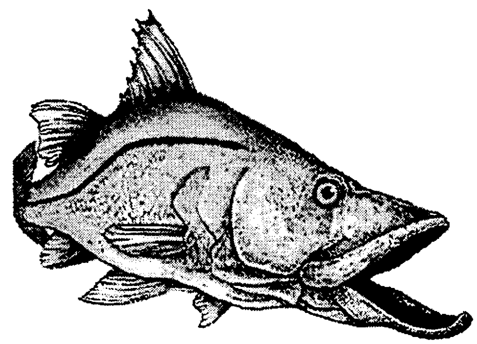
TECHNICAL MEMORANDUM # 19

INTER-AGENCY IMPLEMENTATION OF MODIFIED WATER QUALITY MONITORING PROGRAM FOR THE INDIAN RIVER LAGOON

"METHODS AND QA/QC ISSUES"



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INTER-AGENCY IMPLEMENTATION OF MODIFIED WATER QUALITY MONITORING PROGRAM FOR THE INDIAN RIVER LAGOON

"METHODS AND QA/QC ISSUES"

In Cooperation with:

VOLUSIA COUNTY
NASA-DYNAMAC
BREVARD COUNTY
INDIAN RIVER COUNTY
SJRWMD
EPA-NEP

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I. EXECUTIVE SUMMARY

The purpose of this paper is to address and provide a summary of important methods and quality assurance/quality control (QA/QC) issues associated with the implementation of the modified water quality monitoring program for the Indian River Lagoon (IRL). This report identifies and describes sampling methods to be adopted by the Indian River Lagoon-Water Quality Monitoring Network (IRL-WQMN) participating agencies in an effort to provide program and/or project coordinators, as well as various scientific staff from each county with a basic understanding of appropriate sampling protocols and QA/QC procedures.

The IRL-WQMN participating agencies (Volusia County, Brevard County, Indian River County, NASA-Dynamac, EPA-National Estuary Program, and SJRWMD) were in agreement on a modification plan of the IRL-WQMN. The coordination of a multi-agency monitoring network in a consistent manner demands standardized methods, procedures, and equipment. This standardization is necessary to produce reliable and comparable data.

Utilization of a single (centralized) laboratory by the WQMN agencies as proposed in the modified IRL-WQMN ensured better quality assurance and control. Analytical errors and the magnitude of discrepancies in laboratory results would be reduced and errors may be readily detected and corrected. The adoption of a centralized laboratory facility and services for the IRL-WQMN guaranteed that staff and laboratory resources will be used more effectively and could place less budgetary demand on the participating agencies. The ultimate benefit will be a monitoring network that is more cost-effective and efficient.

II. BACKGROUND

The Indian River Lagoon -Water Quality Monitoring Network (IRL-WQMN) was established in 1988 and continues to operate through the cooperative efforts of the participating agencies: Volusia County, NASA (represented by their consultant, Dynamac, Inc.), Brevard County, Indian River County, St. Johns River Water Management District (SJRWMD) and EPA-National Estuary Program (EPA-NEP).

In 1995, all the IRL-WQMN participating agencies were in agreement on a modification plan of the IRL-WQMN. The adoption of the modified water quality monitoring activities for the IRL call for the continuation of consistent water quality monitoring throughout the lagoon system to be maintained by the participating agencies stated above. The coordination of a multi-agency monitoring network in a consistent manner demands standardized methods, procedures, and equipment. This standardization is necessary to produce reliable and comparable data.

The proposed modifications to the IRL-WQMN are intended to further focus its mission on (a) providing answers to specific questions related to the long-term management of seagrass and the water quality necessary for healthy seagrass, (b) increasing the statistical power of the data collected (and, thus, the performance of the WQMN), (c) increasing the effectiveness of staff and laboratory resources, and (d) collecting complementary data for the calibration of the Pollution Load Reduction (PLR) Model. Furthermore, as management strategies are enacted to achieve pollution load reduction goals (PLRGs), the WQMN can help gauge their effectiveness in improving water quality necessary for seagrass recovery.

The modified IRL-WQMN will require a minimum of 108 samples per retained station over a three-year period to develop a statistically valid database. Three samples per station will be collected during a tidal phase each month for the next three years. This sample number and frequency would greatly complement the calibration of the PLR Model.

III. MODIFIED IRL-WQMN: Synopsis

The SJRWMD proposed a selective reduction in the number of sampling stations to eliminate statistically unnecessary sampling, resulting in a more efficient sampling effort in the IRL system (Table 1). The stations that are retained will continue to provide information on the long-term spatial and temporal trends of water quality and help discern the covariant or causal link between seagrass coverage (distribution/density) and water quality. In addition to the selective reduction of sampling stations (Figures 1, 2, 3, and 4) within the IRL system, the proposed modifications plan also included the following changes:

1) the selection of existing sampling stations based on their proximity to seagrass measurement transects;

2) an increase in the sampling frequency at each station to three times per station during a tidal cycle each month (dropping back to one sampling per station per month after three years);

3) the inclusion of near-bottom nutrient samples to be collected at each station, at least once during a tidal cycle (~12 hr) each month, to help calibrate the PLR Model;

4) the measurement of the separate organic and inorganic fractions of total suspended solids; and

5) the centralization of laboratory analyses to reduce potential analytical errors (which can occur when several laboratories are involved in a monitoring program).

By streamlining the WQMN as proposed, staff and laboratory resources will be used more effectively and place less budgetary demand on the participating agencies. The ultimate benefit will be a more cost-effective and efficient monitoring tool to measure the water quality of the seagrass environment.

Table 1. Sampling stations per modified IRL-WQMN in the Indian River Lagoon.

Sampling Station	*IRL Segment*	*Sampling Agency*
V02	Mosquito Lagoon	Volusia County
V11	Mosquito Lagoon	Volusia County
V17	Mosquito Lagoon	Volusia County
ML02	Mosquito Lagoon	NASA-Dynamac
I02	Indian River Lagoon	SJRWMD
I07	Indian River Lagoon	SJRWMD
I10	Indian River Lagoon	SJRWMD
I13	Indian River Lagoon	SJRWMD
I16	Indian River Lagoon	SJRWMD
I18	Indian River Lagoon	Brevard County
I21	Indian River Lagoon	Brevard County
I23	Indian River Lagoon	Brevard County
I27	Indian River Lagoon	Brevard County
B02	Banana River Lagoon	NASA-Dynamac
B04	Banana River Lagoon	Brevard County
B06	Banana River Lagoon	Brevard County
B09	Banana River Lagoon	Brevard County
IRJ01	Indian River Lagoon	Indian River County
IRJ04	Indian River Lagoon	Indian River County
IRJ05	Indian River Lagoon	Indian River County
IRJ07	Indian River Lagoon	Indian River County
IRJ10	Indian River Lagoon	Indian River County
IRJ12	Indian River Lagoon	Indian River County

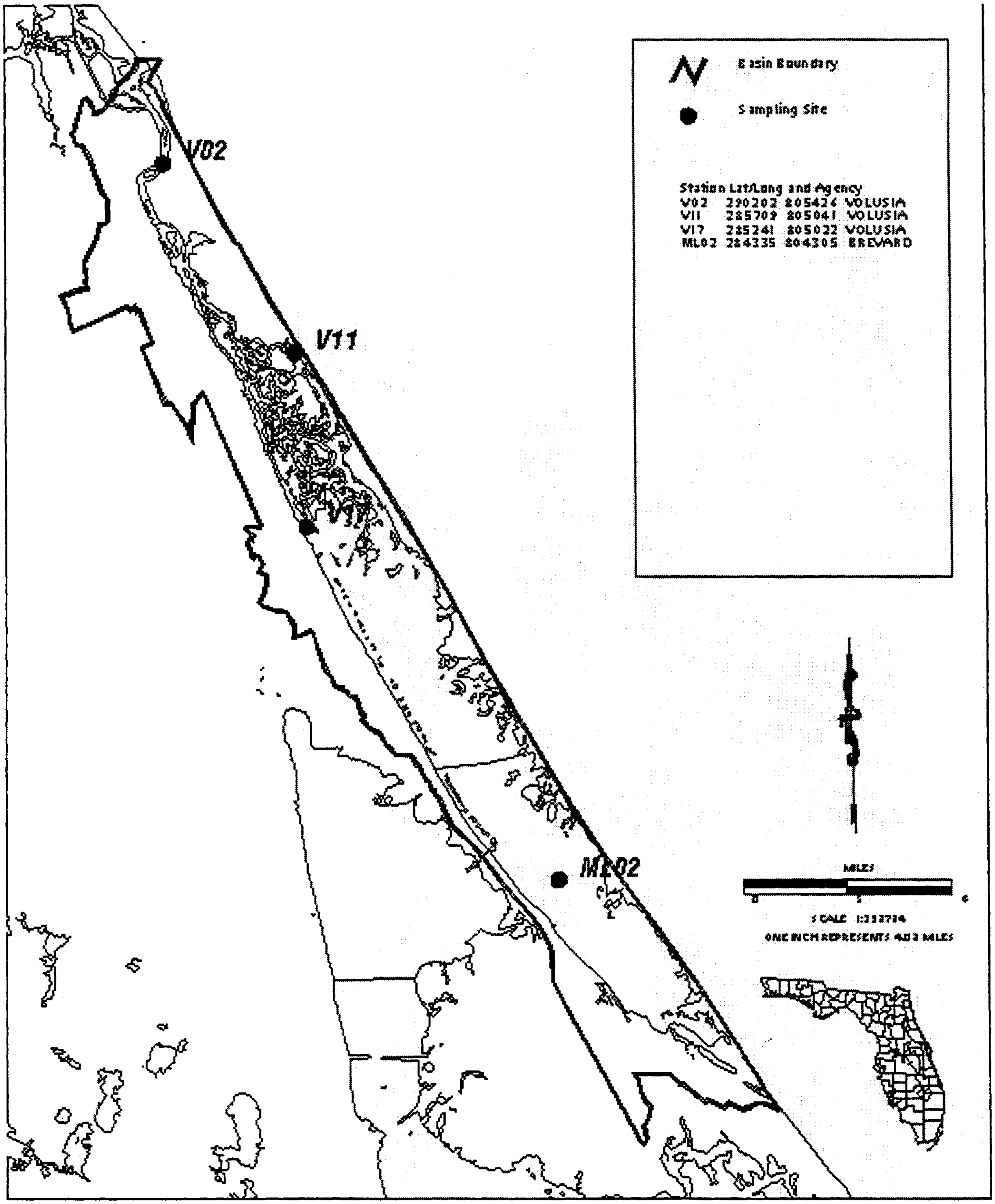


Figure 1. Water quality monitoring sites in the Mosquito Lagoon.

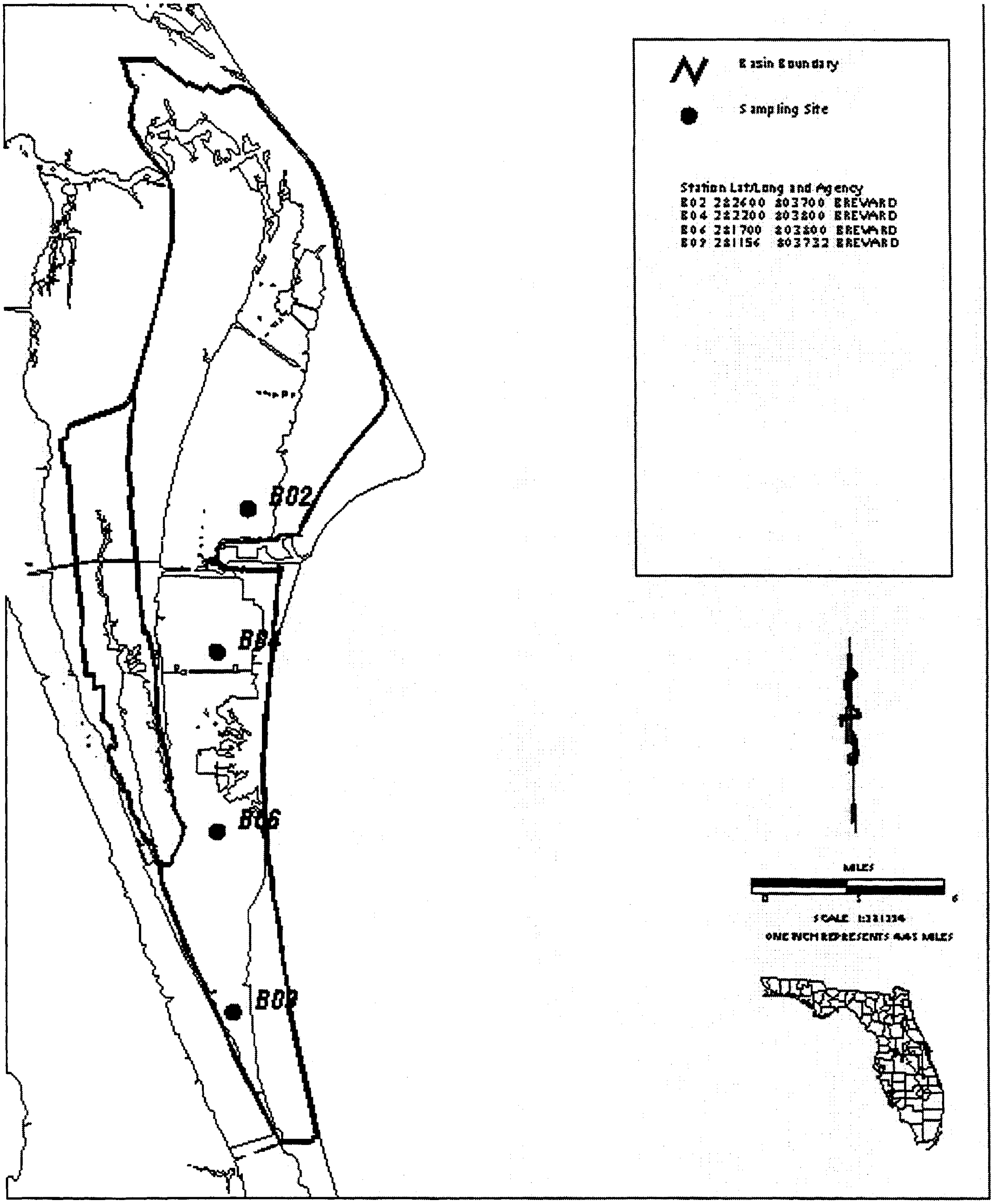


Figure 2. Water quality monitoring sites in the Banana River Lagoon.

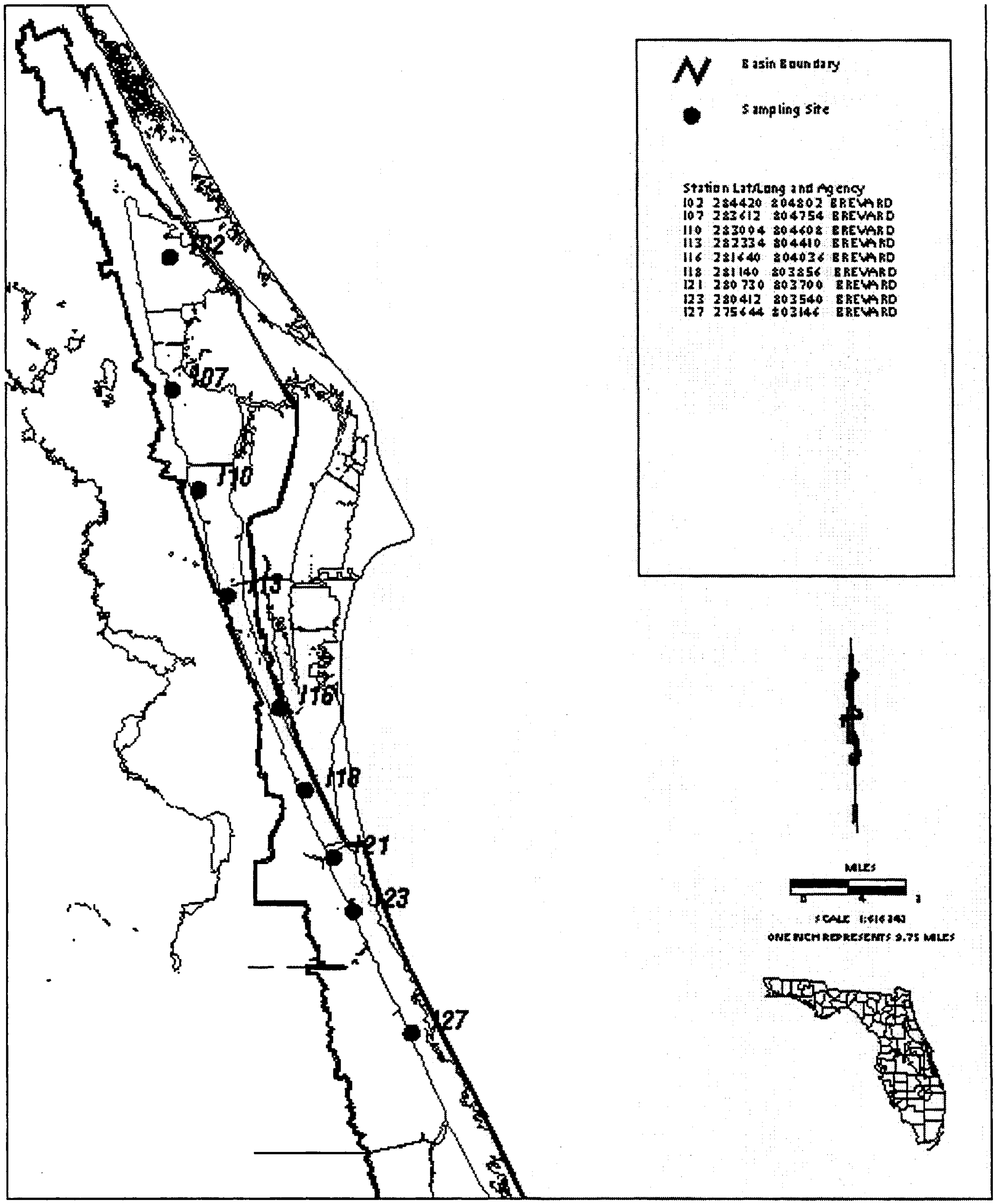


Figure 3. Water quality monitoring sites in the North Indian River Lagoon.

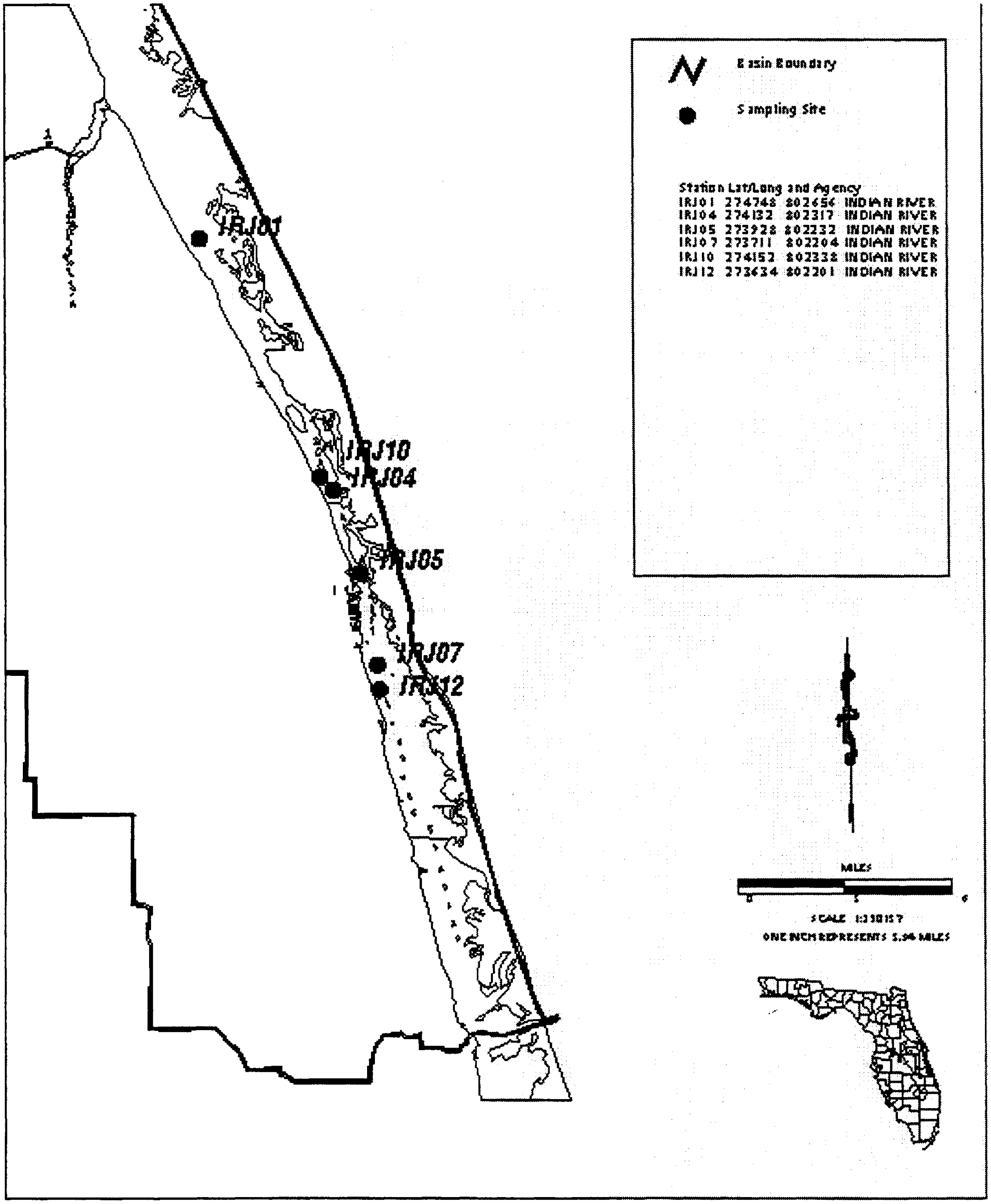


Figure 4. Water quality monitoring sites in the South Indian River Lagoon.

IV. SAMPLING METHODS AND PROTOCOLS

General:

This section is intended to provide a summary of available information and to address important issues associated with the implementation of the modified water quality monitoring program for the IRL. This section identifies and describes sampling methods to be adopted by the IRL-WQMN participating agencies in an effort to provide program and project coordinators and various scientific staff with a basic understanding of sampling methods. As stated earlier, coordination of a multi-agency monitoring network in a consistent manner demands standardized methods, procedures, and equipment. This standardization is necessary to produce reliable and comparable data. The methods described in this section can be used to guide individual scientific staff from each county on appropriate methods and techniques as well as appropriate quality assurance and quality control (QA/QC) procedures.

General Sampling. Three samples per station at near-surface will be collected during a tidal phase each month to capture any tidal or seasonal trends in the lagoon. Near-bottom nutrient samples will be collected at each station at least once during a tidal cycle (~12 hr) each month. Photosynthetically active radiation (PAR) measurements for each station will be done after 10:00 a.m. at least once a month. Sampling will be done on the Tuesday following the second Monday of each month, or on the day(s) agreed to by the WQMN group, or as soon as possible after that day if inclement weather prevents sampling. Water samples will be shipped within the appropriate holding time to a centralized laboratory for chemical analyses. Each county will continue to sample and measure for the different parameters (meteorological and physical) listed in Tables 2a and 2b. Monitoring schemes and measurements for these physical characteristics should involve ***in situ*** methods. The list of water column chemical properties shown in Tables 3a and 3b will be a major consideration for the centralization of laboratory analyses in the IRL.

Near-Surface and Near-Bottom Sampling. It is recommended that at least one of the three samplings (Circuits 1, 2, and 3), (Figures 5a to 5f) during the tidal cycle run include a near-bottom water sample. The near-surface sample can be taken using a water grab sampler (Van Dorn). Prior to and at the time of sampling from the near-surface or near-bottom depth, it is very important that there is minimal sediment disturbance. The station should be approached slowly, ideally with boat engine cut-off as the boat is coasting into position, and then the anchor gently lowered. The sample should be taken as far away from any points of possible disturbance (anchor, engine, other sampling activities, etc.). The recommended depth at which the near-bottom sample would be taken using a "bilge pump" or peristaltic pump is 0.3 m above the bottom. The IRL database (1987-1991) reveals that the depth of the water column at most of the retained stations is usually more than 1.25 m (Table 4). If the mean water column depth is less than 1 m, no near-bottom sample will be taken; only the near-surface sample. Water column sampling devices should be checked for proper functioning prior to the survey. It is wise to have a backup sampler available onboard the survey vessel in case the primary sampler is found to be unsuitable for use.

Table 2a. Water column (near-surface depth) physical parameters for the Indian River Lagoon Water Quality Monitoring Network.

Physical Parameters	*Unit*
Water Temperature	degrees Celsius
pH	pH units
Dissolved Oxygen	mg/L
Conductivity	μmhos/cm
Salinity	parts per thousand
Secchi	meters
Depth of Collection	meters
Depth of Sample Site	meters
Air Temperature	degrees Celsius
Wind Direction	degrees
Wind Velocity	miles per hour
Cloud Cover	percent

Table 2b. Water column (near-bottom depth) physical parameters for the Indian River Lagoon Water Quality Monitoring Network.

Physical Parameters	*Unit*
Water Temperature	degrees Celsius
pH	pH units
Dissolved Oxygen	mg/L
Conductivity	μmhos/cm
Salinity	parts per thousand
Secchi	meters
Depth of Collection	meters
Depth of Sample Site	meters

Table 3a. Water column (near-surface) chemical parameters for the Indian River Lagoon Water Quality Monitoring Network.

Near-Surface Chemical Parameters	***Unit***
Color	PCU
Turbidity	NTU
Total Organic Suspended Solids	mg/L
Total Inorganic Suspended Solids	mg/L
Chlorophyll a	µg/L
Chlorophyll b	µg/L
Chlorophyll c	µg/L
Pheopigments	µg/L
Chlorophyll a corrected	µg/L
Chlorophyll a / Pheopigment Ratio	
Total Organic Carbon as C	mg/L
Total Kjeldahl Nitrogen as N	mg/L
Nitrate + Nitrite as N	mg/L
Dissolved Kjeldahl Nitrogen as N	mg/L
Total Phosphorus as P	mg/L
Total Orthophosphorus as P	mg/L
Dissolved Phosphorus as as P	mg/L
Silica as SiO2-D	mg/L

Table 3b. Water column (near-bottom) chemical parameters for the Indian River Lagoon Water Quality Monitoring Network.

Near-Bottom Chemical Parameters	***Unit***
Total Organic Suspended Solids	mg/L
Total Inorganic Suspended Solids	mg/L
Chlorophyll a	µg/L
Chlorophyll b	µg/L
Chlorophyll c	µg/L
Pheopigments	µg/L
Chlorophyll a corrected	µg/L
Chlorophyll a / Pheopigment Ratio	
Total Organic Carbon as C	mg/L
Total Kjeldahl Nitrogen as N	mg/L
Nitrate + Nitrite as N	mg/L
Dissolved Kjeldahl Nitrogen as N	mg/L
Total Phosphorus as P	mg/L
Total Orthophosphorus as P	mg/L
Dissolved Phosphorus as P	mg/L
Silica as SiO2-D	mg/L

Volusia County

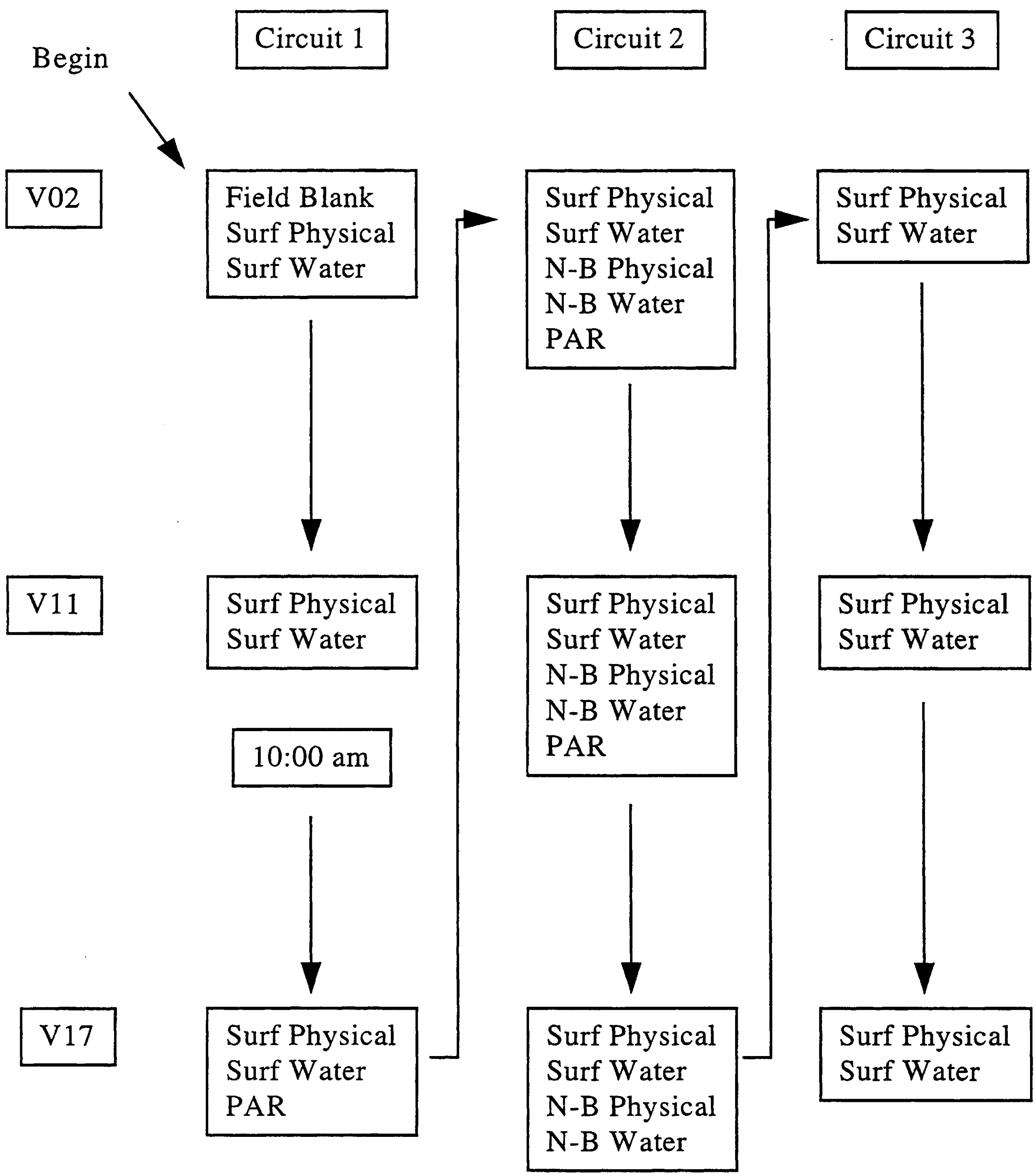


Figure 5a. Sampling strategy for Volusia County - Example.

Dynamac

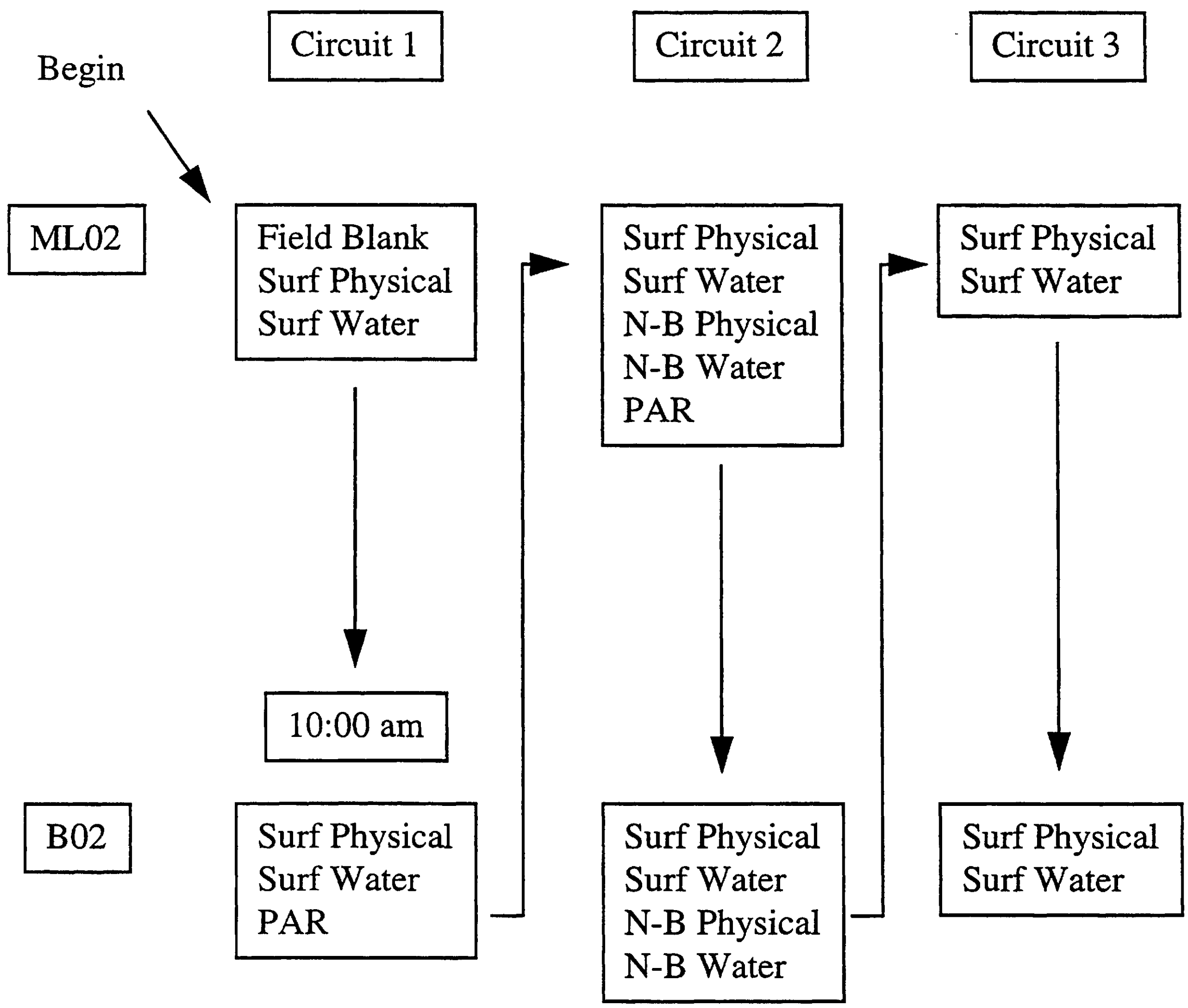


Figure 5b. Sampling strategy for Dynamac - Example.

Brevard County - Day 1

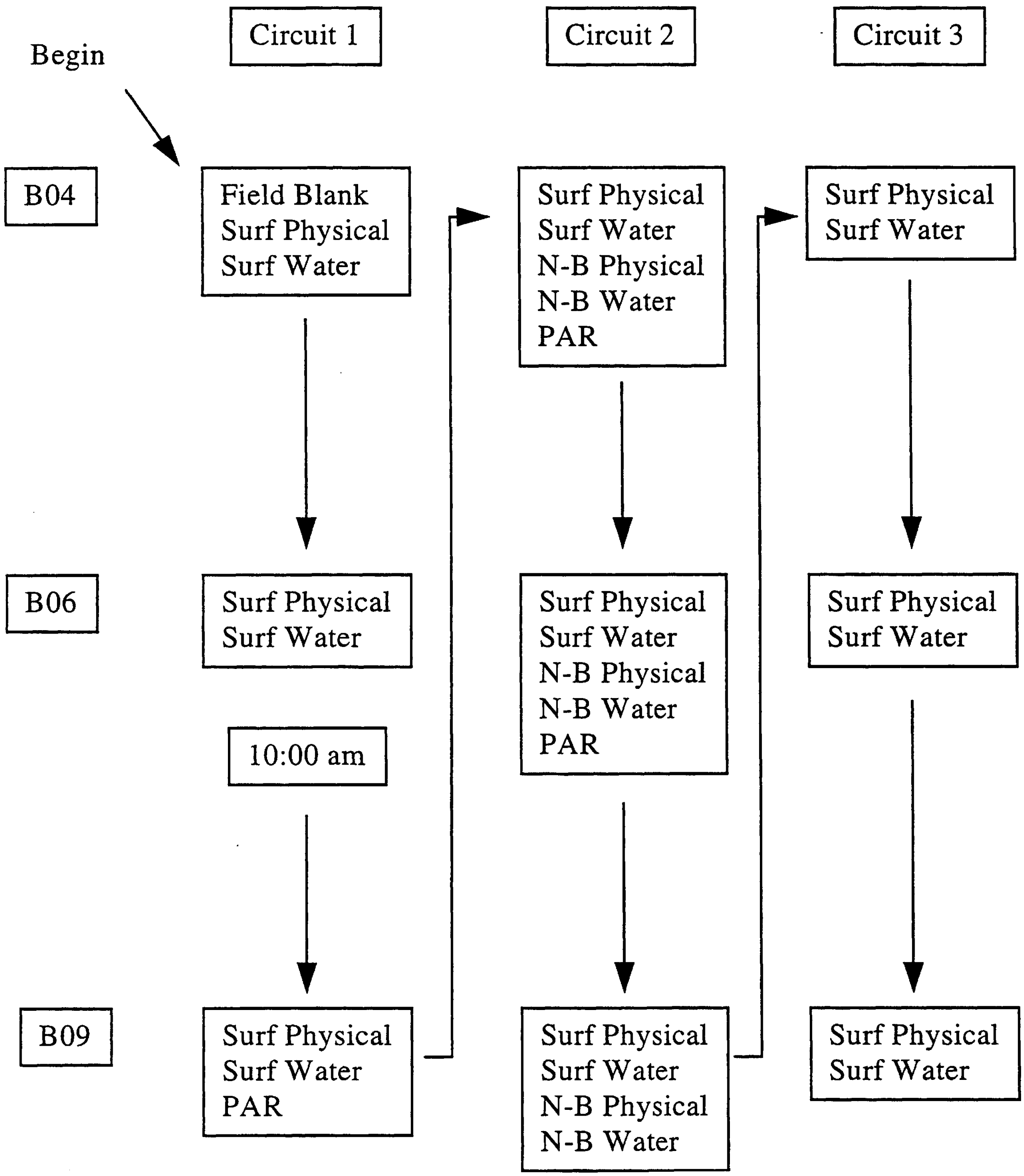


Figure 5c. Sampling strategy for Brevard County Day 1 - Example.

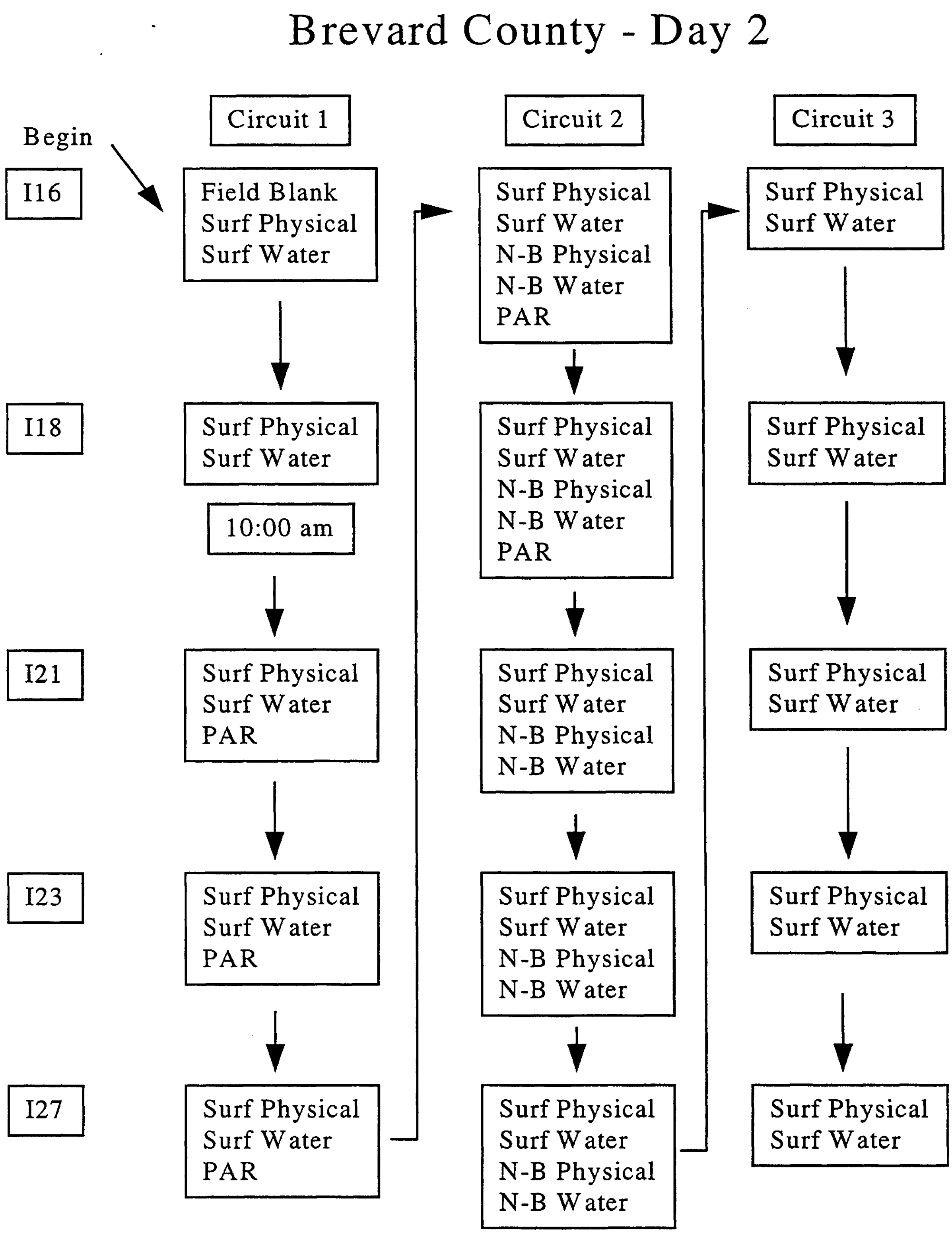


Figure 5d. Sampling strategy for Brevard County Day 2 - Example.

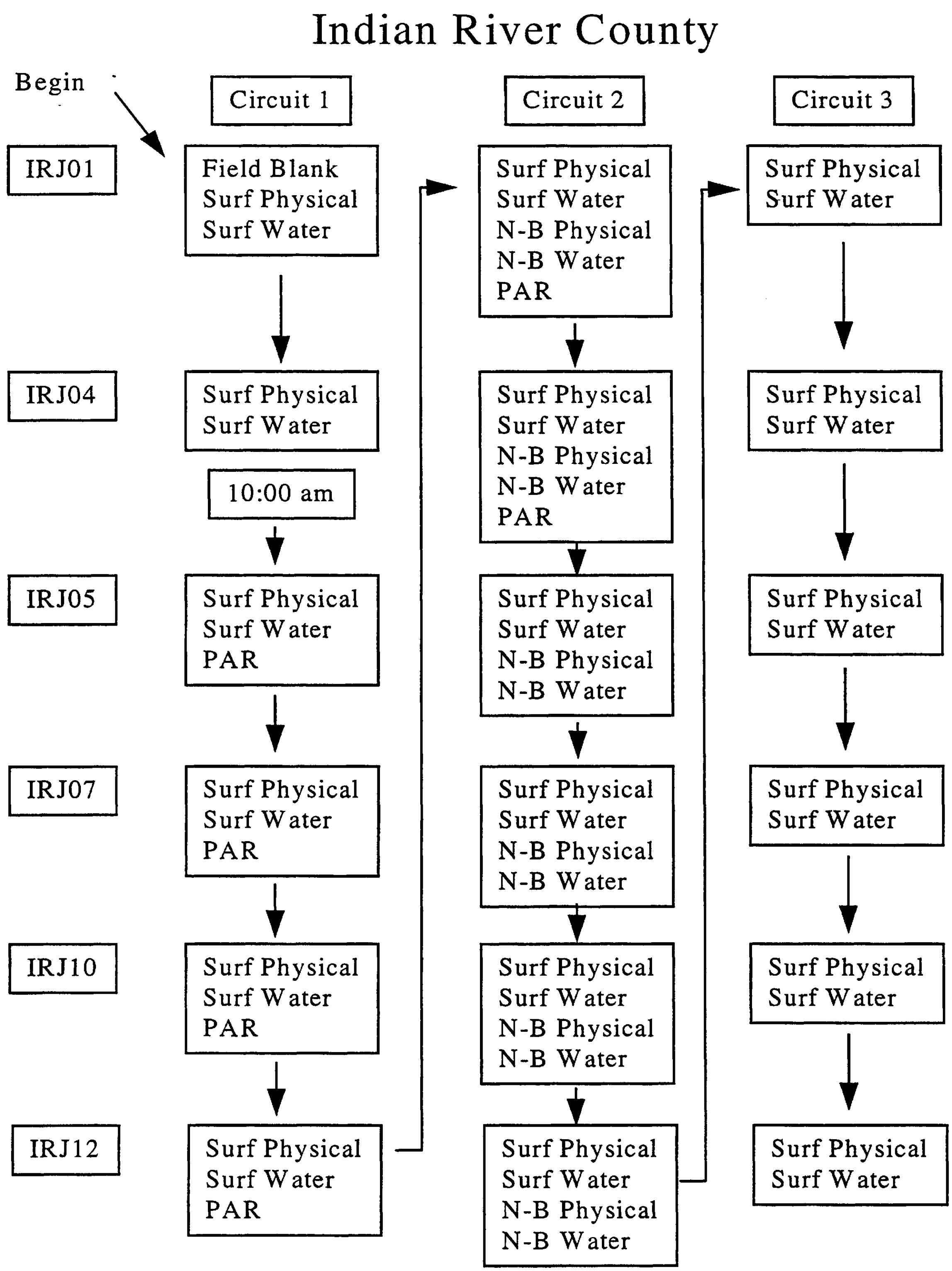


Figure 5e. Sampling strategy for Indian River County - Example.

SJRWMD

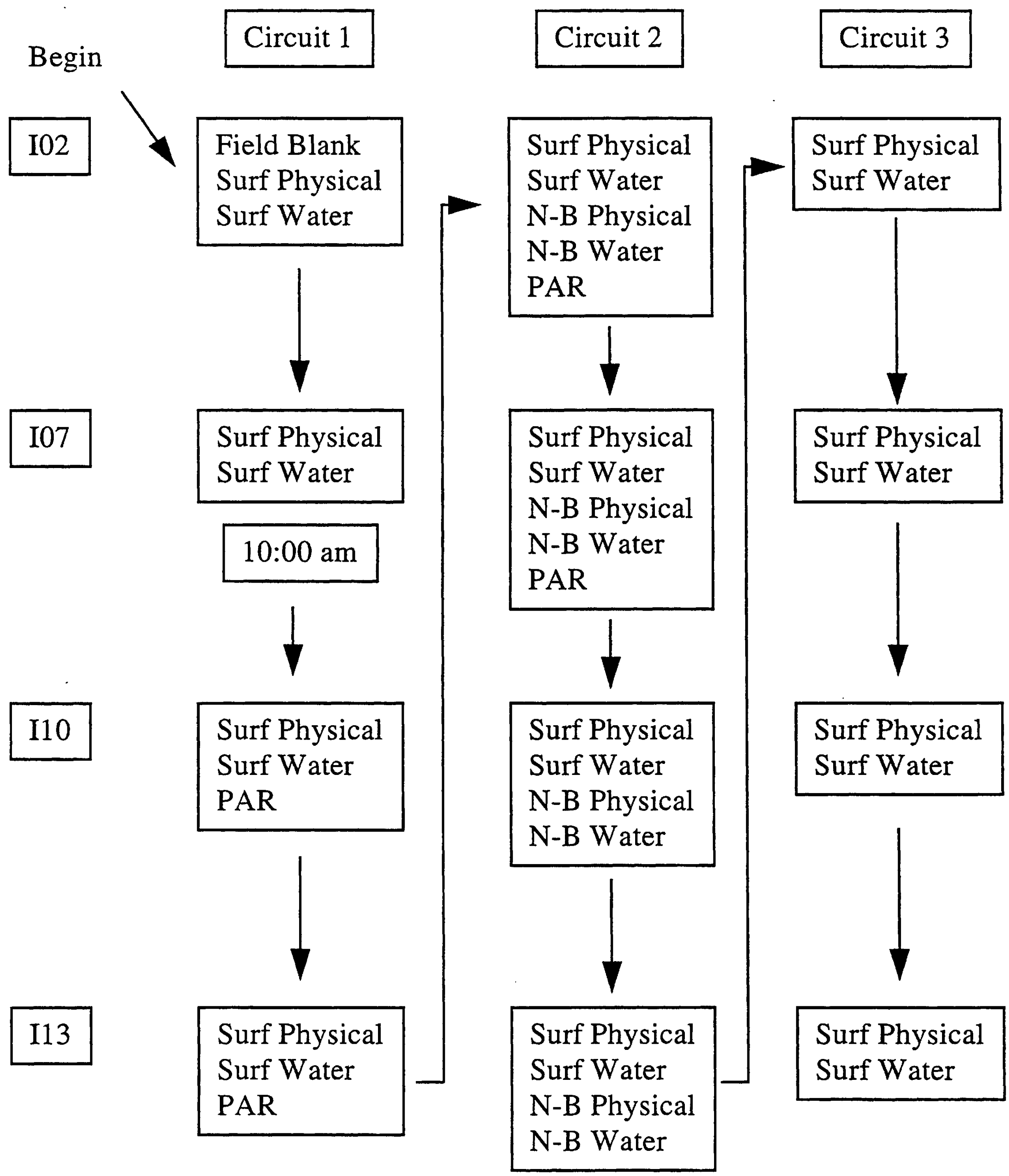


Figure 5f. Sampling strategy for SJRWMD - Example.

Table 4. Mean, minimum, and maximum depth measurements (meters) of retained sampling stations in the Indian River Lagoon.

Sampling Station	*Mean Depth*	*Standard Deviation*	*Minimum Depth*	*Maximum Depth*
V02	4.68	0.68	1.60	6.00
V11	1.25	0.24	0.60	1.70
V17	2.43	0.58	1.20	3.60
ML02	2.11	0.23	1.80	2.80
I02	2.55	1.47	1.20	7.00
I07	2.19	0.22	1.75	2.75
I10	2.92	0.27	2.13	3.35
I13	2.48	0.20	1.60	2.90
I16	3.63	0.33	3.05	4.57
I18	2.83	0.67	1.30	3.96
I21	3.36	0.42	2.44	4.57
I23	2.97	0.46	2.00	4.10
I27	1.88	0.33	1.22	2.74
B02	1.99	0.26	1.50	2.70
B04	1.93	0.24	1.40	2.40
B06	2.75	0.28	2.40	3.70
B09	1.79	0.31	0.80	3.00
IRJ01	1.94	0.34	1.50	2.50
IRJ04	2.03	0.71	0.80	3.50
IRJ05	2.43	0.81	1.50	5.00
IRJ07	1.79	0.59	1.25	4.00
IRJ10	1.14	0.32	0.50	1.50
IRJ12	1.61	0.21	1.50	2.00

Sample Labeling, Blanks, Replication, and Structure

The following is a listing of the parameters and methods for field collections of water samples for the modified IRL-WQMN. Near-surface sampling will take place at 0.5 m depth, and near-bottom sampling will take place at bottom - 0.3 m. Field blanks and replications for the chemical samples will be taken according to the number of stations visited on a day and are specified below and listed in Table 5.

Sample Labeling

- Samples will be labeled with the station name, 2 digit year, 2 digit month, 2 digit day, 4 digit 24 hr time (xxx xxxxxxxxxx).

Example:	Station B02 on January 5, 1996 at 10:00 a.m.	B02 9601051000
	Station I07 on July 10, 1996 at 2:05 p.m.	I07 9607101405

Field Blanks and Replication

- The blank will always be labeled P-IR-- and will be the first sample of the day.

- If you are sampling <5 stations do 1 replication. If you are sampling 5 or more stations - 2 reps are required. Reps are labeled as the time of the sample plus 1 minute.

Example:	surface sample:	V17 9602041200	rep: V17 9602041201
	near-bottom sample:	B06 9602041205	rep: B06 9602041206

Table 5. Agency, number of stations, blanks, and replicates required for the Water Quality Monitoring Network in the Indian River Lagoon.

Agency	*Number of Stations*	*Blanks Required*	*Reps Required*
Volusia County	3	1	1
Dynamac	2	1	1
Brevard County	3	1	1
	5	1	2
Indian River County	6	1	2
SJRWMD	4	1	1

Sampling Structure

Figures 5a to 5f show examples of the three (3)-circuit sampling structure that pertain to each agency. The entire collection plan of the day is shown to simplify the sampling sequence for the IRL-WQMN participating agencies.Using three simple rules below will enable us to carry-out a rather complex sampling structure.

- **Surface physical and a surface water sample are always done.**

- **On the 2nd circuit, a near-bottom physical and water sample are done.**

- **PAR starts at 10:00 a.m. and goes for one complete circuit.**

Some ancillary rules given below will make the paperwork and QA/QC easier:

- **Surface sample time codes always end in "a zero". Exception: Replicates (1)**
  surface sample: IRJ01 9602041200 rep: IRJ01 9602041201

- **Near-bottom sample time codes always end in a 5. Exception: Replicates (6)**
  near-bottom sample: IRJ01 9602041205 rep: IRJ01 9602041206

- **Take replicate samples before or after PAR.**
  This will help to keep PAR in the 10:00 a.m. - 2:00 p.m. window.

Sampling Contingency: Inclement Weather

Because of sediment resuspension and PAR sampling considerations, inclement weather for the purposes of the WQMN is defined as a condition in the Lagoon with ≥ 15 knots wind or with 10 to 12 cm wave action. In any event that sampling activities will be hampered because of inclement weather or other similar conditions, sampling then could be accomplished based on the following considerations.

Situation	Action
1. Unable to sample due to inclement weather	Sample on next possible day, notify staff at SJRWMD
2. First circuit is completed followed by severe weather, making the rest of sampling events impossible to accomplish	Discard samples and sample on next possible day, start the first circuit
3. Completed first circuit, incomplete second circuit	Discard samples and sample on next possible day, start the first circuit
4. Completed second circuit, incomplete third circuit	Send collected samples to the laboratory for analyses, discontinue the rest of sampling

In case of an extended inclement weather (massive storm event, lightning), sampling can still proceed the following week. Sampling will be cancelled for that month if the following week is within the scope of inclement weather definition.

Photosynthetically Active Radiation (PAR) Sampling Protocol

A workshop was held in January, 1993 to develop a standardized protocol for measuring the light available to seagrasses. A number of questions were addressed concerning the correct sensors to use, the appropriate time to sample, the best depth profile to sample, the correct calculation for diffused light attenuation (K), and the use of K as a management tool. Several examples were presented for the different sampling scenarios. From these scenarios, a protocol was developed and PAR MAN emerged. The PAR MAN protocol has been used successfully in the Lagoon for three years, but with the new changes in water quality monitoring comes a change in PAR monitoring. The new **PAR Tree** protocol only differs from PAR MAN in the depth profile and the arrangement of the sensors (Figure 6).

The new field protocol for PAR Tree is as follows:

- ☆ Three 4π sensors mounted on a measured pole will be used: (***A***) a submerged reference sensor at 0.2 m below the surface, (***B***) a second sensor at 0.5 m below the surface, and (*C*) a third sensor fixed at 0.3 m above the sediment surface and also noted as being ***X*** meters below the surface.
- ☆ Sampling should be during a 10:00 a.m. to 2:00 p.m. window.
- ☆ A minimum 30-second integration time at each depth.
- ☆ Replicating each profile a minimum three times.

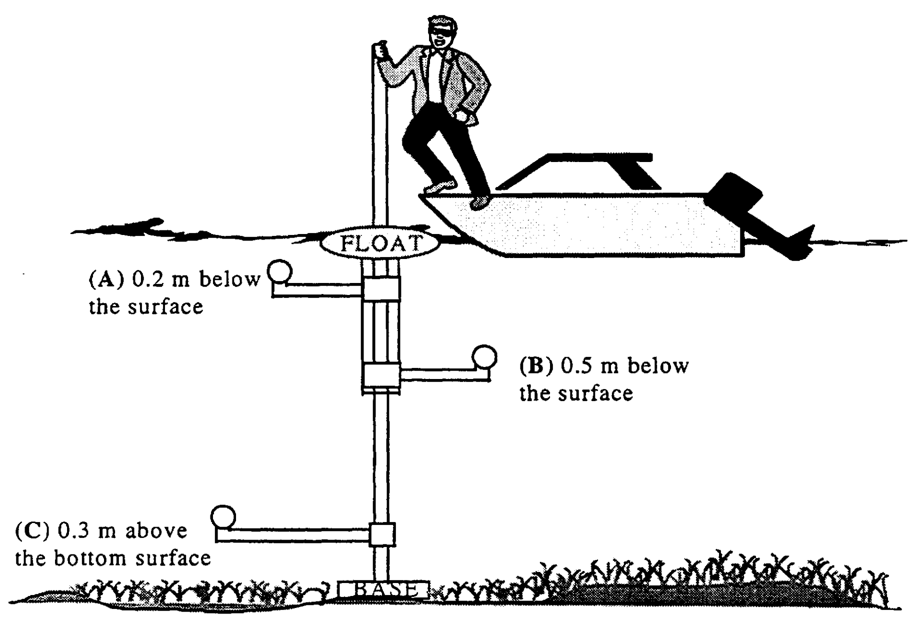


Figure 6. Schematic of PAR Tree for PAR measurements in IRL.

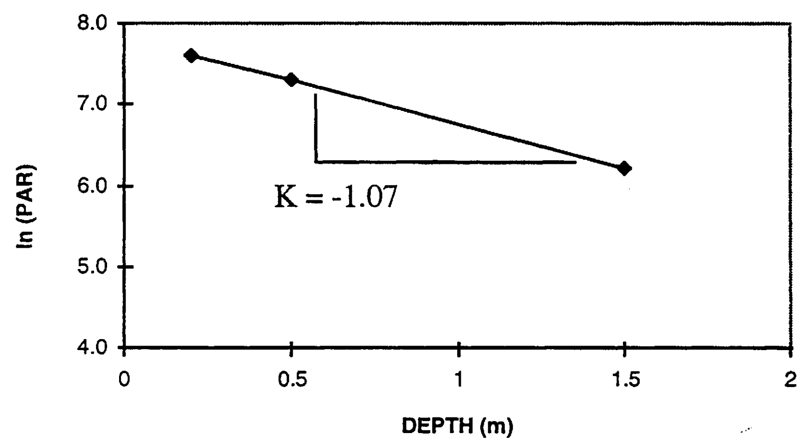
The formula for calculating the percent of incident light reaching a given depth is:

$$\mathbf{I_z = I_0 * e^{-Kz}}$$

where $\mathbf{I_0}$ is the underwater quantum irradiance from the submerged reference sensor and $\mathbf{I_z}$ is the underwater quantum irradiance measured at depth, **z**. *K* is the diffuse attenuation coefficient for PAR. The recommended way to solve for K in the equation is using a semi-log regression of the irradiance values versus the depth profile. By taking the natural log (ln) of the water column sensors (PAR) and regressing those values with the depth measurements (in meters), the slope, or *K* value, can be calculated (Table 6 and Figure 7).

Table 6. Example of *K* calculation.

SITE NAME	TIME	DEPTH	PAR	ln(PAR)	*K*
IRL25	1123	0.2	2000	7.601	-1.07
	1123	0.5	1500	7.313	
	1123	1.5	500	6.215	



$$y = m(x) + b$$

$$\ln(I_z) = K(z) + \ln(I_0)$$

Figure 7. Graphical representation of K calculation.

Near-Bottom Sampling

According to the provisions of the improved Indian River Lagoon Water Quality Monitoring Network it is necessary to collect a near-bottom sample at each station once during a tidal cycle. In order to do this, the depth of the station must be measured and the water sampler lowered to this depth minus 0.3 m. Near-bottom sampling will be accomplished using a bilge pump/hose apparatus which consists of a 12 volt DC operated bilge pump attached to a length of clear vinyl tubing that has been calibrated into 10 cm intervals. At the sample site the bilge pump is gently lowered to the bottom then raised 0.3m off the bottom and turned on. The pump should be allowed to run at least 20 seconds before the first sample is collected to ensure a clean sample. The end of the hose can be attached to a filter plate containing 0.45 micron filter paper to obtain the filtered samples.

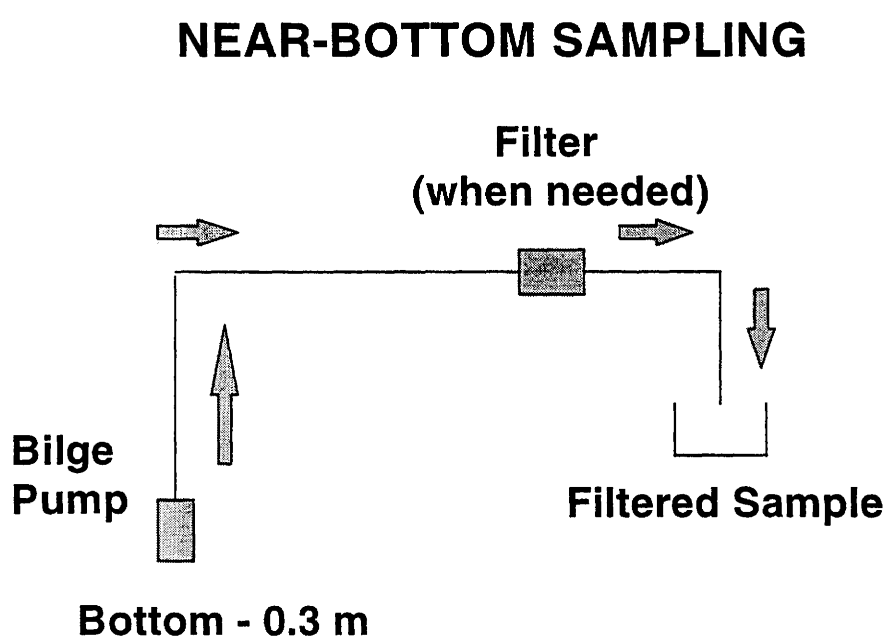


Figure 8. Schematic of near-bottom sampling using the bilge pump/hose apparatus.

V. QUALITY ASSURANCE / QUALITY CONTROL CONSIDERATIONS

Adoption of the proposed changes to the Indian River WQMN will necessitate minor revisions to the Indian River Lagoon Water Quality Monitoring Network Quality Assurance/Quality Control Manual (QA/QC) presently approved by the Department of Environmental Protection. Changes to this document will be made as follows:

1) Water samples which will be analyzed for all parameters (except light attenuation) will now be taken at the following depths: 0.5 m (near-surface) and bottom minus 0.3 m (near-bottom).

2) If the sampling is to be done using a bilge pump/hose apparatus, the details of this procedure and the equipment specifications will need to be included in the QA/QC manual.

3) The procedure for near-bottom nutrient sampling, which will take place once during a tidal cycle, will need to be included in the QA/QC manual. This parameter will be used to help calibrate the Pollution Load Reduction Model for nutrient flux between the sediment and water column.

4) Measurement of light, for calculation of light attenuation, will now be taken at just 3 depths, 0.2 m, 0.5m, and bottom minus 0.3 m.

5) Total Organic Suspended Solids and Total Inorganic Suspended Solids will be added to the list of parameters to be measured.

6) All samples will now be shipped to one central laboratory, which will necessitate inclusion of QA/QC standards of sample custody, specific to this laboratory into this QA/QC manual.

These changes to the IRL-WQMN may also necessitate the inclusion of updated versions of the comprehensive QA/QC plans which are in effect for the various cooperating agencies.

Field and Laboratory Quality Control Checks

I. Field Quality Control Checks

Field Blank - A deionized water sample which has been treated in the same manner as the samples. The data generated will be used to determine what, if any, cross contamination, field reagent contamination, or handling contamination has occurred.

Field Replicates - Field replicate samples and in-situ measurements are taken randomly at 10% of the sites during daily sample.

Split Sample - One sample is taken from which equivalent aliquots are drawn and then shipped to other laboratories for analyses of common parameters. This serves as an external check on the performance of laboratory analysis.

II. Laboratory Quality Control Checks

EPA standard solutions (**audit samples**) - Known standard solutions are analyzed to check for analytical accuracy.

Laboratory Replicates - Replicate analysis is performed on 10% of the samples.

Laboratory Blanks - A deionized water sample prepared and analyzed in the laboratory as an internal performance check for possible laboratory contamination.

Spikes - Prepared samples to which a known quantity of concentrated standard solution (spike) has been added. Samples may be spiked in the laboratory or in the field.

Data Precision, Accuracy, and Completeness

Precision is the reproducibility of a method regardless of whether or not the observed values are widely displaced from the true value as a result of systematic or constant error. Precision can be defined quantitatively as the agreement between two or more results and can be determined from the percent relative standard deviation (%RSD) of the sample set. The relative standard deviation is a function of the ***mean*** and ***standard deviation*** of a sample set, where:

$$\text{Mean } (x) = (x_1 + x_2 + x_3 + \ldots + x_i) / n \qquad \text{or} \qquad (\Sigma x_i) / n$$

$$\text{Standard Deviation } (s) = \{(\Sigma (x_i - x)^2 / n - 1\}^{1/2}$$

$$\text{Percent Relative Standard Deviation } (\%RSD) = (s / x) * 100$$

Accuracy is the agreement between the amount of a component measured by a test and the amount actually present. Accuracy for a given parameter is a measured by calculating the percent recovery of known levels of spike solutions into appropriate sample matrices. Percent recovery (***%R***) is calculated as follows:

$$\%R = ((\text{Spike Sample Concentration}) - (\text{Sample Concentration})) / (\text{Spike Concentration}) * 100$$

Completeness is determined by comparing the number of quality control results which fall within the control limits with the total number of results attempted.

$$\text{Completeness} = 100 * (\text{number of acceptable QC results} / \text{total number results attempted})$$

VI. CENTRALIZATION OF LABORATORY ANALYSES

Utilization of a single (centralized) laboratory by the WQMN agencies as proposed in the modified IRL-WQMN ensured better quality assurance and control. Analytical errors and the magnitude of discrepancies in laboratory results would be reduced and errors may be readily detected and corrected. The adoption of a centralized laboratory facility and services for the IRL-WQMN guaranteed that staff and laboratory resources will be used more effectively and could place less budgetary demand on the participating agencies. The ultimate benefit will be a monitoring network that is more cost-effective and efficient.

Sample Custody and Delivery. As a part of the negotiated contract, the laboratory shall pay all shipping costs for all samples, containers, and coolers. This shall include the cost of sample kits, coolers, and supplies from sample locations to the contractual laboratory. Shipping shall be between the contractor's laboratory and three to four central locations within Indian River, Brevard, and Volusia counties which shall be established at a later date. The contractor shall provide the IRL-WQMN agencies with a method of shipment which guarantees overnight delivery of samples from central locations within the counties to the contractor's laboratory. The contractor shall follow the Chain of Custody procedures in the contractor's Comprehensive Quality Assurance Plan (CQAP). Unless an alternate procedure has been approved in writing by the Project Managers or their designees, the contractor shall perform all services in accordance with the procedures established in the contractor's CQAP. Analyses shall be performed by one of the methods of analyses given in Table 7.

With the exception of chlorophyll, all analyses shall be performed within time frames established in Code of Federal Regulation, Title 40, Part 136, Section 3, Table II. Chlorophyll extraction shall be performed within 24 hours of sample collection and analysis of the extract shall be performed within 21 days of sample collection. The laboratory shall store samples for at least 60 days after sample receipt and shall be responsible for disposing of the samples after the 60-day holding period.

Data Reporting. Results of laboratory analyses and data (physical and chemical) reports shall be submitted to the Project Manager within 30 days or less of the receipt of samples. The flow diagram for data reporting and validation is shown in Figure 9. All data shall be reported in units specified in the bid schedule. The data reports shall contain the results of sample analyses, dates of analyses, and all associated quality assurance data. The results of the sample analyses shall also be submitted to the Project Manager or his designee in electronic media in 5 1/4" or 3 1/2" high density diskette in a format specified by the Project Manager. The contractor shall meet all data reporting and validation requirements specified in Figure 9 and Table 8. Analytes will be reported in the units of measurement specified in the contract, and will be reported in ASCII text in a tabular format as listed below (Table 8). Each sample ID code will consists of the station date and time of sampling. Replicates of samples will be coded as one minute apart to aid in QA/QC.

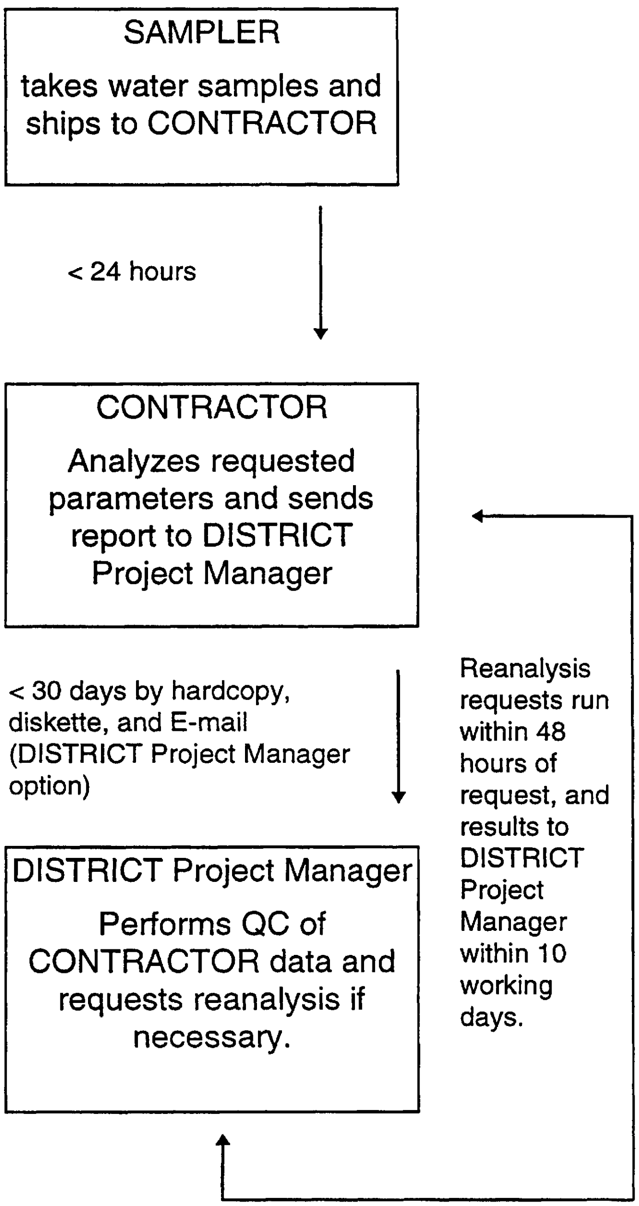
Table 7. Approved methods of analyses for water column.

Parameter	Approved EPA Methods[1]	Other Methods
Orthophosphate (PO4)	365.1; 365.2	
Total Phosphorus (TP) total, dissolved	365.1; 365.2 365.4	
Nitrate+Nitrate (NOx)	353.1; 353.2	
Total Kjeldahl Nitrogen (TKN) total, dissolved	351.2	
Color	110.2	SM204A[2]
Turbidity	180.2	
Total Suspended Solids (TSS)	160.2	
Volatile Solids	160.4	
Silica	200.7	USGS 3-2700-85[3]
Total Organic Carbon	415.1	
Chlorophyll a		SM10200H

[1] EPA - Methods for Chemical Analysis of Water and Wastes
[2] SM - Standard Methods for the Examination of Water and Wastewater
[3] USGS - Methods for Analysis of Inorganic Substances in Water and Fluvial Sediments, US,Department of Interior, USGS

DATA FLOW AND REPORTING

DATA FLOW



1. DISTRICT personnel or their designees will collect samples using pre-cleaned bottles provided by CONTRACTOR.
2. DISTRICT personnel or their designees will ship samples to CONTRACTOR from central locations at CONTRACTOR's expense.
3. CONTRACTOR will analyze all samples for the listed parameters, and perform QA/QC as provided for in the CONTRACTOR's CQAP.
4. CONTRACTOR will submit all specified QA/QC information and analysis results to the DISTRICT Project Manager within 30 days of receipt of samples. Data reports will be made by hardcopy, 3.5 inch diskette and E-Mail (if available) in the specified format.
5. DISTRICT Project Manager will review QA/QC information and request sample reruns if necessary.
6. CONTRACTOR will perform reruns within 48 hours of request, and resubmit results to DISTRICT Project Manager within 10 working days.

Figure 9. Data flow, reporting, and validation for the IRL-WQMN.

Table 8. Data reporting format for the IRL-WQMN.

ID	PO4	TP-T	TP-D	NOx	TKN-T	TKN-D	Color	Turb	TSS	VSS	Si	TOC	Chl a	Chl b	Chl c	Pheo	Chl a corr	Chl/ Pheo

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VIII. REFERENCES

1. Sigua, G.C., J.S. Steward, and W.A. Tweedale. 1996. Indian River Lagoon Water Quality Monitoring Network: Proposed Modifications. Technical Memorandum No. 12. SJRWMD, Palatka, FL. p. 70.

2. Steward, J.S. and J. Higman. 1991. Master water quality monitoring network quality assurance/quality control manual for the Indian River Lagoon surface water quality monitoring network project 1988-1990. SJRWMD, Palatka, Fl. p. 331.

3. Steward, J.S. and J.A. VanArman. 1987. Indian River Lagoon Joint Reconnaissance Report. Contract Report Nos. (CM-137 and CM-1380). Florida Office of Coastal Management, Dept. of Environmental Regulation. p. 367.