates) shall be supported by audit. If the Department determines that multipliers charged by the Contractor exceeded the rates supported by audit, the Contractor shall be required to reimburse such funds to the Department within 30 days of written notification. Interest on the excessive charges shall be calculated based on the prevailing rate used by the State Board of Administration.

   i. Fringe Benefits - Shall be calculated at 20% of direct salaries.

   ii. Indirect Rate - Shall be calculated at 72.33% of total direct costs, less equipment purchases.

C. Contractual (Subcontractors) - Reimbursement requests for payments to subcontractors must be substantiated by copies of invoices with backup documentation identical to that required from the Contractor. Subcontracts which involve payments for direct salaries shall clearly identify the personnel involved, salary rate per hour, and hours/time spent on the project. All multipliers used (i.e. fringe benefits, overhead, and/or general and administrative rates) shall be supported by audit. If the Department determines that multipliers charged by any subcontractor exceeded the rates supported by audit, the Contractor shall be required to reimburse such funds to the Department within 30 days of written notification. Interest on the excessive charges shall be calculated based on the prevailing rate used by the State Board of Administration. Invoices for reimbursement of fixed price subcontracts approved by the Department shall be documented by copies of the paid invoices.

D. Travel - Travel expenses and per diem must be documented by a State of Florida Travel Voucher with appropriate receipts. Reimbursement will be made in accordance with Section 112.061, Florida Statutes.

E. Equipment - (Capital outlay over $500 in value) - Reimbursement for the purchase of equipment is subject to specific approval of the Department. Include copies of invoices or receipts to document purchases.

F. Rental/Lease of Equipment - Include copies of invoices or receipts to document charges.

G. Other Expenses - e.g., Materials, supplies, phone, reproduction, mailing, must be documented by itemizing and including copies of receipts or invoices.

5. This Contract shall begin upon execution by both parties and end twenty-four (24) months following execution, inclusive. In accordance with Section 287.058(2), Florida Statutes, the Contractor shall not be eligible for reimbursement for services rendered prior to the execution date of this Contract.

6. The State of Florida's performance and obligation to pay under this Contract is contingent upon an annual appropriation by the Legislature.

7. Pursuant to Section 215.422, Florida Statutes, the Department's Contract Manager shall have five (5) working days, unless otherwise specified herein, to inspect and approve the services for payment; the Department must submit a request for payment to the Florida Department of Banking and Finance within twenty (20) days; and the Department of Banking and Finance is given ten (10) days to issue a warrant. Days are calculated from the latter date the invoice is received or services received, inspected, and approved. Invoice payment requirements do not start until a proper and correct invoice has been received. Invoices which have to be returned to a contractor for correction(s) will result in a delay in the payment. A Vendor Ombudsman has been established within the Florida Department of Banking and Finance who may be contacted if a contractor is experiencing problems in obtaining timely payment(s) from a State of Florida agency. The Vendor Ombudsman may be contacted at 850/488-2924 or 1-800-848-3792.

8. In accordance with Section 215.422, Florida Statutes, the Department shall pay the Contractor, interest at a rate as established by Section 55.03(1), Florida Statutes on the unpaid balance, if a warrant in payment of an invoice is not issued within forty (40) days after receipt of a correct invoice and receipt, inspection, and approval of the goods and services. Interest payments of less than $1 will not be enforced unless a contractor requests payment. The interest rate established pursuant to Section 55.03(1), by Comptroller's Memorandum No. 3 (1996-97) dated December 3, 1996, has been set at 10% per annum or .02740% per day. The revised interest rate for each calendar year beyond 1997 for which the term of this Contract is in effect can be obtained by calling the Department of Banking and Finance, Vendor Ombudsman at the telephone number provided above or the Department's Contracts Section at 850/922-5942.

9. The Contractor shall save and hold harmless and indemnify the State of Florida and the Department against any and all liability, claims, judgments or costs of whatsoever kind and nature for injury to, or death of any person or persons and for the loss or damage to any property resulting from the use, service, operation or performance of work under the terms of this Contract, resulting from the negligent acts of the Contractor, his subcontractor, or any of the employees, agents or representatives of the Contractor or subcontractor to the extent allowed by law.

10. The Department may terminate this Contract at any time in the event of the failure of the Contractor to fulfill any of its obligations under this Contract. Prior to termination, the Department shall provide ten (10) calendar days written notice of its intent to terminate and shall provide the Contractor an opportunity to consult with the Department regarding the reason(s) for termination.

    The Department may terminate this Contract without cause and for its convenience by giving thirty (30) calendar days written notice to the Contractor. In this event, the Contractor shall be reimbursed for satisfactory work performed up through the date of said termination.

    Notice shall be sufficient if delivered personally or by certified mail to the address set forth in paragraph 11.

11. Any and all notices shall be delivered to the parties at the following addresses:

Contractor	Department
Academy of Natural Sciences of Philadelphia, Inc. Attn: Cynthia G. Gilmour, Ph.D. 10545 Mackall Road St. Leonard, Maryland 20685	Florida Department of Environmental Protection Attn: Thomas D. Atkeson, Ph.D. 2600 Blair Stone Road (MS#6540) Tallahassee, Florida 32399-2400

12. Pursuant to Section 216.2815, Florida Statutes, all records in conjunction with this Contract shall be public records and shall be treated in the same manner as other public records are under general law.

    This Contract may be unilaterally canceled by the Department for refusal by the Contractor to allow public access to all documents, papers, letters, or other material subject to the provisions of Chapter 119, Florida Statutes, and made or received by the Contractor in conjunction with this Contract.

13. The Contractor shall maintain books, records and documents directly pertinent to performance under this Contract in accordance with generally accepted accounting principles consistently applied. The Department, the State, or their authorized representatives shall have access to such records for audit purposes during the term of this Contract and for three years following Contract completion. In the event any work is subcontracted, the Contractor shall similarly require each subcontractor to maintain and allow access to such records for audit purposes.

14. The Department's Contract Manager is Dr. Thomas D. Atkeson, Mercury Coordinator, Phone 850/921-0884. The Contractor's Contract Manager is Dr. Cynthia G. Gilmour, Associate Curator, Phone 410/586-9713. All matters shall be directed to the Contract Managers for appropriate action or disposition.

15. The Contractor warrants that it has not employed or retained any company or person, other than a bona fide employee working solely for the Contractor to solicit or secure this Contract and that it has not paid or agreed to pay any person, company, corporation, individual, or firm, other than a bona fide employee working solely for the Contractor any fee, commission, percentage, gift or other consideration contingent upon or resulting from the award or making of this Contract.

16. The Contractor covenants that it presently has no interest and shall not acquire any interest which would conflict in any manner or degree with the performance of services required.

17. This Contract has been delivered in the State of Florida and shall be construed in accordance with the laws of Florida. Wherever possible, each provision of this Contract shall be interpreted in such manner as to be effective and valid under applicable law, but if any provision of this Contract shall be prohibited or invalid under applicable law, such provision shall be ineffective to the extent of such prohibition or invalidity, without invalidating the remainder of such provision or the remaining provisions of this Contract. Any action hereon or in connection herewith shall be brought in Leon County, Florida.

18. No delay or failure to exercise any right, power or remedy accruing to either party upon breach or default by either party under this Contract, shall impair any such right, power or remedy of either

party; nor shall such delay or failure be construed as a waiver of any such breach or default, or any similar breach or default thereafter.

19. The Contractor recognizes that the State of Florida, by virtue of its sovereignty, is not required to pay any taxes on the services or goods purchased under the terms of this Contract.

20. This Contract is neither intended nor shall it be construed to grant any rights, privileges or interest in any third party without the mutual written agreement of the parties hereto.

21. No person, on the grounds of race, creed, color, national origin, age, sex, or disability, shall be excluded from participation in; be denied the proceeds or benefits of; or be otherwise subjected to discrimination in performance of this Contract.

22. This Contract is an exclusive contract for services and may not be assigned in whole or in part without the written approval of the Department.

23. The Contractor shall not subcontract, assign, or transfer any work under this Contract without the prior written consent of the Department's Contract Manager. The Contractor agrees to be responsible for the fulfillment of all work elements included in any subcontract consented to by the Department and agrees to be responsible for the payment of all monies due under any subcontract. It is understood and agreed by the Contractor that the Department shall not be liable to any subcontractor for any expenses or liabilities incurred under the subcontract and that the Contractor shall be solely liable to the subcontractor for all expenses and liabilities incurred under the subcontract.

24. It is expressly understood and agreed that any articles which are the subject of, or required to carry out, this Contract shall be purchased from the corporation identified under Chapter 946, F.S., if available, in the same manner and under the same procedures set forth in Section 946.515(2), (4), F.S.; and for purposes of this Contract the person, firm or other business entity carrying out the provisions of this Contract shall be deemed to be substituted for this agency insofar as dealings with such corporation are concerned.

    The "Corporation identified" is PRISON REHABILITATIVE INDUSTRIES AND DIVERSIFIED ENTERPRISES, INC. (P.R.I.D.E.) which may be contacted at:

    P.R.I.D.E.
    5540 Rio Vista Drive
    Clearwater, Florida 34620-3107
    Telephone: (813)535-4900

25. To the extent required by law, the Contractor will be self-insured against, or will secure and maintain during the life of this Contract, Workers' Compensation Insurance for all of his employees connected with the work of this project and, in case any work is subcontracted, the Contractor shall require the subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees unless such employees are covered by the protection afforded by the Contractor. Such self-insurance program or insurance coverage shall comply fully with the Florida Workers' Compensation law. In case any class of employees engaged in hazardous work under this Contract is not protected under Workers' Compensation statutes, the Contractor shall

provide, and cause each subcontractor to provide, adequate insurance satisfactory to the Department, for the protection of his employees not otherwise protected.

26. The Contractor, as an independent contractor and not an agent, representative, or employee of the Department, agrees to carry adequate liability and other appropriate forms of insurance. The Department shall have no liability except as specifically provided in this Contract.

27. Since chemical and biological analyses are a part of the Contract Scope of Work, the Contractor shall adhere to the following Quality Assurance requirements.

A. Upon Contract execution the Contractor shall submit a RQAP for the purpose of approval by the Department's Quality Assurance (QA) Section. The RQAP shall be prepared in accordance with Section 6 of the document entitled "DEP Manual for Preparing Quality Assurance Plans, DEP-QA-001/90", revised September 30, 1992.

B. The RQAP shall be submitted <u>through</u> the Department's Contract Manager to the QA Section. Failure to submit the QA Plan within one month of Contract execution shall result in suspension of the Contract until the document has been submitted to the Department's QA Section.

C. The Contractor will have three (3) opportunities to submit the RQAP to the Department's Quality Assurance Section for approval. If the Plan fails the approval process three (3) times, the Department may terminate the Contract in its entirety. The Contractor shall adhere to the data validation requirements for laboratory analysis contained in Attachment C, attached hereto and made a part hereof. Failure to provide an acceptable QA Plan will result in suspension or termination of this Contract.

D. The DEP contract number shall appear on the title page of the submitted RQAP. Within thirty (30) days of receipt of properly identified QA Plan(s) by the Department's QA Section, the QA Section shall review and either approve the QA Plan, or provide comments to the Contractor as to why the Plan is not approved. If further revisions are needed, the Contractor shall then have fifteen (15) days from the receipt of such comments to respond. The QA Section shall respond to all revisions within 30 days of receipt in the QA Section.

E. If QA Plan review is delayed, through no fault of the Contractor, beyond sixty (60) days after the Plan is received by the QA Section, the Contractor shall have the option, after the Plan is approved, of requesting and receiving an extension in the term of the Contract for a time period not to exceed the period that QA approval was delayed. This option must be exercised at least sixty (60) days prior to the current termination date of the Contract.

F. Sampling and analysis may not begin until the RQAP has been given approval or "approval pending" status. However, even if approval pending status has been given, failure to obtain full approval within the time frames specified by the Department will result in suspension or termination of this Contract.

G. All sampling and analyses performed under this Contract must conform to the requirements set forth in Chapter 62-160, Florida Administrative Code (F.A.C.).

H. Once approved, the Contractor shall follow the protocols specified in the RQAP including, but not limited to:

i. Ensuring that all stated quality control measures are collected, analyzed and evaluated for acceptability;
ii. Using only the protocols approved in the RQAP; and
iii. Using only the equipment approved in the RQAP.

I. If any changes as outlined in Rule 62-160.220(6)(d) occur, the Contractor shall submit appropriate amendments through the Project Manager to the QA Section. Such amendments are subject to Rule 62-160.220(6)(d) requirements and the same conditions as the original submittal (see C, D, and E above). Failure to submit the required amendments or to meet any of the above-stated conditions may result in the decision by the Contract Manager to suspend or terminate the Contract.

28. Upon satisfactory completion of this Contract, and since the Department is only paying for a percentage on the equipment purchases under this Contract, the Contractor may retain ownership of the equipment purchased under this Contract. However, the Contractor shall complete and sign a Property Reporting Form, DEP 11-041, provided as Attachment D, and forward it along with the appropriate invoice to the Department's Contract Manager. The following terms shall apply:

A. The Contractor shall have use of the equipment for the authorized purposes of the contractual arrangement as long as the required work is being performed. In the event that this Contract is terminated for failure of the Contractor to perform, the Contractor shall reimburse the Department for the Department's percentage on equipment purchases under this Contract.

B. The Contractor is responsible for the implementation of adequate maintenance procedures to keep the equipment in good operating condition.

C. The Contractor is responsible for any loss, damage, or theft of, and any loss, damage or injury caused by the use of, non-expendable personal property or equipment purchased with state funds and held in his possession for use in a contractual arrangement with the Department.

29. The Department may at any time, by written order designated to be a change order, make any change in the work within the general scope of this Contract (e.g., specifications, time, method or manner of performance, requirements, etc.). All change orders are subject to the mutual agreement of both parties as evidenced in writing. Any change order which causes an increase or decrease in the Contractor's cost or time shall require formal amendment to this Contract.

30. The Contractor and any Licensor, if different from the Contractor, warrants that each item of hardware, software, and/or firmware delivered, developed or modified under this Contract shall be able to accurately process date data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including leap year calculations, when used in accordance with the item documentation provided by the Contractor, provided that all items (e.g. hardware, software, firmware) used in combination with other designated items properly exchange date data with it. **The duration of this warranty and the**

remedies available to the State for breach of this warranty shall be as defined in, and subject to, the terms and limitations of any general warranty provisions of this Contract, provided that notwithstanding any provision to the contrary in such warranty provision(s), or in the absence of any such warranty provision(s), the remedies available to the State under this warranty shall include repair or replacement of any item whose non-compliance is discovered and made known to the Contractor in writing within ninety (90) days after acceptance. Nothing in this warranty shall be construed to limit any rights or remedies the State may otherwise have under this Contract with respect to defects other than Year 2000 performance.

31. The Contractor and any Licensor, if different from the Contractor, represents and warrants that the software, which is licensed to licensee/Department hereunder, is designed to be used prior to, during, and after the calendar year 2000 AD, and that the software will operate during each such time period without error relating to date data, specifically including any error relating to, or the product of, date data which represents or references different centuries or more than one century. Without limiting the generality of the foregoing, the Contractor and any Licensor, if different from the Contractor, further represents and warrants (1) that the software will not abnormally end or provide invalid or incorrect results as a result of date data, specifically including date data which represents or references different centuries or more than one century; (2) that the software has been designed to ensure year 2000 compatibility, including, but not limited to, date data century recognition, calculations which accommodate same century and multi-century formulas and date values, and date data interface values that reflect the century; (3) that the software includes "year 2000 capabilities", which means the software (a) will manage and manipulate data involving dates, including single century formulas and multi-century formulas, and will not cause an abnormally ending scenario within the application or generate incorrect values or invalid results involving such dates; and (b) provides that all date-related user interface functionalities and data fields include the indication of century; and (c) provides that all date-related data interface functionalities include the indication of century.

32. In the event of any decrease in hardware or software program functionality related to time and date related codes and internal subroutines that impede the hardware or software programs from operation beyond the Millennium Date Change, the Contractor and any Licensors, if different from the Contractor, and Vendors of such Contractor/Licensors products agree to immediately make required corrections to restore hardware and software programs to the same level of functionality as warranted herein at no charge to the licensee/Department, and without interruption to the ongoing business of the licensee/Department, time being of the essence.

33. By execution of this Contract, the Contractor certifies that all information technology products resulting from this Contract will continue to operate properly upon the arrival of Year 2000.

34. The employment of unauthorized aliens by any contractor/vendor is considered a violation of Section 274A(e) of the Immigration and Nationality Act. If the Contractor/vendor knowingly employs unauthorized aliens, such violation shall be cause for unilateral cancellation of this Contract. The Contractor shall be responsible for including this provision in all subcontracts with private organizations issued as a result of this Contract.

35. A person or affiliate who has been placed on the convicted vendor list following a conviction for a public entity crime may not perform work as a grantee, contractor, supplier, subcontractor, or consultant under a contract with any public entity, and may not transact business with any public

entity in excess of the threshold amount provided in Section 287.017, F.S., for Category Two, for a period of 36 months from the date of being placed on the convicted vendor list.

36. The Contractor shall comply with all applicable federal, state and local rules and regulations in providing services to the Department under this Contract. The Contractor acknowledges that this requirement includes compliance with all applicable federal, state and local health and safety rules and regulations. The Contractor further agrees to include this provision in all subcontracts issued as a result of this Contract.

37. This Contract represents the entire agreement of the parties. Any alterations, variations, changes, modifications or waivers of provisions of this Contract shall only be valid when they have been reduced to writing, duly signed by each of the parties hereto, and attached to the original of this Contract, unless otherwise provided herein.

IN WITNESS WHEREOF, the parties have caused this Contract to be duly executed, the day and year last written below.

ACADEMY OF NATURAL SCIENCES
OF PHILADELPHIA, INC.

By: _____
Title:

Date: 11/12/97

FEID No.: 23-1352000

FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION

By: Thomas D. Atkeson
DEP Mercury Coordinator

Date: Nov. 3, 1997

_____
DEP Contracts Administrator

Approved as to form and legality:

_____
DEP Attorney

List of attachments/exhibits included as part of this Contract:

Specify Type	Letter/ Number	Description (include number of pages)
Attachment	A	Scope of Services (18 pages)
Attachment	B	Comptroller's Memorandum No. 10 (2 pages)
Attachment	C	Data Validation Requirements (6 pages)
Attachment	D	DEP Property Reporting Form (1 page)

ATTACHMENT A
SCOPE OF SERVICES

DEP CONTRACT SP434
DISTRIBUTION AND BIOGEOCHEMICAL CONTROL OF MERCURY METHYLATION IN THE FLORIDA EVERGLADES
PHASE II: 1997-1999

Phase I of this study was funded by the USEPA and the South Florida Water Management District (SFWMD) for 3 years. Phase I is essentially complete as of the date of this proposal, awaiting only completion of data analysis and preparation of a final report. Final deliverables of Phase I will be provided to FDEP as an in-kind service. Funding for Phase II, as embodied in this proposal, is being sought collectively from a group of agencies: FLDEP Mercury Program; US Geological Survey; and SFWMD. The attached budget reflects DEP's proportional funding as well as that of the cooperating agencies.

PROJECT OVERVIEW

Mercury in the Florida Everglades became an issue with the discovery of high levels of Hg in piscivorous fish and apparent Hg toxicity to fish-eaters, such as certain wading birds and the Florida Panther, in the later 1980's and early 1990's. With regard to elevated levels of Hg in fish, Florida is not unique. Most US states have issued public health advisories for the consumption of fish due to Hg within the last decade. However, the Everglades ecosystem is substantially different from other ecosystems, mainly temperate lakes, where Hg bioaccumulation problems have been previously identified and studied.

In 1994, a consortium of agencies agreed to begin a multi-agency, multi-investigator study of the factors contributing to the high levels of Hg in Everglades biota. The overall objective has been to understand Hg cycling well enough to create management strategies that will minimize MeHg bioaccumulation in the Everglades, while fulfilling other management objectives such as nutrient reduction and hydroperiod restoration.

As part of that study, we have been funded to examine the process of Hg methylation. The rate of in situ MeHg production is a key factor in MeHg bioaccumulation, as Hg(II) must be methylated, forming MeHg, before it will be bioaccumulated. Detailed studies of Hg cycling in lakes have shown that changes in methylation rate can result in increased net MeHg production (Gilmour et al. 1992) and subsequent bioaccumulation in fish (Weiner 1988; Weiner et al. 1990), without increased Hg input to the lake (Bloom et al. 1991; Watras et al. 1994). Changes in methylation rate may be driven by sulfuric-acid deposition, reservoir formation and possibly wetland creation (Bodaly et al. 1984; Kelly et al. 1996). Some types of ecosystems appear predisposed to high rates of methylation, including wetlands (St. Louis et al. 1994, 1995, Krabbenhoft et al. 1995; Branfireun et al. 1996), while other types of ecosystems, like estuaries and coastal waters, are not (Benoit et al. 1997).

The objectives of our work in the Everglades are to determine the importance of Hg methylation in controlling MeHg levels in the Everglades, and to understand how factors such as water chemistry, Hg loading, eutrophication, and hydroperiod affect the methylation process in this wetland. We began work with the hypotheses that sulfate-reducing bacteria (SRB) mediate Hg methylation (Compeau and Bartha 1985; Gilmour et al. 1992; Krabbenhoft et al. in press), and that the primary site of methylation is at the oxic/anoxic interface, which is often near the sediment surface (Korthals and Winfrey 1987; Winfrey and Rudd 1990; Watras et al. 1995; Krabbenhoft et al. in press).

PHASE I RESULTS TO DATE AND DIRECTIONS FOR PHASE II

Methylmercury (MeHg) concentrations and production rates were examined along with sulfur biogeochemistry in Everglades sediments during five field trips in 1995 and 1996, as part of a large, multi-investigator study of the aquatic cycling of Mercury (Hg) in the Everglades (the ACME project). The sites examined constitute a trophic gradient, generated from agricultural runoff, across Water Conservation Areas 2A, 2B and 3 in the northern Everglades, and in the Everglades Nutrient Removal (ENR) Area, which is a re-constructed wetland (Figure 1). MeHg concentrations and %MeHg (MeHg as a percent of total Hg) were lowest in the more eutrophic areas and highest in the more pristine areas in the south (Figure 2). MeHg concentrations ranged from <0.1 ng g^{-1} sediment in the ENR to 5 ng g^{-1}(d.w.) in WCA3 sediments; and MeHg constituted <0.2% of total Hg (Hg_T) in ENR, but up to about 5% in central WCA3. Methylation was generally maximal at or within centimeters of the sediment surface, and was never observed in water overlying cores. The spatial pattern of MeHg production generally matched that of MeHg concentration. The coincident distributions of MeHg and its production suggest that in situ production controls concentration, and that MeHg concentration might be used as a good analog for MeHg production. In addition, the spatial pattern of MeHg in Everglades sediments matches that in biota, suggesting that MeHg bioaccumulation may be predominantly a function of the de novo methylation rate in surficial sediments.

The spatial MeHg pattern was not driven primarily by total Hg concentration. Rather, of the parameters measured by our group, sulfate and sulfide levels were the best predictors of MeHg. Sulfate concentrations (up to 500 μM), microbial sulfate-reduction rates (up to 2000 nmoles cc^{-1} d^{-1}) and resultant pore water sulfide concentrations (up to 300 μM) at the eutrophic northern sites were all high relative to most freshwater systems. All declined to the south, although sulfate reduction rates remained relatively rapid in the south, probably due to rapid recycling of sulfide of sulfide within sediments. Sulfate concentrations in WCA2B and in central WCA3 resemble those in oligotrophic lakes (50-100 μM). MeHg concentration and production were inversely related to sulfate reduction rate and pore water sulfide (Figure 3). Control of MeHg production in the northern Everglades appears to mimic that of an estuary, where sulfate concentrations are high and where sulfide produced by microbial sulfate reduction inhibits MeHg production (Gilmour et al. in press).

Figure 4 shows the hypothetical (4A) and measured (4B) relationships between surface water sulfate concentrations and %MeHg in sediments across a number of freshwater and estuarine ecosystems. Fig. 4B includes Everglades data collected through Dec. 1996. Above about 100 uM sulfate, sulfide accumulates in the sediments of most aquatic systems at levels sufficient to inhibit methylation. Below that level, sulfate reduction is limited by sulfate concentration, and sulfate can stimulate sulfate reduction and methylation.

The relationship between %MeHg ((MeHg/Hg)*100) in sediments and surface water sulfate is roughly the same in the Everglades as we have observed in other ecosystems, with %MeHg increasing dramatically below 100 μM sulfate. In the Everglades this means that %MeHg is high in WCA-2B and central WCA-3, and relatively low in northern WCA-2A and in ENR. This pattern also suggests that as long as sediments in ENR remain sulfidic, methylation rates should remain low in this constructed wetland. Everglades sediments in central WCA-3 are near maximum %MeHg values, and sulfate concentrations appear optimal for support of sulfate-reducers without accumulation of dissolved sulfide. It will be important to find out if

MeHg production and concentration remain high in the southern Everglades, or if sulfate limits sulfate-reduction and MeHg production farther down the gradient, as has been found in other ecosystems. Preliminary data from April 1997 (a relatively dry period sampling) suggests that %MeHg in surficial sediment is also high in southern WCA-3 and in non-brackish areas of ENP (Fig. 5).

Sulfide inhibits methylation by controlling the availability of Hg(II) to methylating microorganisms. Recently we have found that the mechanism of sulfide inhibition of methylation is not the expected one, precipitation of HgS. Sulfide does not inhibit methylation by removing Hg from pore waters (Benoit et al. in press). In fact, Hg concentrations in pore waters increase with sulfide concentration. Experimental work with Hg methylation bacteria and equilibrium modeling of sediment pore waters suggested that negatively charged sulfhydryl-Hg complexes favored at high sulfide concentrations are not available for uptake by cells; while the neutral complex HgS^0, favored under mildly sulfidic conditions, can enter bacterial cells and be methylated. The availability and dissolution rate of Hg in the solid phase and the influence of solid phase speciation on methylation remain unknown.

It appears that the free Hg^{2+} cation is not the species transported into cells. Neutrally charged dissolved species do appear to cross cell membranes. Because the distribution of dissolved and solid Hg(II) phases is strongly affected by sulfur and DOC chemistry, modeling Hg methylation is critically dependent on knowing the bioavailability of these species. The control of Hg solubility and complexation also has wide implications for the relative availability of Hg from various sources for methylation.

The most basic issue in managing Hg in the Everglades is whether increased loading of Hg or other biogeochemical factors are more important in controlling Hg methylation. The most pristine Everglades seem to be excellent MeHg production factories. To date, the more "natural" southern Everglades appears, like many wetlands, to be predisposed to high rates of MeHg production. Conditions, particularly rapid sulfur cycling but low levels of sulfide accumulation, optimize Hg(II) bioavailability and the activity of methylating bacteria. In seeking a solution to the Hg problem, we must consider the possibility that management of hydrology and hydroperiod, and of nutrient and sulfate inputs may not provide a solution. There is some probability that reduction in Hg deposition to the Everglades will be necessary to reduce Hg bioaccumulation. It's also possible that no management strategy, including reduction in Hg input, will solve the problem. To resolve this issue, the quantitative response of the system to added Hg needs to be explicitly addressed.

We began to address the relationship between Hg concentration and methylation in Phase I. The spatial relationship between Hg and MeHg concentrations in sediments across the Everglades is significant, but very non-linear. Total Hg concentrations in surface sediments varied by about a factor of three across the gradient studied, while MeHg concentrations varied by two orders of magnitude. Concentration dependence experiments to date have shown a non-linear response of methylation rate to added Hg, with the magnitude of the response strongly affected by sediment chemistry. For example, the slope of the curve declined as sulfide increased. The slope and shape of the relationship between Hg loading and the rate of MeHg production will vary tremendously across the Everglades.

Methylation of Hg in periphyton was examined during the last three field trips. Methylation was very rapid in certain types of periphyton, specifically non-calcareous periphyton where microbial S redox cycling occurs. This type of periphyton appears to be more common in eutrophic areas. A consortium of microorganisms carry out an anaerobic cycle within this periphyton in which sulfate-reducing bacteria produce sulfide which is then

reoxidized photosynthetically by purple and green sulfur bacteria. Sulfur cycling was measured by direct measurement of microbial sulfate reduction and the presence of photosynthetic S pigments. Production appears to occur most rapidly in the dark, and was related to the measured rate of sulfate reduction.

The occurrence of MeHg production in periphyton has a number of important implications in the Everglades. Periphyton is a major component of total production and biomass in this ecosystem. It may provide a direct entry point for MeHg into the aquatic food web, as well as a source of MeHg to the water column and to surficial sediments. Periphyton-based polishing cells have also been proposed for use in STAs.

MeHg is produced in the sediment and periphyton but the mechanisms of transport of MeHg, whether diffusion, advection or disturbance, remains unknown. In order to estimate the contribution of *de novo* MeHg production in sediments and periphyton to MeHg accumulation in the food web, the routes and rates of MeHg transport out of these media must be understood. A preliminary set of experiments suggested that the diffusive efflux of MeHg from sediments is rapid relative to many ecosystems, where an iron-oxyhydroxide at the sediment surface effectively blocks efflux of MeHg across the sediment-water interface (Gagnon et al. 1996). Efflux of MeHg from intact sediment cores from site U3 was easily measurable in small (2L) chambers over 12 h.

STAs will reduce phosphate loading to the northern Everglades, but to date, ENR does not appear to have a large impact on sulfate loading. Will a decrease in the nutrient load to the northern WCAs change redox conditions and sulfide chemistry in surface sediments even if sulfate loading does not change? Changes in vegetation type and decreased growth rate resulting from reduced nutrient loads should also reduce anoxia and sulfide production in sediments, which may in turn affect Hg methylation rates. These questions arise from study of sulfur gradients and Hg methylation during Phase I, and will be a focus of Phase II.

Understanding the sources and rates of sulfate loading to the Everglades are critical to management of MeHg bioaccumulation. We will work with the ACME team to identify and quantify these sources in time and space. A key question is whether marine limestone underlying the Everglades, sulfur used in agriculture, or (in the southern Everglades) rain is the more important source. Another important issue is whether the source of sulfate changes from north to south. If limestone is an important source, can management practices such as the depth and location of canals alter sulfate input from this source? Or is limestone-derived sulfate carried through the peat in groundwater? If agriculture is an important source, can or should agricultural practice be changed to affect sulfate loading? How will changes in water flow and hydroperiod within the Everglades affect the concentration and distribution of sulfate? Will STA construction shift the maximum in MeHg production spatially? Or change the magnitude of MeHg production? Would a change in the timing or amount of sulfate loading impact Hg bioaccumulation?

RESULTS AND BENEFITS EXPECTED

This work will provide information necessary to the management of Everglades restoration. Overall, knowledge gained in Phases I and II will be used to help predict how construction of the STA, changes in hydroperiod, flow and other management practices will affect MeHg production. Specifically, this work will be used to select management options for the STA, agriculture, the WCAs and ENR that will minimize MeHg production and therefore bioaccumulation.

The overall goal of this project is to produce a predictive model for MeHg production in the Everglades. Work in Phase I suggests that net MeHg production is a key driver of MeHg accumulation in biota. The model will include eutrophic and unimpacted areas, and cattail- and periphyton-based STAs. The model will be based on field and experimental studies that consider the impact of sulfur chemistry; total Hg concentration and speciation; vegetation; hydroperiod; age of STAs; and peat depth and type. This work will also be used to help construct a model of MeHg production among ecosystem types. Such a model will help to identify critical areas of MeHg production, allow managers to minimize the impact of Hg contamination, and aid policy makers' decisions about the regulation of this global pollutant. This study will also shed light on those aspects of Hg methylation in aquatic systems that can't be explained by the concentration of total Hg alone. The control of Hg solubility and complexation has wide implications for the relative availability of Hg from various sources for methylation. Used together, the laboratory and field results will provide information about a crucial step in the complex pathway of Hg emissions, deposition, methylation, and eventual bioaccumulation and effects.

PUBLICATIONS AND PRESENTATIONS

The first series of publications from the ACME project are in press in *Biogeochemistry*:

Cleckner, L. B., P.J. Garrison, J.P. Hurley and D.P. Krabbenhoft. Relationships between water chemistry and trophic transfer of total and methylmercury in the northern Everglades.

Gilmour, C.C., G.S. Riedel, M.C. Ederington, J.T. Bell, J.M. Benoit, G.A. Gill and M.C. Stordal. Mercury methylation and sulfur cycling across a trophic gradient in the northern Everglades.

Hurley, J.P., D.P. Krabbenhoft, L.B. Cleckner, M.L. Olson, G. Aiken and P.J. Rawlik. System controls on aqueous mercury distribution in the Northern Everglades.

Krabbenhoft, D.P., Hurley, J.P., M.L. Olson, and L.B. Cleckner. Diurnal variability of mercury phase and species distribution in the Florida Everglades.

A number of presentations at scientific meetings have also been made including the following from our group:

1997 Gilmour, C.C., J. Benoit, G.A. Gill and M.C. Stordal. Mercury Methylation and Sulfur Cycling in the Northern Everglades. Am. Soc. Limnol. Oceanogr., Aquatic Sciences Meeting, Santa Fe, NM, February.

Benoit, J.J. and C.C. Gilmour. Mercury Speciation Controls on Bacterial Methylation. Am. Soc. Limnol. Oceanogr., Aquatic Sciences Meeting, Santa Fe, NM, February.

Gilmour, C.C. and J. Benoit. Methylation of Hg-S Complexes by Sulfate-Reducing Bacteria. Am. Soc. Microbiol. Miami, May.

1996 Gilmour, C.C., G. A. Gill, M. C. Stordal, and E. Spiker. Mercury Methylation and Sulfur Cycling in the Northern Everglades. Fourth International Conference on Mercury as a Global Pollutant, Hamburg, Germany, August, 1996.

PHASE II STUDY QUESTIONS

1) *Does MeHg production in sediments decrease southward from central WCA3, or is there a maxima between Tamiami Trial and Alligator Alley?*

2) *Does the relationship between MeHg production and MeHg concentration in sediments, water and biota in the northern Everglades extend into the southern Everglades?*

3) *What is the pool of Hg(II) available for methylation and how does its size change across the Everglades?*

4) *How will changes in nutrient loading affect sulfur chemistry and methylation in the Everglades?*

5) *How is MeHg transported from sites of production in surface sediments and peat into the water column? At what rate?*

6) *How important is periphyton in MeHg production in the WCAs, ENP and ENR?*

7) *Will periphyton-based STAs favor the growth of MeHg-producing periphyton? How might PASTA's be engineered to favor the growth of periphyton that adequately removes phosphate without producing MeHg?*

8) *How will changes in Hg loading affect MeHg production in the Everglades?*

9) *How will changes in Everglades management affect the distribution and magnitude of MeHg production in the Everglades?*

PHASE II TASKS

Seven tasks are described below to address the Phase II study questions. Methodology will continue as in Phase I, and only changes and additions to existing methods are given.

TASK 1. MEHG PRODUCTION AND BIOGEOCHEMISTRY IN THE SOUTHERN EVERGLADES.

We will extend our intensive studies of MeHg production south of the existing transect. The current southern extent of this transect is in central WCA3, at site 3A-15 south of Alligator Alley (Fig. 1). Southern sites will be chosen and work will be done in close conjunction with the other components of ACME - water column Hg biogeochemistry; pore water chemistry; photochemistry; diel cycling; and food web studies. Distributions of various S species through time and vertically and horizontally within sediments will be used to help allocated sulfate sources, in conjunction with work by Orem and Kendall. Field work will also be coordinated with developing studies of Hg deposition and evasion within the Everglades.

Study sites and intensity: Up to five intensive study sites and five synoptic sites in WCA 3A, 3B and ENP will be examined 3 times a year during calendar 1998 and 1999. Site choice will be based on surface water sulfate and nutrient concentrations; sediment sulfur chemistry, vegetation, and proximity to areas of high Hg concentrations in biota. Phase I study sites in the WCA 2A and 2B will be examined on a less frequent basis, as determined by the ACME group as a whole. Intensive sampling at ENR 103 and synoptic sampling at other ENR sites will continue 3 times per year.

Parameters: Parameters described in the Phase I proposal and currently being measured at the northern study sites will be measured at each southern site. Parameters in addition to basic weight and water content measurements are listed below. Parameters added for Phase II are in parentheses. The most significant change is an estimate the relative rate of total bacterial metabolism, measured through CO_2 + CH_4 production. A large suite of additional parameters on solids and pore waters are available from other ACME groups. Some parameters are being examined by multiple groups for QA and for comparability of data sets among ACME groups.

At intensive sites, all parameters will be measured with depth in duplicate cores, and selected parameters will be measured in three additional surface composites. At synoptic sites, parameters will be measured in duplicate 0-4 cm surface composites only. This design was used in Phase I.

Whole sediment	Solid phase	Pore water
^{203}Hg methylation	Reduced S, AVS,CRS (OS)	sulfate, sulfide
^{35}SO4 reduction	(Fe)	pH
(CH_4 and CO_2 production)		(chloride)
Hg, MeHg		(Fe)

Methods

Hg methylation

Hg methylation rates will continue to be measured using tracer additions of ^{203}Hg as described in Gilmour and Riedel (1995) and Gilmour et al. (1997). However, it is our intent to move toward measurement of methylation rate using stable Hg isotopes and ICP/MS analysis. We are working with Gary Gill and Texas A&M Galveston on this method. Whether 1) equilibration of added Hg with the solid phase is rapid enough relative to methylation to provide good estimates of ambient rates, and 2) the speciation of ^{203}Hg newly sorbed to sediments adequately reflects ambient speciation with regard to availability for methylation are subjects of continuing research in our laboratory.

Hg and MeHg analysis

Phase II represents a substantial increase in effort for our group over Phase I. To increase sample throughput and reduce costs, we propose to purchase and retrofit, in 1998, an automated headspace gas analyzer for use in MeHg analysis, modeled after the one in place in the Florida DEP's Hg laboratory in Tallahassee. Partial support ($20,000) for an automated headspace analysis system for MeHg is requested (total estimated cost $40,000). This system should almost double sample throughput, saving considerable technician time. We also propose to replace an aging Brooks Rand CVAF with a newer and more stable Tekran CVAF.

CO_2 and CH_4 production

Methane and carbon dioxide production will be measured with depth in sediments, using mini-cores in sealed vials, over very short time courses. Methane and CO_2 (after conversion to CH_4 using a methanizer), will be measured with a flame ionization detector. This work will be done pending funding for a Shimadzu Mini-GC system, proposed as part of a separate project. Funding for the GC is is not requested as part of this proposal. The GC will also be fitted with a flame photometic detector for very low level sulfide analysis (see below).

Sulfur chemistry

Because our models of Hg speciation predict that sulfide will impact Hg(II) bioavailability and methylation at concentrations below our current detection limit (5×10^{-7} M), we propose to improve our detection limit for sulfides in 1998 with the purchase of a flame photometric detector (FPD), using the gas-phase analytical method of Radford-Knoery and Cutter (1993). Analysis of total dissolved sulfide by gas chromatography with an FPD can yield detection limits of less than 10^{-10} M. As for the CO_2 and CH_4 work, purchase and use of the FPD will be done pending funding from a separate project; funding for the FPD is is not requested as part of this proposal.

Analysis of field data

Statistical analysis of field data will be performed to look for relationships between various measures of MeHg methylation (methylation rate, bulk MeHg, and percent MeHg) and the predicted speciation of Hg in both solid, colloidal and dissolved phases. To examine how Hg speciation might be used to predict Hg methylation rates, measured methylation rates within discrete samples (e.g. a sediment horizon or algal mat layer) will be compared to the following parameters:

1) Total measured Hg in each phase: dissolved, colloidal and solid.
2) The equilibrium speciation of dissolved Hg, calculated using stability constants and measured solution chemistry, as described above.
3) The ligand strength of colloids (stability constants with Hg), for the limited number of

samples for which this information will be available

4) The measured fractionation of Hg in the solid phase.

Comparisons will be made using statistical measures such as single and multiple regressions, and analysis of variance and covariance, across a number of scales: vertically within sediments; horizontally within an ecosystem, and across ecosystems of similar and dissimilar chemistries. Because of the size of the data base being generated from past and ongoing field studies, and the diversity of chemistries among existing and proposed field sites, these comparisons should be able to determine if, for example, methylation rates can be predicted from the dissolved HgS^0 concentration; or from the fraction of Hg_S that is loosely bound to surface organic layers; or from the type of colloidal organic matter present.

TASK 2. BIOAVAILABILITY OF HG(II) FOR METHYLATION.

We will examine the availability of dissolved, colloidal and solid-phase Hg species for methylation by 1) modeling Hg methylation rate and MeHg concentration against Hg speciation and sediment biogeochemisty at the intensive study sites across the Everglades; 2) empirical measurements of solid phase Hg speciation at the intensive study sites; 3) examination of the Hg(II) species available to methylating microorganisms using pure cultures and 4) manipulation of Hg speciation in Everglades sediments. This task is a continuation of ongoing work on the biogeochemical control of methylation.

Methods

Hg speciation and dissolution modeling.

Equilibrium calculations will be used to estimate the speciation of dissolved Hg in sediment porewaters and other matrices, using MINEQL (Westall et al. 1977) or a similar program that provides solutions to multiple simultaneous stability equations. Equilibrium models will be focused to calculate the concentration of those Hg complexes that are available for microbial uptake, based on culture work. In order to carry out these calculations a number of parameters including Hg_D, MeHg, Fe, pH, HS^-, SO_4^{2-}, total S, and DOC are measured. Polysulfides will be analyzed by cold cyanolysis (Then and Truper 1983), which yields low micromolar detection limits. Below that detection limit, the concentration and speciation of polysulfides will be calculated from sulfide, total S and pH as described above (Paquette 1994). With the exception of total S, these measurements are being made routinely in ongoing field studies of methylation.

Little work has been done to date to establish Hg binding constants with DOC (Hintelmann et al. 1995). Natural Everglades DOC will be isolated and characterized, and separated by functional group by G. Aiken at the USGS Boulder, CO, and J. Hurley of WI DNR and UW Madison Water Chemistry Dept. Aiken and Hurley will focus on determining stability constants for Hg with various DOC types and functional groups. These stability constants will be incorporated into speciation models as they become available. We will also use the isolated DOC in SRB culture experiments to will examine the availability of DOC-Hg complexes for methylation (see below).

While it is difficult to examine the speciation of Hg in sediments directly, the concentration of dissolved Hg and other important ligands can be measured and tested against calculated Hg concentrations. If HgS dissolution predicts dissolved Hg concentrations, it is a reasonable assumption that HgS forms are the major solid Hg phases in sediments, and

that their dissolution controls dissolved Hg concentrations. Preliminary data suggests that this will not be the case, especially in highly organic matrices.

In calculating HgS dissolution, both HgS polymorphs, cinnabar (red HgS) and metacinnabar (black HgS), will be considered. Cinnabar is the more stable form. However, when HgS is produced by precipitation in aqueous solution, it takes the form of metacinnabar because of the presence of impurities in natural waters. Studies by Barnes et al. (1967) and Paquette (1994) suggest that the concentration of dissolved Hg-sulfide complexes generated by the dissolution of metacinnabar can be anywhere from 23% to 3X higher than that generated by cinnabar.

Solid phase speciation.

We will begin to examine, empirically, the speciation of Hg in the solid phase. As part of the proposed study we will add measurement of Hg in the various solid phases, particularly Hg in amorphous and crystalline sulfide phases, and Hg in various extractable fractions. Analyses will focus on determination of Hg speciation under anoxic conditions, because Hg methylation is an anaerobic process. In particular, we will measure Hg in the solid sulfur phases using Hg-clean techniques that are extensions of the "Simultaneously Extractable Metals" methods described by DiToro et al. (1990) and techniques for the analysis of reduced S (AVS, CRS and OS) in sediments (Cornwell and Morse 1987; Fossing and Jorgensen 1989; Levnethal and Taylor 1990). Sequential extraction techniques similar to those described by Tessier and Campbell (1987) and by Mahoney et al. (1996) will be used to examine sorbed and more weakly bound Hg, particularly Hg sorbed to organics. Mahoney's technique (anoxic sequential batch titration) provides a method to examine metal sorption to organics under anoxic conditions in excess of metals in AVS/CRS fractions. Additionally, sediment organic carbon content, porosity and grain-size will be used to model the sorption of dissolved Hg to the solid phase.

Hg(II) bioavailability to sulfate-reducing bacteria.

We will continue to study the bioavailability of Hg(II) complexes for methylation by using pure SRB cultures and culture media in which the speciation of Hg can be defined and controlled. By changing that speciation in a known way, the Hg species that are available to cells for uptake and methylation can be determined. We will focus on dissolved and colloidal S-bearing ligands, including DOC. Isolated and well-characterized Everglades DOC for use in culture studies will be provided by George Aiken and Jim Hurley.

The availability of solid-phase Hg associated with a number of different sediment matrices will be tested with culture experiments. The source of Hg in these experiments will be a variety of ground ores and dried sediments of known total Hg content. Sorbed Hg sources will be made from standard reference materials that have been spiked with Hg prior to introduction into the cultures. The dissolved Hg concentration in culture medium will be monitored to determine the Hg concentration in solution over the time-course of the incubation. It is expected that in these experiments the amount of Hg in solution will be less than predicted based on the solubility of $HgS_{(s)}$ due to sorption to the solid-phase. However, for matrices that allow ready exchange with the aqueous phase, there is likely to be methylation in excess of dissolved Hg pool. We predict that the nature of the matrix will have a greater effect on the methylation rate than the total Hg concentration in the solid phase.

Sediment manipulation experiments.

This work is a continuation of Phase I work. The speciation of Hg(II) in either intact sediment cores or anoxic sediment composites is changed by the addition or removal of

ligands and adsorption surfaces. In Phase I we examined the effect of sulfide and sulfate using direct additions. In Phase II we will focus on the interactions of Hg and sulfide with DOC, and the solid phase.

TASK 3. NUTRIENT LOADING AND SULFUR BIOGEOCHEMISTY.

Phase I studies examined the levels of sulfate reduction and sulfide production at the study sites, but did not study how nutrients might affect sulfide production and Hg methylation through the growth and decay of vegetation. In phase II, we propose to examine how vegetation type and growth rate affects microbial processes, including sulfide production.

In particular, we will examine how the ecosystem will respond to continued high sulfate loads but decreased nutrient loadings. We propose to do this by continuing and intensifying study of a set of paired sites in WCA-2A (F1 and U3). Site F1 is currently a high sulfate (400-600μM), high nutrient, cattial-dominated site. It is high in sulfide and low in MeHg concentration and production. Site U3 is farther from the S-10 input structures, and nutrient concentrations are lower, but sulfate remains high, in the 300-500 μM range. Both are existing ACME intensive sites.

In addition to the parameters listed in Task 1, study of S and C cycling will be intensified at F1 and U3. Measurements will include sulfide production and reoxidation rates in root zones; horizontal and vertical variability in processes around plants; and manipulation studies where sediments from one site are amended with decaying vegetation from the paired site. Short-term (hours to days) studies will continue to address the direct effects of changing sulfate and sulfide concentrations on MeHg production rates. Short-term studies will be conducted using small-volume sediment samples manipulated and incubated in under anaerobic conditions. Longer-term studies will include litter bags (Heyes et al. 1997). If feasible, the field enclosures near U3 in WCA-2A would be an ideal way to examine the response of the microbial S cycle to nutrients through vegetation changes.

TASK 4. TRANSPORT OF MEHG FROM SITES OF PRODUCTION.

We proposed to quantify the flux of MeHg from sediments to the overyling water column via a suite of potential flux mechanisms. Flux directly into the food web will be examined by other ACME researchers. Flux will be measured using as follows:

A. Diffusive flux will be estimated via sediment pore water profiles, by 2 methods:
    1. Sliced cores
    2. Thin film gels (DGT)

B. Diffusive/advective flux will be estimated in stirred flux chambers deployed over peat and periphyton in the field.

D. Movement of MeHg out of periphyton and peat in the laboratory will also be estimated using stirred chambers, and by following the flux of *de novo* $Me^{203}Hg$ produced within peat of periphyton.

C. *In situ* flux from sediment and periphyton during wind events will be observed in the field. We will work during ACME diel studies at 3 sites. Sites will be chosen for

different levels and types of periphyton cover, and low and high MeHg concentrations in surficial sediments and periphyton. Flux will be measured by the change in MeHg concentrations in surface waters after mixing events, using wind speed, suspended solid and other ancillary parameters to estimate mixing.

Methods

Thin Film Gels (DGT). The sediment water interface is often a key division in the redox gradient, and rapid changes in the redox gradient can occur over a few centimeters if not millimeters. Redox transformations can greatly influence a metal solubility directly or through redox cycling of more sensitive metals such as Fe and S resulting in the scavenging of metals from the porewater (Mayer et al. 1982). An important methodological barrier to determining metal mobility lies in making fine scale measurements of metal concentrations through the redox gradient from which to calculate flux. A method called "Diffusion Gradients in Thin films" (DGT) has been developed to address this issue (Davison et al. 1997; Zhang et al., 1995). Strips, formed from a polyacrylamide gel sandwiched between a chelating resin and a diffusion membrane cover, are inserted into sediments, and the accumulation of the metal (whose diffusion rate across the gel is known) on the chelating resin over a period of time is measured. Extraction of the metals taken up by the strips can be performed on the millimeter scale thereby providing a resolution that is unattainable by other methods. To calculate the porewater free ion concentration, the exposure time must be short enough not to deplete the porewater pool and not upset the sediment porewater equilibrium. To calculate the total dissolved metal concentrations requires modeling the speciation, and thus requires further knowledge of the porewater chemistry.

TASK 5. MEHG PRODUCTION IN PERIPHYTON AND PERIPHYTON-BASED STAs.

The level and distribution of Hg methylation in periphyton in the southern Everglades: (WCA 3A, 3B and ENP) will be measured as described for surficial sediments in Task 1. Periphyton and sediment measurements will be made concomitantly. Periphyton methylation work will also be integrated studies of MeHg flux from periphyton and with food web and stable C,N, and S studies. As a team, ACME will increase its emphasis on characterization of periphyton with regard to type and quantitative distribution during Phase II.

The design of studies to examine MeHg concentration and production in periphyton-based STAs periphyton will be determined as test cells are designed and constructed. In collaboration with Hurley and Cleckner we will characterize periphyton as it develops in the PASTAs by microscopy, pigment analysis, S chemistry, rates of microbial sulfur cycling, Hg and MeHg concentrations and MeHg production rates. This work would need to be done in collaboration with researchers studying the basic relationships between PASTA design, phosphate loading and periphyton growth.

TASK 6. RESPONSE OF MEHG PRODUCTION TO HG LOADING/ENCLOSURE STUDIES.

In Phase II, we propose to pursue quantification of the relationships between Hg loading and MeHg production by a) broadening the spatial extent of our data set on Hg and MeHg concentration, methylation rates and sediment biogeochemistry as described in Task 1; b) additional short-term studies of the concentration dependence of methylation on Hg under different biogeochemical conditions and c) long-term studies of Hg addition in Everglades field

enclosures or mesocosms.

Because the gradient in Hg concentration (expressed as dry weight) across the study sites in the northern Everglades is only about a factor of 5 (while MeHg ranges across more than two orders of magnitude), because of small-scale spatial heterogeneity in sediments, and because of the overriding influence of sulfur chemistry, careful quantification of the relationship between Hg loading and MeHg production using the Everglades field data set will be difficult. Short term Hg addition experiments are useful in examining processes, and will continue in Phase II, but may not predict long-term responses, because of changes in Hg speciation over time after loading. We therefore propose longer-term Hg addition experiments to confined systems, either field enclosures or laboratory mesocosms. Criteria for choosing a field site for a first trial might be a) a site with significant MeHg production, which is representative of the major portion of the Everglades studied to date, and so that responses to Hg additions will be readily measured; b) a well-characterized site such as one of the intensive sites studied in Phase 1 and c) a site with reasonable accessibility by airboat and/or existing enclosures, to minimize costs.

Stable Hg isotopes could be used as part of an initial Hg spike to follow the cycle of new Hg added to the system, from initial partitioning, accumulation in vegetation, MeHg production and accumulation in sediments, fluxes and accumulation in the food web. Stable isotope additions could also be used to trace burial, postdepositional reworking of Hg through sediments and plants, and Hg^0 formation. Important unknowns are the availability of Hg in decaying plant material relative to newly deposited Hg sorbed to sediments for methylation; and the recycling of buried Hg to the sediment surface through plant growth and decay.

The choice and design of enclosures as an approach to studying Hg loadings must be made by the supporting agencies and by the ACME group as a team. This approach will require significant support from the SFWMD and the other agencies supporting ACME. Because the use of stable isotopes is a very attractive methodology for studying Hg cycling in enclosures, significant support for a laboratory with the ability and experience to do the stable isotope analyses will also be needed. Only limited work on MeHg production, microbial processes and S chemistry in a small number of enclosures can be accommodated with the proposed budget, unless other studies are minimized.

TASK 7. MODELING MEHG PRODUCTION. Quantitative models for MeHg production remain weak because of the complexity of the process. Hg methylation rates in natural systems are a function of the activity of methylating bacteria and of the availability of Hg for methylation. We hypothesize that the chemical speciation of Hg, including dissolved, colloidal and solid forms, is at least as important as the rate of microbial activity in controlling MeHg production.

However, our understanding of MeHg production is now at the point where the research community can begin to construct a model for MeHg production among ecosystems. Good information is available, or will be available soon, on the rate and control of MeHg production in a temperate and a sub-tropical seepage lake, a boreal reservoir and nearby wetlands, a heavily contaminated sub-tropical and a moderately contaminated temperate estuary, and a highly-contaminated temperate drainage lake, in addition to the Everglades. One of the goals of this project will be to determine if a predictive model for MeHg production among ecosystems can be produced, based on the chemical speciation of Hg in the matrix where methylation occurs. Such a model will help to identify critical areas of MeHg production, allow managers to minimize the impact of Hg contamination, and aid policy makers' decisions about

the regulation of this global pollutant.

As part of this study, we propose to collaborate with other researchers in the field to produce this model. John Rudd and Carol Kelly, who work mainly in boreal systems in the Experimental Lakes Area (ELA); and Reed Harris, lead modeler for the Mercury Cycling Model (MCM) development, have agreed to work with us to develop a trial model for methylation in late 1997, which would then be used to guide field and experimental work during Phase II of the ACME project, and in continuing work in ELA. We will also continue to work with Bob Ambrose at EPA AERL pending EPA support for his Hg modeling work. Use of box models (with STELLA) within our own group will be used as a simple check on more complex models.

Time line:

1997: Initiate Phase II, Year 1:

Scoping work in "southern" Everglades - WCA -3A, 3B and ENP
Experimental studies on relationships between sulfate, sulfide and methylation.
Scoping sediment/water and periphyton/water flux studies.
Manuscripts planned for 1997:

1) Distribution of MeHg production in the Northern Everglades (Gilmour et al. in press);
2) Bioavailability of HgS^0 (Benoit et al, in prep). 3) MeHg production in Everglades periphyton (Cleckner et al. in prep).

1998 and 1999: Phase II field work.

Complete field portions of Tasks listed above.
Planned manuscripts for early 1998:

1) Comparison of %MeHg among ecosystem types including northern Everglades;
2) MeHg production in ENR.

ACME session at Fifth Conference on Hg as a Global Pollutant, 1999.

1999: Wrap up Phase II.

Complete laboratory and data analyses from Phase II.
Complete modeling work.
Data analysis and modeling workshops with ACME group
Final Report, Phase II
ACME summary presentations at major scientific meetings .

	The Academy of Natural Sciences											
	Esturarine Research Center - Execution through 9/31/99											
			SFY 97/98			SFY 98/99			SFY 99/00			
NAME	Cost Code	# Days	Daily Rate	Salary	# Days	Daily Rate	Salary	# Days	Daily Rate	Salary		TOTALS
BELL	1173	85	$142.76	$12,135.00	110	$148.93	16,382.00	60	$156.72	$9,403.00		$38,623.41
BENOIT	1284	28	$129.71	$3,632.00	42	$134.05	5,630.00	14	$139.57	$1,954.00		$11,703.33
GILMOUR	1877	50	$285.22	$14,261.00	60	$298.03	17,882.00	30	$312.90	$9,387.00		$42,566.15
Technician		80	$117.63	$9,410.00	130	$121.24	15,761.00	50	$126.60	$6,330.00		$32,126.46
HEYES	1532	90	$170.86	$15,377.00	110	$178.43	19,627.00	55	$187.78	$10,328.00		$46,124.06
RIEDEL, GEORGIA	1880	85	$170.25	$14,471.00	100	$178.00	17,800.00	50	$186.88	$9,344.00		$42,385.13
TOTAL SALARIES				69,286			93,082			46,746		209,114
FRINGE BENEFITS - 20% SAL.				13,857			18,617			9,349		41,823
Analytical Services	7501 9			3,500			3,500			2,000		9,000
Laboratory Supplies	7511 4			15,400			15,400			1,900		32,700
Equipt. Purchase - Lab	7532 5			7,000			20,000			4,000		31,000
Travel - other	7578 7			29,860			30,000			7,600		67,460
Shipping Costs	7626 9			3,000			3,000			1,000		7,000
Lab Equipt Usage	7661 9			1,000			1,000			500		2,500
Lab Equipt. R & M	7534 5									4,000		4,000
Chemical Waste Disposal	7667 9			500			500			500		1,500
Photocopy Expense	7691 9			150			150			150		450
TOTAL DIRECT COSTS				143,553			185,249			77,745		406,547
MODIFED TOTAL DIRECT COSTS(TDC less equipment)				136,553			165,249			73,745		375,547
INDIRECT COSTS	72.33%		(MTDC)	98,769			119,525			53,340		271,633
TOTAL COSTS				242,322			304,774			131,085		678,180
FUNDING AGENCY COMMITMENTS				SFY 97/98	FFY 97/98		SFY 98/99	FFY 98/99		SFY 99/00	FFY 99/00	
FLA DEP				75,000			100,000			75,000		250,000
SFWMD					75,000			75,000				150,000
USGS					75,000			75,000			75,000	225,000
				75,000	150,000		100,000	150,000		75,000	75,000	$625,000

BUDGET JUSTIFICATION AND PERSONNEL

The project will be supervised by Cynthia Gilmour at the Academy of Natural Sciences Estuarine Research Center. Andrew Heyes, a postdoctoral associate at ANSERC, will oversee the field work, data management and experimental work using Thin Film Gels (DGT). Janina Benoit will oversee bioavailability studies. Ms. Benoit is a graduate student the University of Maryland who is doing her dissertation work jointly with Dr. Robert Mason at U. MD Chesapeake Biological Lab. and with Dr. Gilmour at ANSERC. Gilmour, Heyes and Benoit will all participate in manuscript and report preparation.

Technical assistance of 19 months per year in 1998 and 1999 is requested, for field work, laboratory analyses, and data analyses. Technical assistance will be provided by Georgia Riedel (lab manager and lead Hg analyst) and Tyler Bell, both of whom have been working on Hg and S biogeochemistry at ANSERC for a number of years, and both of whom have worked on this project throughout Phase I.

The budget for laboratory supplies includes custom production of high specific activity ^{203}Hg, at $2,500 per synthesis. Two batches will be made each year, because the half-life of the radioisotope is fairly short, 47 d. Other supplies include: Teflon bottles, vials and other equipment for taking and analyzing "clean" Hg samples; chemicals and gases required for laboratory analyses; cleaning acids; chromatography supplies; glassware; pipettors and tips, core tubes and racks; field and shipping containers; supplies for maintenance of glove boxes; and some field supplies. Logistical support in Florida will be provided by SFMWD.

Permanent equipment is requested in 1997, 1998 and 1999. In 1997, a Cold Vapor Atomic Fluorescence Analyzer (CVAF) is requested ($7000). The CVAF will be used to replace and 8 year old Brooks Rand instrument with a new Tekran. In 1998, partial support ($20,000) for a automated headspace analysis system for MeHg is requested (total estimated cost $40,000). ANSP will contribute the remaining cost to this system. This system will be modeled after the one in place in the Florida DEP's Hg laboratory in Tallahassee, and should almost double sample throughput, saving considerable technician time. In 1999, an autosampler for T-Hg and MeHg sampling over the course of storm and wind events will be purchased and modified for non-contaminating sampling at a cost of $4000. Laboratory equipment repair and maintenance costs in 1999 ($4000) include new bags for glove boxes, HEPA filters for laminar flow hoods and repair of pipettors and G-M counters.

The travel budget will support three field trips per year in Florida at $7500 per trip (2 weeks and 4 personnel per trip); the cost for Gilmour and Heyes to attend one ACME workshop and for Gilmour, Heyes and Benoit to present Everglades work at one national scientific conference per year.

Indirect costs are calculated as 72.33% of the modified (total minus equipment) total direct costs, as negotiated with NSF. Fringe benefits are 20.0% of salaries.

It is understood and agreed that the maximum compensation provided under this Contract though incremental funding by the Florida Department of Environmental Protection shall not exceed $225,000. All amounts necessary above this amount, as set forth in the budget detail, shall be provided by the Contractor through in-kind services provided by the Contractor, and/or through other funding sources available to the Contractor.

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ATTACHMENT B

OFFICE OF COMPTROLLER

DEPARTMENT OF BANKING AND FINANCE

STATE OF FLORIDA

TALLAHASSEE
32399-0350

GERALD LEWIS
COMPTROLLER OF FLORIDA

December 18, 1991

COMPTROLLER'S MEMORANDUM NO. 10 (1991-1992)

SUBJECT: CONTRACTUAL SERVICES - COST REIMBURSEMENT CONTRACTS

This memorandum is to provide clarification relative to the documentation requirements for those contractual service contracts which provide for payment on a cost reimbursement basis. In general, cost reimbursement contracts require an itemized listing (by category) of all expenditures claimed along with supporting documentation for each amount for which reimbursement is being claimed indicating that the item has been paid. Check numbers may be furnished in lieu of copies of actual checks. Each piece of documentation should also clearly reflect the dates of service. The types of documentation listed below are examples and represent the minimum requirements.

(1) Salaries: A payroll register or similar documentation should be submitted. The payroll register should show gross salary charges, fringe benefits, other deductions and net pay. If an individual for whom reimbursement is being claimed is paid by the hour, a document reflecting the hours worked times the rate of pay will be acceptable.

(2) Fringe Benefits: Fringe benefits should be supported by invoices showing the amount paid on behalf of the employee (e.g., insurance premiums paid). If the contract specifically states that fringe benefits will be based on a specified percentage rather than the actual cost of fringe benefits, then the calculation for the fringe benefits amount must be shown.

(3) Travel: Reimbursement for travel must be in accordance with Section 112.061, Florida Statutes, which includes submission of the claim on the approved State travel voucher.

(4) Other direct costs: Reimbursement will be made based on paid invoices/receipts. If nonexpendable property is purchased using State funds, the contract should include a provision for the transfer of the property to the State when services are terminated. Documentation must be provided to show compliance with Department of General Services Rule 13A-1.017, F.A.C., regarding the requirements for contracts which include services and that provide for the contractor to purchase tangible personal property as defined in Section 273.02, Florida Statutes, for subsequent transfer to the State.

(5) In-house charges: Charges which may be of an internal nature (e.g., postage, copies, etc.) may be reimbursed based on a usage log which shows the units times the rate being charged. The rates must be reasonable.

(6) Indirect costs: If the contract specifies that indirect costs will be paid based on a specified rate, then the calculation should be shown.

It should be noted that the documentation submitted with each voucher will be evaluated individually using the above guidelines. Should you have questions or require further clarification, please contact Cheri Greene at 488-4098, SUNCOM 278-4098.

Sincerely,

Jana I Walling, Director
Division of Accounting
and Auditing

JIW:Mcs

ATTACHMENT C

Analytical Data Validation Requirements For Department Contracts

I. INTRODUCTION

Environmental studies or measurements are contracted out by the Department (DEP) on an as needed basis. Some contracts include requirements for sampling and analytical test procedures. Analytical parameters and methods are also commonly specified in such contracts or in individual task assignments. Each contract/task which involves sampling and/or analysis activities may require the preparation of a site- or project-specific QA Project Plan (QAPP) on DEP Form 62-160.900(1), which references the contractor's and/or subcontractor's Comprehensive Quality Assurance Plan (CompQAP). In certain cases, and at the discretion of the DEP Quality Assurance Officer and/or DEP Project Manager, different quality assurance requirements may be specified (e.g., CompQAP, Research QAP, etc.). The type of quality assurance plan required will be stipulated in the contract/task language, in addition to any contract/task-specific data quality objectives (DQO's) not already addressed in any associated quality assurance plan.

While routine data validation, reduction and reporting requirements are addressed in an organization's approved CompQAP, these guidelines establish additional uniform requirements for analytical data validation, documentation and reporting. They shall be followed by all contractors and subcontractors involved with the sampling and/or analysis specified by the contract. **Additional requirements may be designated by the DEP Project Manager.**

These guidelines do not impose any analytical quality control (QC) requirements beyond those already included in the DEP approved methods (as referenced in DEP QA-001/90) and Chapter 62-160, F.A.C., but are meant to complement the contractor's CompQAP(s). Their purpose is to further assure that legally defensible data will be generated which meet U.S. Environmental Protection Agency criteria without following the full EPA Contract Laboratory Program (CLP) protocols. In addition, these guidelines define in more precise terms the requirements for storage of analytical raw data, field documentation and records, custody records, and non-reportables so that the audit and review of these documents can be facilitated.

II. RECORDS RETENTION

All laboratory and field records described in section III, IV and V should be maintained in project-specific task/project files. These files should contain the original data or records. However, if this is impractical, copies of the pertinent information, or unambiguous and accurate cross-references to the location of the original documentation, shall be maintained in the project-specific task/project file(s).

Active files shall be maintained for a period of at least one year from data generation. All records, as specified in Sections 62-160.600, F.A.C., shall be retained for at least three years after project completion. However, it is strongly recommended that all records be maintained for at least five years after project completion.

III. LABORATORY REPORTING LEVELS AND DELIVERABLES

The analytical laboratory data required by the subject investigations shall meet the general QA for the EPA level III classification (i.e., qualitative, quantitative and legally defensible) [1]. Each laboratory shall perform internal data validation according to protocols specified in their approved CompQAPs or Research QA Plans (RQAPs). The minimum quality control data to be included in each laboratory analysis report is specified below. The laboratory QA officer is responsible for this data. At the discretion of the DEP project manager, the laboratory may be asked to provide routine QA reports to the DEP which will include any additional remarks concerning the validity or quality of the analytical data.

The following shall be supplied as a part of the laboratory deliverables:

1. All information specified by Section 62-160.670, F.A.C.;
2. Sample specific method detection limits for each parameter (see DEP QA 001/90 for specific definitions and calculations);
3. Results of all field-generated quality control samples:
   a. Trip Blanks (if applicable);
   b. Equipment blanks;
   c. Field duplicates;
   d. Field blanks (if analyzed and/or required);
   e. Field spikes (if identified, analyzed and/or required).;
4. Results of laboratory quality control data for replicates and spikes. This shall include for each parameter and matrix:
   a. Sample ID # used for QC sample;
   b. Calculated % RSD for replicates (Relative Percent Difference (RPD) may be used for reporting duplicate precision) ;
   c. Calculated % recovery; and
   d. Control limit values utilized for precision and accuracy for each parameter/matrix;
5. At the discretion of the DEP project manager, routine quality assurance reports shall be submitted in accordance with the format specified by the project manager. These reports shall address any problems or difficulties encountered in meeting the specified project/contract DQO's.

The above shall apply to all analyses and will assure that the DEP project manager is apprised, through each laboratory report, on the quality level of the analytical data and its ability to meet the DQO's specified in the contract and/or quality assurance plan.

IV. FIELD DATA VALIDATION

The validation and documentation of data generated in the field (e.g., conductivity, pH, temperature, etc.) is only applicable if the contract specifies field work to be performed by the contractor.

All field information shall be recorded in field records, as approved by the Department's QA Section, and be made using non-erasable, waterproof ink. If standardized forms (e.g., field trip approval form, field sampling request form, field data sheet, well sampling data log, equipment calibration forms, sample custody records, etc.) are used, these shall be assembled into logbooks, sequentially numbered, and maintained in a project file. If it is impractical to maintain all original documents in a central project file, copies of the pertinent information, or unambiguous and accurate cross-references to the original documentation, shall be maintained in the project-specific task/project file(s). The organization shall maintain all other project information as specified in Sections 5.1, 5.2 and 5.3 of DEP QA-001/92 (DEP SOPs). Other field documentation such as photographs, memoranda or task orders shall also be maintained in the project file(s).

The field data validation process shall follow the contractor's CompQAP and the protocols specified in Section 10 of DEP QA-001/92. Field team leaders shall be responsible for initial data validation including:

a. the use of properly calibrated instruments;
b. following DEP approved methods as outlined in the relevant CompQAPs or QAPP;
c. reviewing and documenting acceptance of the results from field QC samples (e.g., trip blanks, duplicates, etc.) and field calibration checks; and
d. making careful, accurate and complete records of field activities as specified in Chapter 5 of the DEP SOPs.

The overall project validation as specified in Section 10.3 of the DEP QA-001/92 shall be conducted by the contractor's designated project manager(s) or task manager(s). Project validation shall be conducted in a manner in which inability to meet project/contract DQO's are specifically addressed.

V. LABORATORY DATA VALIDATION

The in-house data validation process begins with the analyst at the bench level and concludes with an independent review of data by the supervisor and laboratory QA officer. Specifically, the data must be reviewed and assessed in terms of its ability to meet the DQO's as specified in the project/contract. The data validation process shall include:

a. the recalculation of at least 5% of the test results for each analytical batch, parameter group and matrix. The samples that are checked in this manner shall be randomly selected, and apply to the analytical batch containing DEP samples. The DEP samples shall not be considered apart from other client samples that are included in the sample batch;
b. verification of all supporting functions (e.g., sample preparation, calibration, standard preparation, etc.);
c. review, assessment, and acceptance/rejection based on quality controls;
d. assessment of data in terms of its ability (or lack thereof) to meet project/contract-specified DQO's, and;
e. all other report and data validation requirements as specified in DEP-QA-001/92, Section 10.

The list of laboratory reportables is specified in Section III. The list of non-reportables is listed below for inorganics and organics. Non-reportable data/records shall be kept in central files with the relevant reportable data. If it is impractical to maintain all original documents in a central project file, copies of the pertinent information, or unambiguous, accurate cross-references to the location of the original documentation, shall be maintained in the project-specific task/project file(s). The laboratory QA officer(s) shall be responsible for the completeness and accuracy of these files.

V. A. General Non-reportables

The following information shall be included for each task/project:

1. A chronological master list of laboratory tracking sample ID numbers correlated with field sample ID numbers (per batch) and sample analysis batch identification to correlate quality control samples to the applicable analysis batch;

2. Copies of the chain of custody forms signed by the sample collector and laboratory sample custodian;

3. A narrative summary identifying any QA or sample problems and the specific corrective action measures that were taken to correct the problem(s);

4. Concentration of calibration standards with acceptance criteria, their preparation and traceability, including initial calibration data and internal or external standard parameter (compounds) and concentrations;

5. Results of batch-applicable continuing calibration verification standards (CCVS) and/or system performance check compounds, percent recoveries and expected values;

6. Results of batch applicable laboratory control samples (LCS) or QC check sample recoveries and expected values or results of independent QC Samples (EPA, NIST, etc.) with expected values and percent recoveries;

7. Results of method (laboratory control) blank analyses;

8. Results of matrix spikes, calculated percent recoveries, control limits and their source;

9. Results of surrogate spikes, percent recoveries and control limits (where applicable);

10. Results of laboratory replicates (matrix spike duplicates or laboratory replicates), calculated percent recoveries and % RSD (%RSD or RPD for duplicates) amongst replicates, control limits and their source (summary is reportable);

11. Results of analytical (post-digested) spikes when used or required to determine matrix effects;

12. Identification, raw data and results (including acceptance/rejection) of all continuing calibration standards analyzed as a requirement of Chapter 62-160, F.A.C.;

13. Results and raw data from all performance evaluation and/or QC check samples analyzed during the project; and

14. Sequential measurements readout records (including calibration curves), digestion logs, raw data calculation worksheets, and chromatograms (where applicable) for all samples, standards and QC samples (blanks, duplicates, spikes, etc.).

V.B. Inorganics Non-reportables

For analyses involving the use of atomic absorption (flame or furnace) spectroscopy (AAS), inductively coupled plasma (ICP), ion chromatography (IC), light (visible, UV and IR) spectroscopy, and turbidimetric, gravimetric, titrimetric and autoanalyzer procedures, the following data shall be maintained in the project file (or linked through unambiguous, accurate cross-references to the original documentation) in addition to the data specified in V.A above:

1. Results of interference check sample (CS) analysis and expected values (ICP only); and

2. Results of dilution check samples (DCS) analysis and expected values (when required and/or used).

V. C. Organics Non-Reportables

1. Gas Chromatography - For analysis by GC, all applicable records specified in V.A. above shall be on file. In addition, the calculated response factors (if used) for all compounds at each concentration level which shows linear invariance shall be documented.

2. Gas Chromatography/ Mass Spectroscopy - In addition to the information listed in V.A. and V.C.1., the following shall be maintained:

    a. GC/MS tuning and mass calibration data including summary for tuning compounds indicating compliance with acceptance criteria; and

    b. Chromatograms and mass spectra for all samples, standards and QC samples.

V.D. Microbiology Non-Reportables

In addition to the applicable records specified in V.A, the documentation and raw data demonstrating compliance with DEP minimum QC requirements shall be maintained in the project files (or shall be maintained in linked files using unambiguous cross-references to the original documentation):

1. Results and documentation for dilution and sample carry over blanks;

2. Documentation and results of positive duplicate samples with acceptance criteria;

3. Positive and negative control records for media (including source of microorganisms);

4. Records of Water Quality Indicators as specified in 9.1.2.2.d of QA-001/92 (includes laboratory performing tests if not analyzed in-house);

5. Records showing verification and/or confirmation of positive confirmed samples (9.1.2.2.f of QA-001/92); and

6. Media preparation records including preparation dates, and pH or source and lot number of purchased pre-made media.

V.E. Bioassay Non-Reportables

In addition to maintaining the applicable records in V.A and V.B, the organization shall maintain the following records in the project file (or in linked files using unambiguous cross-references to the original documentation):

1. Raw data, calculations, and records associated with each test;

2. Results and raw data associated with reference toxicants;

3. Records pertaining to the origin, identification, culture and maintenance of species; and

4. All records on temperature, light measurements and feeding regimens.

V.F. Macrobenthic Invertebrate Identification Non-Reportables

In addition to the applicable records in V.A, the following shall be maintained in the project file (or in linked files using unambiguous cross-references to the original documentation):

1. Specimen collection that may have been used in identifying organisms (including source);

2. Documented internal verification of all phases of the identification procedures;

3. Documented use of external experts to corroborate the findings (include name of individual(s) and CompQAP #); and

4. Record of keys used for identification.

ATTACHMENT D

PROPERTY REPORTING FORM FOR DEP CONTRACT NO. SP434

CONTRACTOR: List non-expendable equipment/personal property* costing $500 or more purchased under the above contract. Also list all upgrades* under this contract, costing $500 or more, of property previously purchased under a DEP contract (identify the property upgraded and the applicable DEP contract on a separate sheet).

DESCRIPTION	SERIAL NUMBER	COST**	LOCATION/ADDRESS (include County name)	DEP USE ONLY (PC)	DEP USE ONLY (LC)

*Not including software. **Attach copy of invoice, bill of sale, or other documentation.

CONTRACTOR:_____ Contractor Contract Manager:_____ Date:_____

----------BELOW FOR DEP USE ONLY----------

DEP CONTRACT MANAGER: COMPLETE AND SIGN THIS SECTION AND SEND ORIGINAL DOCUMENTS WITH THE INVOICE FOR PAYMENT TO DEP FINANCE AND ACCOUNTING (MS#78); SEND COPIES TO DEP PROPERTY MANAGEMENT (MS#87).

Organization Code:_____ Grant Number:_____ Contract End Date:_____

DEP Contract Manager Signature:_____ Date:_____

DEP FINANCE AND ACCOUNTING: Record above listed items as OCO, enter Voucher number below, and forward a copy to DEP Property Management (MS#87).

Voucher Number:_____

DEP PROPERTY MANAGEMENT: Assign OCO Property Control (PC) number and Location Code (LC) above.

DEP 11-041 (Revised 11/96)