C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

EXHIBIT "A"

STATEMENT OF WORK

FIELD STUDIES ON ATMOSPHERIC DEPOSTION OF PHOSPHORUS INTO SOUTH FLORIDA

1.0 INTRODUCTION AND BACKGROUND

The atmosphere is recognized as the primary source of both water and essential nutrients to the remnant Florida Everglades. The vast majority of the remnant Everglades marshes are very shallow and often display ambient phosphorus levels at or below 10 µg P/L (McCormick et al., 1996). Atmospheric loading, even at the low end of the range of published values, could be a highly significant source of enrichment to this ecosystem. The Everglades Forever Act, passed by the Florida Legislature in 1994, requires the South Florida Water Management District (District) to restore the remaining Everglades ecosystem, in cooperation with several other State and Federal Agencies. The control of phosphorus loading to this oligotrophic, subtropical environment is a cornerstone of the restoration. Based on the literature reviewed by Redfield (1999) and data collected to date by various organizations in South Florida, estimates of phosphorus (P) loading from the atmosphere have great uncertainty for any individual location or for the region as a whole. For example, assuming that dustfall buckets reflect actual deposition rates, Ahn and James (1999) estimate a 25% error in the regional mean deposition rates. This lack of definitive information on phosphorus inputs from the atmosphere is typical for most aquatic ecosystems and provides the motivation for this study. While better estimates of deposition for managing the Everglades ecosystem is a primary objective, virtually all information on phosphorus deposition and its measurement is of equal relevance to any ecosystem for which P is the target of management efforts.

The District and other agencies have attempted to quantify P deposition rates using standard bucket collectors manufactured by Aerochem Metrics™, Inc. Currently, the District has collectors at 18 sites throughout South Florida (Attachment 1). The Loxahatchee Refuge (U.S.F.W.S.) operates four sites and researchers from Duke University have data from two sites in Water Conservation Area 2B. For all collecting sites with little contamination by birds and insects, the wet precipitation collectors (buckets) seem to provide reasonable estimates of wet P deposition (as Total Phosphorus).

Dry deposition rates are much more problematic using Aerochem collectors. First, the buckets themselves are less than adequate from an aerodynamic perspective and particles arriving during moderate winds may be underrepresented. Second, high winds may resuspend materials collected in the dry bucket. Third and most importantly,

contamination from extraneous debris and bird droppings is a continuing problem. At marsh collecting sites, it is not unusual to find that over 50% of samples are contaminated to some degree. Ahn and James (1998) use a statistical approach to derive estimates of dry deposition from the District's Network. Ahn and James (1999) continue their statistical investigation and derive overall estimates of mean deposition and associated error in data from the District's monitoring network.

Three size categories of particles provide a framework for considering methods of measuring deposition rates in this project. Table 1 from Redfield (1999) summarizes three classes of particles that must be measured to assess deposition. Fine particles are less than 2.5 μm and can be sampled by methods suitable for aerosols. Coarse particles are from 2.5 to 10 μm and can be sampled by high volume devices to determine air concentrations. Estimates of deposition velocities from coarse particles remains an area for research. Finally, large particles are greater than 10 μm and are not sampled by standard EPA methods for PM_{10} compliance. Determining methods from air concentration sampling and calibration to surface accumulation and deposition velocities remains a technical challenge for large particles.

The literature provides some options for measuring dry deposition rates (see Redfield, 1999), but there is no standard method for the collection of particulate deposition, particularly P deposition derived from larger (>2.5 μm) particles. Micro-meteorological techniques use continuous data collection on atmospheric concentrations combined with data from local meteorology. This approach then uses the physics of mass and energy movement through turbulent exchange to calculate flux rates. The technique is very well developed for gases and aerosols, but is probably not suitable for P associated with rapidly settling particles. Surface accumulation methods, using throughfall measurement, various plates or plant surfaces and dustfall buckets, can be applied to particles. However, such surrogate surfaces must be calibrated so that data can be used to estimate total P deposition rates to natural surfaces and possibly to land cover types, such as open water, marsh canopy, and sugarcane canopy. Also, surrogate surfaces of all types tend to sample very large particles (ca. >20 μm) effectively, but their efficiency at capturing mid-range particles (ca. 2.5 – 20 μm) remains very uncertain. This middle range of particles could be a very important component of phosphorus deposition and must be assessed as a part of this project.

The approach recommended by a recent scientific advisory panel to the District (McDowell, 1997) and by other experts in the literature is called the inferential technique; it combines measurement of atmospheric concentrations using high volume samplers with estimates of particle deposition velocity. When used on a size-class specific basis, this approach can be applied to particles and, if based on a carefully designed sampling program, it can provide deposition estimates for large areas, such as the Everglades Protection Area (EPA). This contract will apply the inferential technique in some form, supported by direct measurements using surrogate surfaces or other devices recommended by the contractor to assure that all particle sizes are assessed. None of these techniques are developed into standardized methods for measuring particle deposition that can be applied without pilot studies and calibration. This leaves the

Table 1. The characteristics of atmospheric dry deposition of phosphorus. The information summarized in this table is drawn from various sources in the literature, particularly from Finlayson-Pitts and Pitts (1986), Hicks et al. (1993), Lovett (1994), Noll and Fang (1989) and USEPA (1996).

Characteristic	Particle Size Category*		
Key Attributes of Dry P Deposition	**Fine Particles (< 2.5 μm)****	**Coarse Particles (2.5 – 10 μm)****	**Large Particles (>10 μm)**
Transport Scale	Global/Regional	Regional/Local	Local
Source	Combustion, air transformations	Fugitive dusts, biotic processes, sea spray	Fugitive, cement, coal, metallurgical dusts, organic debris, vehicular particles
Land Use Association	Low density, low landscape disturbance	High density urban, or high disturbance agriculture	Dependent on local groundcover and biological communities
P Content	High, emission sources vary (0.1 – 1.0%)	Crustal levels (0.1-0.2%)	Variable based on biotic source
Transport Mechanism	Atmospheric circulation, follow local air eddies, suspended	Local and atmospheric processes, less dependent on eddies	High energy events, gravitational settling, density affects
Deposition Velocity	Low (< 1cm s^{-1})	High (1-10 cm s^{-1})	Very high, density important (>10 cm s^{-1})
Surface Effects	Fine structure and wetness are important,	Variable effects, wetness important, inertia involved	Surface less involved, inertia and sediment-ation dominate
Canopy Effects	Important as sink	Variable, resuspension and bounce-off	Important as source, esp. organic debris
Deposition Rate Variability	Lower variability, more continuous,	High variation, event related	Very high, more episodic and seasonal variation

* Size of groups of particles is usually expressed as aerodynamic diameter; the diameter of a sphere with a settling velocity at a density of 1g cm^{-3} equal to that being considered.
** The fine and coarse size categories follow those developed for particulate matter monitoring and assessment by the U.S. Environmental Protection Agency (1996). The large particle category is not relevant for air pollution assessment based on human health considerations and can not be measured by most high volume samplers that have a cut-off point of about 10 μm.

District with an unmet information need and no immediate means of acquiring new information and reducing uncertainty in P deposition rates.

This contract has as its primary objective a synthesis of information from the literature, development of a detailed plan for pilot studies, execution of field monitoring and research in South Florida. Results from several approaches to dry deposition measurement will be cross-calibrated and compared to the extent possible. It is critical that data be collected on total P deposition to surfaces even though there is substantial uncertainty in such measurements. Total deposition rates are needed to calibrate sampling methods and validate models to be used in estimating size-specific deposition velocities. Validating estimates of P inputs to natural landscapes is the real challenge and there are no cases known to the District in which P flux from the atmosphere has been derived from inferential monitoring and validated with other techniques. A reasonable outcome of this 3-year study will be increased certainty in P deposition rates and data to support methods to monitor deposition with better accuracy and precision than is currently possible. Landscape-level deposition estimates dealing with habitat mosaics is beyond the scope of this project except possibly in the form of preliminary estimates.

2.0 SCOPE OF WORK

The District seeks the services of a qualified respondent (CONTRACTOR) to develop and carry out a detailed work plan on the measurement of total phosphorus deposition. This will involve a literature review to identify methods for the study of dry particle deposition, air concentration sampling and estimating deposition velocities in the Inferential Method, development of a detailed work plan for field studies of TP deposition for proof of concepts and methods, conducting the field work and sample collection, data analysis, report writing and manuscript preparation.

The overall purpose of this contract is to reduce the uncertainty in estimates of the rate of atmospheric deposition of the nutrient element phosphorus as total phosphorus. Questions to be addressed in this project are:

a) Methods Testing and Calibration / Validation: What combination of methods provide sound estimates of total (wet and dry) P deposition? What device(s) yields the best air concentration data for fine, coarse and large particles, and how should deposition velocities be set or determined for size classes of particles? How often should collectors be assayed? How should data be utilized to compute/model deposition rates and to validate estimates of total phosphorus deposition?

b) Temporal and Spatial Analysis: What are the weekly, monthly, seasonal and annual rates of total P deposition in selected areas of the District? What are the major anthropogenic and meteorological events and size classes by which P is conveyed into each area?

c) Future Monitoring: If future monitoring of deposition is needed and feasible, what suite of methods might be utilized to generate reliable data and how should the sampling network be designed?

d) Preliminary Evaluations: What are the relationships between TP deposition rates and those of nitrogen, calcium and other parameters measured in deposition samples, and how do these relationships guide method selection and sampling designs for future monitoring of deposition? Can data from a small network of field sites be used to derive a 'net' flux of P into the northern Everglades region? Can data from particulate chemical analysis be used for source distribution?

Careful attention to quality control and scientific validity are performance attributes to be applied throughout this project. Products are primarily publications focussed on issues relevant to measuring P deposition into the EPA, possible procedures for future monitoring and recommendations to District on specific actions needed in the near future to increase certainty in P deposition estimates.

3.0 WORK BREAKDOWN STRUCTURE

All atmospheric deposition sample collection and laboratory analyses in conjunction with this project shall be the responsibility of the CONTRACTOR. The laboratory conducting the water quality analyses must have a Florida Department of Environmental Protection (FDEP) approved Quality Assurance Plan, and participate in the FDEP-sponsored Round Robin for total phosphorus analyses. The CONTRACTOR shall be responsible for the storage, handling or disposal of any chemicals, residues, process byproducts, etc. involved with this study. The CONTRACTOR shall disassemble and dispose or salvage all equipment and installations and restore the study sites to their prior condition at the conclusion of the study. It may be negotiated that the sample equipment used during the course of this project may become the sole property of the District after the terms of this contract expires.

The CONTRACTOR will collaborate with District staff in conducting this project. Staff will cooperate with field logistics, development of measurement methods and publication of results in the open literature. Staff of the District's Water Quality Monitoring Division will work cooperatively with the contractor in setting up the field-sampling program, and doing sample collection.

The CONTRACTOR's staff, Project Manager and key task leaders, in conjunction with the District's Project Manager, shall prepare a series of research articles based on the results, conclusions and recommendations of this study. Article preparation shall be of a form and quality suitable for submission to a peer-reviewed scientific or engineering journal. The CONTRACTOR's staff shall act as authors and the order of authorship shall be determined in accordance with common practice in science. The role of District staff in data analyses, manuscript development and submittals shall be determined in cooperation with the CONTRACTOR. Plans for publications will be part of the

development of the work plan for the project, although they will be flexible enough to deal with unexpected results and possible setbacks in the project.

PHASE I: IDENTIFICATION AND RECOMMENDATION OF METHODS AND MODELS FROM A LITERATURE REVIEW and the CONTRACTOR's EXPERIENCE

Task 1. Particle Deposition to Surfaces – Identification and Recommendation of Methods using Surrogate Surfaces

Using information in Redfield (1999) and Chow (1995) as a starting point and adding other recent information from the literature, the CONTRACTOR will identify and prioritize candidate methods for estimating particle deposition rates to surfaces for coarse and large particles. Key attributes, strengths and weaknesses of each method will be discussed in summaries provided by the CONTRACTOR.

The information synthesis should include at least the following categories of surrogate surface collecting devices that may be deployed in field studies:

1. Small plate samplers, e.g., Davidson device, frisbee-type collectors as used in the U.K. for dust collection,
2. Moveable mylar collectors, e.g., Noll and Fang (1988),
3. Large surface collectors (1 m^2), e.g., CRAPAL sampler, Dulac et al. (1989), and
4. One or two other devices as recommended by the CONTRACTOR for comparative particle deposition measurements.

The final decision on collectors to be used for the field studies will be reached cooperatively with the CONTRACTOR and the District based on available information; if agreement can not be reached, the District will have the final choice of methods to be tested in both Phase II and Phase III field studies.

Deliverable: A one-page summary for each potential method and sampler. Summaries will include recommendations on prioritization, weaknesses and strengths of each method, and literature citations.

Date Due: See Task 5

Task 2. Air Concentration Sampling for Particles - Identification and Recommendation of Methods

The CONTRACTOR will investigate air samplers available for measuring particle concentrations in the ambient air, particularly those perfected for routine sampling for air quality (e.g., Chow 1995; Lodge, 1988). The air sampler (s) selected must, separately or collectively, be capable of producing quantitative concentration data on fine (<2.5 μm), coarse (2.5 - 10μm) and large particles (>10μm). Although 100 μm in diameter appears

to be a reasonable upper limit for quantification, the CONTRACTOR shall advise the District if a different upper limit is appropriate. To capture fine and coarse particles appears to require high volume samplers like the Andersen Model 1200 or the Sierra 235. Capturing large particles (>10μm) may require some other sampler, such as the Wide Range Aerosol Classifier (Lundgren et al. 1984) or the Noll rotary impactor (Lin et al. 1993). The recommended device (s) must also be capable of separating atmospheric particles into size classes as is done by cascade rotary impactors, and must be readily available on the commercial market. The CONTRACTOR should advise the District on what the specific sorting capabilities are, but quantitative concentration data must be available for at least 5 size-classes of particles. Chow (1995) provides a review of the devices currently available for particle sampling and should be used as a starting point for this investigation.

Deliverable: A one-page summary for each potential method and sampler. Summaries will include recommendations on prioritization, weaknesses and strengths of each method, and literature citation. Limited edition, research-oriented samplers should not be used unless compelling justification is provided to the District.

Date Due: See Task 5

Task 3. Review Models for Estimating Deposition Velocities Using the Inferential Method

The CONTRACTOR will review the literature on mathematical models used in estimating deposition velocities for various size classes of particles. After this investigation, the CONTRACTOR shall advise the District on the most appropriate model for P particles and provide a general description of the model, its data needs and supporting literature citations. Examples are sought particularly for cases in which deposition models have been validated against deposition data and are fully documented.

Deliverable: A one-to-two page summary on each model. Summaries will include recommendations on prioritization and weaknesses and strengths of each model and literature citation. Limit summaries to the five most suitable models.

Date Due: See Task 5

Task 4. Update Literature Information Base on P Deposition

Redfield (1999) contains a literature review on P deposition through 1998 and basic methods for estimating particulate dry deposition. The CONTRACTOR will conduct a literature search for papers published during or since 1998, and will review files or other sources of literature to assure that important papers on P deposition rates from the atmosphere have not been overlooked in the Redfield review. Publications on ways of analyzing data from inferential approaches and validating rate estimates should also be included in the search.

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

Deliverable: One-paragraph summaries of literature on TP deposition published since 1998 or not included by Redfield (1999).

Date Due: See Task 5

Task 5. Compilation of Information from Tasks 1-4

The CONTRACTOR will collate all the information generated from Tasks 1-4 into one document. This will include all the one-page summaries and paragraph descriptions. Using the information reviewed in Tasks 1-4, the CONTRACTOR will recommend a preliminary design for pilot studies of P deposition. If the approach involves several simultaneous methods for various size classes, the CONTRACTOR should describe how data will be analyzed to yield total deposition estimates. This preliminary design will be used as a basis for discussions during the District site visit.

Deliverable: Draft Information Report

The CONTRATOR shall submit 10 copies of the Draft work plan to the District for internal review and comment.

Date Due: Seven (7) weeks after contract approval

District Deliverable: Review of Information Report

Date Due: Seven (7) weeks after contract approval

Deliverable: Final Information Report

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of the Report.

Date Due: Five working days prior to District site visit

Task 6. District Site Visit - Orientation Meeting and Field Site Visit – Three Days

The CONTRACTOR and project team will attend an orientation meeting at the District. In a series of meetings over three days, District staff and the CONTRACTOR's team will:

1) clarify study objectives and products,
2) outline a work plan for field studies of deposition,
3) discuss techniques to be used comparatively in studies,
4) develop elements of a plan for cooperation and logistics support in field sampling,
5) locate and collect local information relevant to site selection and land uses adjacent to proposed sites, geology and meteorology,

6) outline a teamwork approach to data management, analysis and publication, and
7) agree on basic equipment and supply needs and schedule for purchase.

The array of field sites that the CONTRACTOR should consider as a starting point for developing a network of field sites for these studies is listed under Section 5.0

The CONTRACTOR's team will visit sites identified by District staff as most likely to be useful to the field study of deposition. The CONTRACTOR will be asked to recommend sites as part of their work plan for field studies. While at least 3-4 pairs of sites appear to be an appropriate design for upwind/downwind comparisons, the CONTRACTOR is free to suggest an alternative design that will yield better information.

The CONTRACTOR will prepare meeting notes and generate a Letter Report on all conclusions and points of clarification during the meetings. These will serve as a record of the meetings and will guide work plan development.

Deliverable: Participation in orientation meetings and site visits

Date Due: +8 weeks to +10 weeks

Deliverable: Meeting Notes / Letter Report

The CONTRACTOR will provide a summary of the meetings which will include conclusions made, points of clarification and preliminary outlines for field work, equipment needs, and data analysis

Date Due: 10 working days after site visit

Task 7. Develop a Work Plan for Phase II and III Field Studies

Based on the information from Tasks 1 - 6, the CONTRACTOR will develop a detailed work plan for Phases II, and III. The detailed outline from Task 6 will be the framework of this work plan that will provide complete descriptions of how the investigation will actually be done. The work plan should be constructed to guide the actual execution and communicate each essential aspect of the work to be done by the CONTRACTOR's team and by District staff. Timelines for tasks should reflect a flow of information from the field, through laboratory analyses, to data base development and quality assurance, to analysis and report/publication preparation.

Sampling will be designed around a 7-day schedule used by the National Atmospheric Deposition Program, but will also involve field campaigns or close-interval sampling designed to collection data during unique events and to conduct more intensive studies of deposition. Sampling should be designed in close cooperation with the District's Water Quality Monitoring Division and should detail responsibilities for each aspect of field work. Data analysis and summation should be an on-going process during the project to shorten time for publication and to allow for adaptive changes in the work plan to

accommodate unforeseen problems. The work plan should provide a clear summary of how the questions for the project as a whole are going to be addressed explicitly by the contracted effort.

The work plan shall include, but not necessarily be limited to:

- site study maps,
- number of replicates,
- experimental variables, measurements (physical, chemical, meteorological),
- table of analytical methods and monitoring frequencies for all water quality parameters,
- routine and special event sampling descriptions,
- descriptions of measures/methodologies to collect data,
- data retrieval and storage,
- statistical procedures and interpretation methods to be employed,
- the CONTRACTOR's FDEP Approved Laboratory Quality Assurance Plan,
- rational and objectives,
- time lines,
- methodology for tracking costs,
- description of deliverables for all tasks, and
- cost proposal for Phase II and preliminary cost proposal for Phase III.

Deliverable: Draft Work Plan

The CONTRACTOR shall submit 10 copies of the Draft work plan to the District for internal review and comment.

Date Due: + 9 weeks to + 21 weeks

District Deliverable: Review of draft work plan

Date Due: 10 working days following delivery of draft

District staff will review the draft work plan and provide comments within 10 working days of delivery. At the District's option, external reviewers may be asked to evaluate and comment on the work plan within 21 days. CONTRACTOR will provide a revised work plan within 21 working days of the date comments are received.

Deliverable: Final Work Plan

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of a Final Work Plan, incorporating review comments provided by the District.

The Final Work Plan will become a binding document when the District's Project manager has agreed to the plan in writing.

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

Date Due: 15 working days after receiving comments from District staff.

STOP / GO EVALUATION

The District, in consultation with outside experts or whomever the District deems suitable, will make a final evaluation of the CONTRACTOR's work plan and a final determination of whether the work plan will be carried out. Should the District determine that the research is not viable for whatever reason, the project will end at this point and the District will terminate the contract.

PHASE II: FIELD STUDIES – PROOF OF CONCEPTS AND METHODS

Task 8. Equipment Purchase, Design and Construction

The CONTRACTOR shall design, purchase materials and construct equipment necessary to make the measurements required.

Deliverable: Equipment Purchase, Design and Construction

Date Due: + 21 weeks to + 57 weeks

Task 9. Equipment Installation and Testing

The CONTRACTOR shall install and test the equipment at the approved study sites for the purposes of taking measurements.

Deliverable: Installed and Calibrated Equipment

Date Due: + 21 weeks to + 57 weeks

Task 10. Field Research and Monitoring

Field research and monitoring will commence within 2 months of acceptance of the final work plan and cost proposal. The CONTRACTOR will have full time support personnel on site to carry out the sampling regime as specified in the work plan for a six-month duration. This sampling effort will be done in coordination with District staff.

The fieldwork will continue for a period of six months after initiation of Phase II Tasks 1 and 2.

Deliverable: Field Research and Monitoring

Date Due: + 21 weeks to + 57 weeks

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

Deliverable: Phase II Draft Report

After 5 months of sampling, the CONTRACTOR will produce a report detailing observations during this period on how well sampling devices are working with recommendations on changes in the Phase II work plan based on this experience. The report will include description of activities performed, problems encountered and corrective actions taken. The draft report will contain preliminary data analyses of P concentration data in water and air samples, deposition rates derived for various size classes and any spatial and temporal trends noticed in Phase II data. The CONTRACTOR will also provide a cost proposal for Phase III.

The CONTRATOR shall submit 10 copies of the Draft Report to the District for internal review and comment.

The CONTRACTOR will produce both in hardcopy and electronic format (according to District standards) all raw data collected during Phase II as well as copies of all statistical programs used and statistical output produced during this phase of the data analysis.

Copies of all field notes taken will also be provided by the CONTRACTOR.

Date Due: 6 months following the initiation of sampling

District Deliverable: Responses to draft report and recommended changes, if any, to the work plan for initiation of Phase III.

Sampling is to continue as planned during this review period and any changes in the work plan will be implemented within 10 working days of the CONTRACTOR receiving the District's response.

Date Due: 10 working days after receipt of draft report

Deliverable: Phase II Final Report

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of the Report.

Date Due: 10 working days after receiving comments on draft

(Total elapsed contract time at this point is 57 weeks (14 months).

STOP / GO EVALUATION

The District, in consultation with outside experts and/or whomever the District deems suitable, will make a final evaluation of the CONTRACTOR's Phase II Report and a final determination of whether the work plan will be carried out during Phase III. Should

the District determine that the research is not viable for whatever reason, the project will end at this point and the District will terminate the contract.

PHASE III: FIELD STUDIES – EXTENDED

Task 11. Field Studies - Extended

Modifications (if any) to the work plan will be implemented at the seventh month of field studies. The CONTRACTOR will have a full time support personnel on site to carry out the sampling regime as specified in the work plan for a 14-month duration. This sampling effort will be done in coordination with District staff.

Routine monitoring and special event sampling will be part of Phase III studies.

Deliverable: Participation in field studies and sample analysis as specified in work plan for Phase III.

Date Due: + 57 weeks to +111 weeks

Deliverable: Quarterly Letter Reports

The CONTRACTOR will provide quarterly letter reports that will contain at a minimum, activities undertaken, problems encountered and cumulative graphs of data collected.

Date Due: + 21 weeks to + 57 weeks

Task 12. Work Plan – Report Writing

After 12 months of Phase III field work, the CONTRACTOR will provide a draft report with recommendations on what sampling should be done during the final two months of Phase III and updating/expanding the work plan for the final phase of the contracted project. The report should be very specific and will include:

- Data analysis procedures and topics to be addressed in final reports and publications,
- Identify methods for which detailed procedures will be developed for monitoring,
- Identify writing responsibilities,
- Content of manuscript articles, titles, authors and names of target journals, and
- Specific topics and contents of the Final Report.

Deliverable: Draft Phase III Report

The CONTRATOR shall submit 10 copies of the Draft Report to the District for internal review and comment.

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

Date Due: + 21 weeks to + 57 weeks

District Deliverable: Comments on draft report

Date Due: 10 working days of receipt of draft report

Deliverable: Final Report

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of the Report.

Date Due: 10 working days of receipt of comments

(Total elapsed contract time at this point is 111 weeks or 28 months)

Task 13. Demobilization and Project Closeout

The CONTRACTOR shall submit a Demobilization Plan for approval by the District. Upon approval by the District, the CONTRACTOR shall demobilize all equipment and monitoring instruments and disconnect all units upon completion of the sampling plan. Demobilization shall be constructed in accordance with District policy and construction standards.

Any and all equipment purchased shall remain the property of the District upon completion of the project.

A project closeout debriefing will be held with the District.

Deliverable: Draft Demobilization Plan

Date Due: + 21 weeks to + 57 weeks

District Review: Responses to draft demobilization plan and recommended changes

Date Due: Ten (10) working days after receipt of draft

Deliverable: Final Demobilization Plan

Date Due: Ten working days after receipt of District review

Deliverable: Demobilization

Date Due: + 21 weeks to + 57 weeks

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

PHASE IV: DATA ANALYSIS, PUBLICATION AND REPORT WRITING

In cooperation with District staff, the contractor will conduct data analysis, interpretation and publication. For methods found to be effective in measuring deposition rates and useful to the District for future monitoring, the CONTRACTOR's team will develop detailed operating procedures. This task will produce the following kinds of deliverables as specified in the modified work plan:

- Quality assured data sets from field studies,
- Meta-data and method descriptions,
- Publications on P deposition rates, methods and other information generated during the project,
- Operating procedures for monitoring methods, and
- Final Report summarizing the above and detailing any information not provided through other deliverables.

Task 14. Data Analysis

The CONTRACTOR shall provide all statistical output and shall document statistical procedures:

- alternative methods considered for analyzing these data;
- rationale/criteria used for selecting a specific statistical procedure;
- properties and limitations of the data set and recommendations for optimizing future spatial and temporal sampling based on the available data;
- results of statistical analysis of the data; and
- an assessment of the strengths and limitations of the analysis.

Deliverable: Draft Report – Data Analysis

The report will include an appendix including the computer code used to conduct the statistical tests with sufficient documentation to facilitate future use by District staff and the raw output. An electronic copy of the SAS code will also be included.

Date Due: +111 weeks to + 144 weeks

District Review: Responses to draft report and recommended changes

Date Due: Ten (10) working days after receipt of draft report

Deliverable: Final Report – Data Analysis

Date Due: Ten (10) working days after receipt of comments

Deliverable: Quality assured data sets from field studies

The data set will be delivered in an electronic format acceptable to the District on a DOS-formatted, 3.5-inch diskette.

Date Due: +111 weeks to + 144 weeks

Task 15. Meta-data

Deliverable: Meta-data

The CONTRACTOR shall provide a meta-data set that will include field notes and processing observations. The data set will be delivered in an electronic format acceptable to the District on a DOS-formatted, 3.5-inch diskette.

Date Due: + 111 weeks to +144 weeks

Task 16. Detailed Operating Procedures

The CONTRACTOR will produce individual detailed operating procedures for each monitoring method identified in the Phase III Work Plan.

Deliverable: Detailed Operating Procedures

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of the Report.

Date Due: + 111 weeks to +144 weeks

Task 17. Journal Publications

The CONTRACTOR will produce draft manuscripts as identified in the Phase III Work Plan.

Deliverable: Journal Publications

Date Due: + 111 weeks to +144 weeks

Task 18. Final Project Report

The CONTRACTOR will produce the final report identified in the Phase III Work Plan. The report will at least include:

- Detailed descriptions of the methodologies used during the course of this study,
- Pros and cons for each method and recommendations for their use,
- Copies of all manuscripts produced on the project,
- Summary of findings and recommendations, and
- And other details as determined in the work plan.

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

Deliverable: Draft Final Report

Date Due: + 111 weeks to +144 weeks

District Deliverable: Responses to draft report and recommended changes

Date Due: Ten (10) working days after receipt of draft report

Deliverable: Final Report

The CONTRACTOR shall submit five (5) hard copies and one electronic copy (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of the Report.

The CONTRACTOR shall provide hardcopies as well as electronic copies (in a format acceptable to the District on a DOS-formatted, 3.5-inch diskette) of all data collected.

Date Due:

The CONTRACTOR will provide copies of all field notes.

4.0 SCHEDULE OF TASKS

Work for this 36-month project will be phased with each phase having a set of specific tasks and deliverables. The contract will encompass:

- **Phase I**: 6-month planning and mobilization process;
- **Phase II**: 7-month period of Phase I 'proof of concept' studies;
- **Phase III**: 15-month Phase II monitoring and research program at several locations in South Florida; and
- **Phase IV**: 8-month period of data evaluation, report preparation and publication.

The project will end with the delivery of a final report composed of a series of draft publications and a summary report to the District with conclusions from the monitoring and research program, standard operating procedures for preferred methods of measurement, and recommendations for additional research and monitoring.

5.0 ATTACHMENTS

The following array of field sites should be considered as a starting point for developing a network of field sites for these studies (see attached map):

1. Western Shore of Lake Okeechobee at S131
2. Eastern Shore of Lake Okeechobee at S308

3. Southern Shore of Lake Okeechobee and northern Everglades Agricultural Area at BG1/BG2
4. ENR Project reference site representing eastern EAA, western suburban area
5. Loxahatchee National Wildlife Refuge eastern border in the vicinity of Ranger Station, western to suburban / agricultural area
6. Loxahatchee Wildlife Refuge, western levee, S-6 area, eastern border of EAA
7. S-7, representing southern EAA and western WCA 2A
8. S-10, representing eastern WCA 2A, and western urban/ agricultural area

6.0 DISTRICT RESPONSIBILITIES

During development of work plan, staff of the Water Resources Evaluation Department will be available to develop areas of cooperation with the CONTRACTOR.

7.0 REFERENCES

Ahn, H. 1998. Statistical modeling of total phosphorus concentration from south Florida rainfall. Ecological Modeling (in press).

Ahn, H. and R.T. James. 1998. Outlier detection in dry deposition rates for phosphorus measured in south Florida. Atmospheric Environment (in press).

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Dulac et al. 1989. Atmospheric input of trace metals to the western Mediterranean: uncertainties in modelling dry deposition from cascade impactor data. Tellus. 41B:362-378.

Finlayson-Pitts, B.J. and J.N. Pitts. 1986. Atmospheric Chemistry: Fundamentals and Experimental Techniques. John Wiley and Sons, N.Y., New York.

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Lin, J.J., G.C. Fang, T.M. Holsen and K.E. Noll. 1993. A comparison of dry deposition modeled from size distribution data and measured with a smooth surface to total particle mass, lead and calcium in Chicago. Atmospheric Environment Part A, 27: 1131 – 1138.

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the atmosphere. In: Methods of Air Sampling and Analysis. J.P. Lodge, ed. Lewis Publishers, Inc.

Lovett, G.M. 1994. Atmospheric deposition of nutrients and pollutants in North America: an ecological perspective. Ecological Applications 4: 629-650.

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McCormick, P.V., P.S. Rawlik, K. Lurding, E.P. Smith and F.H. Sklar. 1996. Periphyton-water quality relationships along a nutrient gradient in the northern Florida Everglades. J. N. Am. Benthol. Soc. 15:433-449.

McDowell, W.H., D.F. Gatz, J.M. Ondov, C.J. Pollman and J.W. Winchester. 1997. Atmosperic deposition into South Florida: Advisory panel final report. South Florida Water Management District, PO Box 24680, West Palm Beach, FL 33416-4680. December 245, 1997; 37 pgs.

Redfield, G.W. 1999. Quantifying Atmospheric Deposition of Phosphorus: Concepts, Constraints and Published Rates. Revision of Tech. Pub. WRE #360. South Florida Water Management District, West Palm Beach, FL 35 pgs.

USEPA. 1996. Air Quality Criteria for Particulate Matter, Vol.I. EPA/600/P-95/001aF.

C-10740 This Statement of Work is under review by District staff. TOC members please send your comments to Garth Redfield or Nancy Urban by March 31, 1999.

8.0 TIME SCHEDULE AND TIME FRAMES

Task Number	Description	Date
PHASE I: IDENTIFICATION AND RECOMMENDATION OF METHODS AND MODELS AND LITERATURE REVIEW		
Task 1.	Particle Deposition – Identification/Recommendation of Methods	Contract Approval to +7 weeks
Task 2.	Air Concentration Sampling – Identification and Recommendation of Methods	Contract Approval to +7 weeks
Task 3.	Review Methods for Estimating Deposition Velocities in the Inferential Method	Contract Approval to +7 weeks
Task 4	Update Literature Information Base on P Deposition	Contract Approval to +7 weeks
Task 5.	Compilation of Information from Tasks 1-4 - Draft Report	Contract Approval to +7 weeks
Task 5.	***DISTRICT REVIEW***	Contract Approval to +7 weeks
Task 5.	Final Information Report	Contract Approval to +7 weeks
Task 6.	District Site Visit – Three Days	+8 weeks to +10 weeks
Task 6.	Letter Report – District Site Visit	
Task 7.	Draft Work Plan – Phase II and II Field Studies	+9 weeks to +21 weeks
Task 7.	***DISTRICT REVIEW***	+9 weeks to +21 weeks
Task 7.	Final Work Plan – Phase II and II Field Studies	+9 weeks to +21 weeks
*****STOP / GO*****		
PHASE II: FIELD STUDIES – PROOF OF CONCEPTS AND METHODS		
Task 8.	Equipment Purchase, Design and Construction	+21 weeks to +57 weeks
Task 9.	Equipment Installation and Testing	+21 weeks to +57 weeks
Task 10.	Field Research and Monitoring	+21 weeks to +57 weeks
Task 10.	Draft Report – Phase II	+21 weeks to +57 weeks
Task 10.	***DISTRICT REVIEW***	+21 weeks to +57 weeks
Task 10.	Final Report – Phase II	+21 weeks to +57 weeks
*****STOP / GO*****		
PHASE III: FIELD STUDIES - EXTENDED		
Task 11.	Field Studies – Extended	+57 weeks to +111 weeks
Task 11.	Quarterly Letter Reports	+57 weeks to +111 weeks
Task 12.	Draft Report – Phase III	+57 weeks to +111 weeks
Task 12.	***DISTRICT REVIEW***	+57 weeks to +111 weeks
Task 12.	Final Report – Phase III	+57 weeks to +111 weeks
Task 13.	Draft Demobilization Plan	+57 weeks to +111 weeks
Task 13.	***DISTRICT REVIEW***	+57 weeks to +111 weeks
Task 13.	Final Demobilization Plan	+57 weeks to +111 weeks
Task 13.	Demobilization	+57 weeks to +111 weeks

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Task Number	Description	Date
PHASE IV: DATA ANALYSIS, PUBLICATION AND REPORT WRITING		
Task 14.	Draft Report – Data Analysis	+111 weeks to +144 weeks
Task 14.	***DISTRICT REVIEW***	+111 weeks to +144 weeks
Task 14.	Final Report – Data Analysis	+111 weeks to +144 weeks
Task 14.	Quality Assured Data Sets	+111 weeks to +144 weeks
Task 15.	Meta-data	+111 weeks to +144 weeks
Task 16.	Detailed Operating Procedures	+111 weeks to +144 weeks
Task 17.	Journal Manuscripts	+111 weeks to +144 weeks
Task 18.	Draft Final Project Report	+111 weeks to +144 weeks
Task 18.	***DISTRICT REVIEW***	+111 weeks to +144 weeks
Task 18.	Final Project Report	+111 weeks to +144 weeks