PART VII - MONITORING AND TRACKING TECHNIQUES

Section 6217(g) of the Coastal Zone Act Reauthorization Amendments (CZARA) requires a description of any necessary monitoring techniques to accompany the management measures to assess over time the success of the measures in reducing pollution loads and improving water quality. EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* provides:

(1) Guidance for measuring changes in pollution loads and in water quality that may result from the implementation of management measures; and
(2) Guidance for ensuring that management measures are implemented, inspected, and properly maintained.

Each of the above stated guidance will be discussed further in separate chapters within this Part. Included in each of those chapters will be a description of a plan to fulfill these guidance goals.

By tracking management measures and water quality simultaneously, Hawaii will be in a position to evaluate the performance of those management measures implemented under the coastal nonpoint pollution control program. Management measure tracking will provide the necessary information to determine whether pollution controls have been implemented, operated, and maintained adequately. This is needed so that the State can determine whether these management measures are effective and whether additional ones are needed in specific waterbodies to improve water quality.

Water quality monitoring is the most direct and defensible tool available to evaluate water quality and its response to management and other factors (Coffey and Smolen 1990). The Department of Health (DOH) is the lead agency for water quality monitoring and enforcement of State water quality standards. Hawaii is in the process of revising its water quality monitoring plan so that it can be used in planning and support of water quality management programs, compliance reporting, status and trend assessment, and other purposes. The overall objective of the monitoring design is to integrate a combination of data and information to serve both regional and site specific information needs, specifically for target waterbodies on the Section 303(d), Clean Water Act (CWA), list; Section 319, CWA, Nonpoint Source Assessment; and Section 304(I), CWA, Toxic Substance List. Currently, DOH is revising its inland water quality standards and monitoring protocols, its section 303(d) list of impaired waterbodies, and its ambient water quality monitoring strategy. Current monitoring strategy, methodology and monitoring stations may be revised pending finalization.

As mentioned in the above paragraph, DOH is in the process of revising its inland water quality standards and various monitoring components. Despite the fact that these monitoring items are in the process of being revised, these items are included in this coastal nonpoint pollution control program management plan.

This is so that all components of the plan can be assessed together, even if some components are still in draft form. Sections 1, 2 and 3 of this Part are from DOH's draft "Hawaii Ambient Water Quality Monitoring Strategy." This Part will be revised pending EPA's recommended revisions to that monitoring strategy.

Environmental Indicator

The monitoring program will be guided by environmental indicator goals that identify environmental and ecosystem quality, in addition to providing evidence of progress. The monitoring program will focus on three broad areas: nonpoint source pollution, public health, and ambient water quality. A combination of environmental and water specific indicators (*e.g.*, phytoplankton, turbidity, suspended solids, sediment toxicity, fish tissue contaminant, stream alteration, flow diversion, and physical habitat modification) will be considered in quantifying and addressing pollution effects.

Data and Information Sharing

DOH will continue to use the Environmental Protection Agency's (EPA's) STORET and Waterbody System as the primary database and information system. In addition to the ambient water quality data collected, selected monitoring data resulting from the Section 401, CWA, National Pollutant Discharge Elimination System (NPDES) and Zone of Mixing permits will be entered into STORET. A database will be established for environmental indicators meeting quality assurance and quality control (QA/QC) and data quality requirements.

Other government agencies also produce water quality information. These sources include the U.S. Army Corps of Engineers (USACOE), U.S. Geological Survey (USGS), U.S. Fish and Wildlife Service (USFWS), City and County of Honolulu, and private consultants. Coordination with other monitoring programs will be a program goal. Sharing and verifying data from other water quality monitoring programs will assist in achieving a more comprehensive water quality data information base both for water quality parameters and geographical scope. For instance, volunteer water quality monitoring programs have been or will be instituted in the Kailua-Waimanalo and Ala Wai watersheds. In addition, universities and community colleges conduct monitoring as a component of specific studies or classroom curriculum.

Water body assessments will use the most current data and information from the STORET system. The end users of the STORET data system are government agencies, consultants, students, and the general public.

1. Monitoring Plan

The management of polluted runoff is often complicated by the difficult and costly task of defining the specific sources and pollutants causing an adverse impact on receiving waters. To detect and verify statistically a particular agent as the cause of a nonpoint pollution problem requires the isolation of the most probable source and the application of a monitoring program designed to link the source to the impact. This procedure is highly resource-intensive and costly to institute

(Reinelt *et. al.* 1988). The monitoring plan for Hawaii's coastal nonpoint pollution control program needs to coincide with existing State resources.

As mentioned at the beginning of this Part, the National Oceanic and Atmospheric Administration (NOAA) and EPA gave general guidance on monitoring and tracking techniques to accompany management measures. The first monitoring goal identified in the guidance is to measure changes in pollution loads and in water quality that may result from the implementation of management measures. This goal can be achieved through the implementation of the draft revised monitoring plan proposed by the DOH's Clean Water Branch (DOH-CWB). The draft monitoring plan will incorporate four water quality monitoring categories: core network, recreational bathing waters, watershed protection, and toxic contaminant screening. The scope and indicators of these four monitoring categories meet the first objective of NOAA and EPA's monitoring guidance. Therefore, it is recommended that information related to changes and trends in water quality be provided from the existing monitoring activities conducted by DOH-CWB.

A. DOH Water Quality Monitoring Framework

DOH-CWB is currently revising the existing water quality monitoring network to include watershed protection, in addition to public health protection of recreational waters and ambient water quality monitoring activities. As part of the revision, existing ambient monitoring stations will be relocated or eliminated in order to utilize limited resources more efficiently and re-focus waterbody-specific needs consistent with the water quality management goals. These areas will include waterbodies where Total Maximum Daily Load calculations (TMDLs) are lacking. Areas that need greater protection of beneficial uses are also targeted, particularly in watersheds where pollution control strategies for nonpoint sources are badly needed. Other sites include areas where violations in water quality standards occur, but meaningful data for water quality decisions are lacking. The overall goal is to focus available resources to the most critical needs, avoiding duplication of monitoring sites and undefined target populations.

The revised water quality monitoring plan will consist of four main categories, as shown in Table VII-1. The scope or coverage, indicators, and regulatory basis are identified.

Section 305(b), CWA, requires each state to submit a biennial (5-year cycle beginning 1996) report to EPA describing the quality of its navigable waters. The report includes an analysis of the physical, chemical, and biological integrity of the State's waters and the extent to which it supports the protected uses, among other information on water quality. Section 303(d)(3), CWA, requires each State to identify all waters where violations of water quality standards occur, and more data must be collected or a pollution control strategy developed.

B. Developing Criteria for Prioritizing Waterbodies

The next critical step in the strategy is to select the criteria for prioritizing waterbodies and establishing TMDLs for these areas. This step is necessary to

determine water quality priorities based on existing water quality needs. The priority listing will be part of the State's review and selection process established for listing of water quality limited segments (WQLSs) in accordance with Section 303(d), CWA. The selection criteria will focus on critical problems and needs determined by the DOH water quality management program. Water quality problems will be identified in totality of valued resources. The critical factors will be based on citizen concerns and regulatory issues involving public health, public recreation, groundwater protection, wastewater management, nonpoint source pollution, and aquatic/marine life protection.

TABLE VII-1. WATER QUALITY MONITORING CATEGORY

Type	Scope	Indicator	Regulatory Requirements
Core Network	Regional	Ambient; Long Term Trend; Baseline Data	CWA 305(b) Report; Annual State Report
Recreational Bathing Waters	Site-Specific; Shoreline; and Nearshore	Compliance; Cause & Effects; Sewage Spills	CWA 305(b) Report; Annual State Report; Chapter 11-54
Watershed Protection	Watersheds and Receiving Waters	Complex Trends or Patterns; Cause & Effects; Compliance; TMDLs; Multi-Media and Parameter Relationships; Impacts on Biological & Physical Habitat	CWA 305(b) Report; CWA 303(d)(3)
Toxic Contaminants Screening	Site Specific	Health Risk; Sediment Toxicity; Bioaccumulation	CWA 305(b) Report

The existing WQLSs will be reviewed and revisions made as deemed appropriate. The final approval of the listed segments will be determined by a State-Regional process for identifying the State's priority waterbodies. By September 1996, the State will revise this list, pending assessments of waterbodies according to the Section 303(d) criteria.

C. Developing Workplans

Workplan development is the most important step in the monitoring strategy. The workplan consists of monitoring activities that are covered in the following chapter for each monitoring category shown in Table VII-1 (Core Network, Recreational Bathing Waters, Watershed Projects, and Toxic Contaminants Screening).

The monitoring activities under Watershed Assessment are a new addition to the

DOH-CWB monitoring program. The monitoring activities will be part of DOH's watershed protection program. The role of DOH-CWB is to provide monitoring support and available resources as part of the watershed team.

The remaining monitoring programs are on-going. These monitoring activities are also discussed in more detail in Section 2. Although annual workplans for each are subject to change with priorities, the workplans for watershed projects will be most subject to change. The watershed projects are selected through a State-Regional grant process and will be the main thrust of the State's monitoring program. Selected watershed projects may last from 1 to 3 years, depending on critical problem needs and available resources. The workplans will be part of the DOH water quality management effort in the overall planning process. The monitoring workplan will be jointly determined and approved through the annual State-Regional agreement.

The workplans for watershed monitoring activities will, therefore, play a key role in the DOH-CWB monitoring activities. For the purposes of this document, the details of the current watershed project are highlighted in this strategy. The monitoring plan will describe the water monitoring workplans of the listed monitoring categories shown in Table VII-1.

Depending on the nature and scope of the monitoring project, the workplan elements will:

1. Identify and describe the project goal or goals.
2. Define data quality objectives for each goal.
3. Identify and describe the geographic boundaries.
4. Identify and describe monitoring parameters, markers or environmental indicators, etc.
5. Establish reference or baseline conditions.
6. Determine the relative contributions of various sources (point/nonpoint) of pollutants and compliance with water quality standards.
7. Report status and trends.

It is widely recognized that nonpoint sources are the major contributors to Hawaii's water pollution problems. Therefore, workplans developed for the monitoring plan will emphasize water quality activities that are consistent with management goals and objectives to minimize nonpoint source pollution. The design and approach of workplans will stress data and information that are useful in making decisions and answering resource management questions.

This element of the monitoring strategy will serve as a working tool for the monitoring program. Monitoring workplans will be designed and integrated with various watershed activities developed for the targeted waterbodies. The Ala Wai Canal, for example, is designated as a priority waterbody (WQLS), with the Ala Wai Canal Watershed Project currently initiated to address watershed issues. A monitoring program will address the issues related to the watershed problems. As a priority waterbody, the Ala Wai Canal Watershed Project is the current focal point of the monitoring workplan.

D. Implementation of Workplan

Following approval of watershed projects through the State-Regional process for designating priority waterbodies, workplans will be implemented as part of the water monitoring program and overall strategy. DOH-CWB will implement the annual workplan as designed and approved. The findings and data will be reported in the annual State Water Quality Report, as well as in the State's Section 305(b), CWA, Reports.

2. Overview of Water Quality Monitoring Workplan

This section provides a framework for the monitoring program, and can be used as the basis for developing monitoring workplans. This phase of the monitoring strategy briefly describes the annual monitoring activities and the monitoring goals for each of the four monitoring categories identified in Table VII-1.

The specific draft workplans that outline the water quality monitoring activities of DOH's Core Network, Recreational Bathing Waters, and Toxic Contaminants Screening Program follow. The proposed monitoring plan designed for a watershed (The Ala Wai Canal Watershed Workplan) emphasizes polluted runoff control.

A. Core Network

(1) Description: The Core Network consists of permanent stations located in open coastal and oceanic waters that are designed to collect long-term monitoring data to determine status and trends in water quality. Water column samples taken from offshore waters are located in selected waterbodies on Kauai, Oahu, Maui, and Hawaii. They provide benchmark data reflecting normal or seasonal variations, as well as trends over a period of time. Water chemistry parameters are measured for nutrients and physical-chemical properties such as total phosphorus, total nitrogen, nitrate-nitrite nitrogen, temperature, pH, salinity, dissolved oxygen, etc. Sampling frequencies vary from once per month on Oahu to once per quarter on the neighbor islands.

DOH Core Network Station locations on each island are as follows:

Kauai	Oahu	Maui	Hawaii
1. Hanapepe Bay	1. Pokai Bay	1. Kahului Bay	1. Hilo Bay
2. Nawiliwili Bay	2. Mamala Bay		2. Keahole Point
	3. Hanauma Bay		3. Kealakekua Bay
	4. Maunalua Bay		
	5. Kaneohe Bay		

In addition, the Core Network utilizes selected water quality data that are reported under the NPDES and Zone of Mixing discharge permits. The permit programs that require water quality monitoring also serve as a valuable source of data and information for use in the State Annual Report and the Section 305(b), CWA, reports. Since the permittees are required to routinely measure ambient water quality throughout the permit's 5-year life span, long term water quality impacts can be evaluated. The NPDES reports are submitted to the DOH-CWB

either monthly, quarterly or annually, depending on the permit requirements.

Most of the major discharge permits are for domestic sewage that is discharged from deep ocean outfalls. The various types of discharge and general locations where monitoring activities are conducted are as follows:

Domestic Sewage:
1. Kauai: Wailua Wastewater Treatment Plant, Wailua
2. Oahu: Honouliuli Wastewater Treatment Plant, Barbers Point
3. Oahu: Sand Island Wastewater Treatment Plant, Honolulu
4. Oahu: East Honolulu Comm. Svc. Wastewater Treatment Plant, Hawaii Kai
5. Oahu: Kailua Wastewater Treatment Plant, Mokapu
6. Oahu: Fort Kamehameha Wastewater Treatment Plant, Pearl Harbor
7. Oahu: Waianae Wastewater Treatment Plant, Waianae
8. Hawaii: Hilo Wastewater Treatment Plant, Hilo

Oil Refinery:
1. Oahu: Chevron U.S.A., Barbers Point

Thermal Cooling Water:
1. Kauai: Citizen Electric, Port Allen
2. Oahu: Hawaiian Electric Industries, Kahe
3. Oahu: Hawaiian Electric Industries, Waiau
4. Oahu: Hawaiian Electric Industries, Honolulu
5. Maui: Maui Electric, Kahului
6. Hawaii: Hawaii Electric Company, Hilo

(2) Purpose: The Core Network provides long-term data on ambient water quality of regional scope. The primary purpose is to assess status and trends in water quality. The data serve as an indicator of environmental impacts attributed to both point and nonpoint sources. Since monitoring data are collected from water quality segments that receive point source discharge, the Core Network monitoring serves as a means to determine the relative compliance with ambient water quality standards. In addition, the monitoring program provides quantifiable data as a basis for making monitoring program changes and decisions to address resource management issues.

All water quality data collected by DOH-CWB, including selected Zone of Mixing and NPDES monitoring data, are maintained in the EPA STORET system. Water quality data are shared with the general public, private consultants, government agencies, the academic community, public interest groups, and volunteer monitoring organizations. The uses of data are for a wide variety purposes among which include: environmental assessments, government statistical reports, student papers, environmental impact statements, enforcement actions, water quality standards revisions, problem assessments, and program evaluation. DOH-CWB uses the data primarily for its water quality reports, such as the State Annual Water Quality Report and the Section 305(b), CWA, Report.

(3) Data Quality Objectives: The Core Network monitoring provides answers to

questions about ambient water quality on a larger regional scale. Water column measurements of open ocean waters are made that ensure collection of representative background data for making such determinations. It determines if water quality is changing over time and explains the existing conditions. Where major point source discharges occur, the Core Network data also serve to identify waterbodies impacted by point sources. The results of monitoring data provide the basis for decisions on enforcement actions, permit revisions, mixing zone reviews, and for any permit-related action as determined appropriate and necessary.

The Core Network monitoring also provides decision-makers with benchmark data that form the basis for setting program priorities. The data will be used to answer questions on whether nonpoint source impacts occur in a given area, where they occur, and at what level they occur. Determinations are made on whether they occur on a regional or site-specific scale, and whether impairments are limited to water quality column or the biological communities and beyond (*e.g.*, sediment toxicity, bioaccumulation, etc.). Water monitoring program directions and priorities will be established from these findings. In addition, the Core Network database is used in program planning and resource management, such as allocating limited resources where it is most needed.

Field sampling for each test is performed nearly identically for each site, such as location siting (visual triangulation method or GPS) and water column depth (HydroLab DataSonde). The DataSonde is a multiparameter instrument used for *in situ* measurements on pH, salinity, dissolved oxygen, and temperature at each 10 meters. Water column samples are collected with a Van Dorn water sampler lowered at three depths: surface, middle and bottom. Specific depths for each location vary depending on the bottom depth. Data are recorded and stored automatically into the system and down -loaded to a personal computer in the office.

To protect sample integrity, all samples are kept chilled with "blue ice" in ice chests during handling and transport to the laboratory. The holding time, container and preservation requirements are carried out for each test. Calibration, operation and maintenance inspection of the instrument are made one day prior to sampling. Factory servicing is made yearly, as needed.

B. Recreational Bathing Waters

(1) Description: Marine recreational waters are extensively monitored for the safety and protection of public health against risks associated with sewage discharge. Enterococci and *Clostridium perfringens* are used as the indicator organisms to measure water quality. Research studies in Hawaii have shown that enterococci are prevalent in Hawaiian soils, and that *Clostridium perfringens* is a preferred indicator of human sewage.

Water sampling is performed at fixed stations located in shoreline waters of popular bathing beaches throughout the State. There are a total of 161 monitoring stations routinely monitored on six of the eight major islands in Hawaii. The total numbers on each island vary as follows: Kauai 28, Oahu 43, Maui 48, Molokai 2,

Lanai 2, and Hawaii 38. The sampling frequencies vary depending on sampling logistics and available resources on each island. Oahu, with the largest population among the islands, also has the most heavily-used beaches.

With the largest land area of the islands serviced by municipal sewer systems, surface waters on Oahu also have the highest potential for raw sewage contamination. Sewage spills that enter storm drains and streams could reach recreational beaches, thereby resulting in temporary closures. There are no combined storm sewer systems in the State; therefore, storm drains under normal conditions do not discharge human sewage. Municipal raw sewage is treated and the effluent from most wastewater treatment plants is discharged from deep ocean outfalls. The threat of sewage from deep ocean outfalls is not so critical due to their treatment, outfall efficiency, and distance away from recreational areas.

(2) Purpose: The purpose of this monitoring is to quantify levels of bacteria and to assess the health risk of swimmers exposed to bacteria levels exceeding State standards.

(3) Data Quality Objectives: The concern over public health safety is an intense issue whenever raw sewage spills contaminate marine recreational waters. Of nearly equal importance to the concerned public is swimming in waters with high bacteria levels, caused not by sewage spills but from nonpoint sources. The issue is raised where surface runoff and runoff into storm drains cause indicator bacteria levels to exceed State standards, invariably during wet weather periods. Marine recreational waters that are seasonally impaired by high bacterial counts include highly popular areas such as Hanauma Beach, Kuhio Beach in Waikiki, and Kailua Beach (Kaelepulu Stream).[1] The data quality objective is to ensure that the monitoring data are adequate in making informed decisions on the potential health risk associated with point and nonpoint source contaminants.

In addition to the use of enterococci data, *C. perfringens* provides information for making assessments and decisions on when to clear beaches that are closed for swimming after sewage spill events. The use of two indicators reduces the risk of making incorrect decisions, in view of the inherent weakness of enterococci as a reliable indicator. Further, background data from fixed stations are compared before and after spills for added assurance in making correct decisions. Upon returning to normal background levels, decision can be made to remove warning signs. Beaches are not closed due to elevated bacteria levels caused by nonpoint sources; however, waters that exhibit chronic violations will have warning signs posted. Existing signs, notifying the public of such chronic conditions, are posted at the Ala Wai Canal and Kaelepulu Stream at Kailua Beach Park. DOH is working with the County of Hawaii to consider posting warning signs at Honolii Cove, a popular surfing area near Hilo.

As with all field sampling activity, QA/QC measures are thoroughly observed. The samples are collected at the same place and in the same manner on a regular

[1] In addition, water quality standards have been frequently exceeded in this areas for nutrients and turbidity, attributed to nonpoint sources.

schedule. Samples are properly documented, recorded for sample custody, stored in ice chests, and transported to the laboratory within six hours of collection.

C. Watershed Protection

(1) Description: Workplans for Watershed Protection projects consist of planned activities for watersheds that are selected as part of the annual State-Regional federal grant agreement.

The Ala Wai Canal, a WQLS, is an example where DOH-CWB will address water quality monitoring needs for controlling polluted runoff (*e.g.,* the Ala Wai Canal Watershed Project). The Ala Wai Canal's water quality has been impaired by high nutrients and enterococci level recorded since the start of the monitoring program in 1971. More recently, elevated levels of synthetic organic compounds and trace metals were found in biota sampled in 1992. Bottom sediments have not been sampled in recent years, but a 1971 survey showed elevated levels of toxic metals and chlorinated hydrocarbons.

One of the most persistent component that contributes to the aesthetic quality of the Ala Wai Canal is the heavy phytoplankton population that adversely reduces water clarity. A suggested solution for improving water clarity is to increase the rate of flushing of the canal so that it exceeds the rate of phytoplankton growth. However, the sources contributing to their growth would remain uncontrolled by this approach alone, regardless of light or other limiting nutrients.

(2) Purpose: For the purpose of reducing or controlling phytoplankton blooms and ultimately improving water clarity, the sources contributing nutrients that can stimulate phytoplankton growth also must be identified, if regulatory action is necessary or water quality management programs are to remain cost-effective in providing the long-term benefits. Therefore, the purpose of the proposed monitoring workplan is to carry out the following tasks:

a. Locate land areas and identify the sources (point and nonpoint) that contributes to nutrient loadings.
b. Quantify levels of nutrients by each stream segment and tributary that contributes to the total nutrient load in Ala Wai Canal.
c. Identify management options that may provide for effective controls in reducing the amount of nutrients in receiving waters.
d. Establish benchmarks and provide a long term basis for comparing water quality improvements in the Ala Wai Canal. This will also serve as a basis for measuring the effectiveness of management controls.

(3) Data Quality Objectives: The details of data quality objectives for Watershed Protection projects cannot be described for all projects since the appropriate objectives vary with each survey. In this example of the Ala Wai Canal Watershed Project, the scope of work is specified and therefore the level of data quality necessary for making informed decisions can be determined.

The sampling will be designed to determine the amounts of nutrients in the natural environment. The data are necessary to identify benchmark levels that

determine whether or not it would be difficult to control. Sampling data will further quantify watersheds segments and their in-stream contribution of nutrients. The sampling will be designed to yield data to identify locations and sources contributing significant levels of nutrients. (The data will not quantify the relationship between nutrients and phytoplankton growth in the Ala Wai Canal, which is beyond the scope of this project.)

The Ala Wai Canal is identified as a WQLS as defined by the CWA. To date, no final TMDL has been adopted for the Ala Wai Canal. New monitoring data for the Ala Wai Canal may be useful in calculating TMDLs.

D. Toxic Contaminants Screening

This section is included as part of the monitoring strategy as an option that will be implemented as funding becomes available. DOH-CWB has conducted a screening program over the years; however, due to budget constraints and the high cost of the screening program, CWB is forced to restrict this activity, including many on-going programs.

(1) Description: The main objective of toxic contaminants screening is to identify waterbodies in the State where levels of chemical contaminants in biota indicate the potential for significant health risk to consumers. The primary target animals will be those that are commonly consumed locally.

The sampling strategy is a two-tiered screening process, similar to the screening programs performed in the past:

a. Conduct statewide surveys on selected chemical contaminants found in fish and shellfish that are consumed by the local population.
b. Conduct site-specific surveys of either known existing problems or potentially significant contamination.

(2) Purpose: The main objective of the screening program is to identify locations of toxic contamination and determine levels of contaminants that are harmful to consumers of fish and shellfish.

(3) Data Quality Objectives: With either approach selected for screening toxic contaminants, the data quality objectives will ensure management needs as follows:

a. The results are useful in making fish consumption advisories based on health risk assessments.
b. The sampling data are adequate to describe specific contaminant levels found on the basis of critical biological and environmental factors.
c. The design of the sampling program provides for acceptable hypothesis testing based on appropriate statistical analysis.
d. The outcome of the survey meets public health objectives in the most cost-effective manner.

3. Specific Workplans for Water Quality Monitoring Activities

Over the past two years, the State's Water Quality Monitoring Program has undergone major changes resulting from severe budget restrictions and monitoring staff reductions. Monitoring activities were scaled down and/or eliminated completely. Combined with other spending restrictions and reductions in federal funding, the monitoring program has been required to make major shifts in program priorities.

The following Sections A-D specify the draft workplans for the water quality monitoring activities of the Core Network, Recreational Bathing Waters, and Toxic Contaminants Screening Program. Despite the many changes taking place in the monitoring program, the major emphasis will be on specific issues that address both human health and environmental concerns.

A. Core Network Monitoring Program

The Core Network monitoring is currently an on-going program. The ambient water quality database for the Core Network will be expanded to include more data from sources outside DOH. Most of these data will come from the NPDES permit program. Although some data from this source are currently being utilized, additional new data are available to fill data gaps in the existing monitoring program.

With the expanded database, the Core Network monitoring program will serve three main purposes. First, it will provide data and information on ambient water quality characteristics to determine compliance with the State's water quality standards (Table VII-2). Secondly, the additional monitoring stations will serve as benchmarks for ambient water quality on a regional scale to give a historic perspective on the long-term effects on water quality. Also, as a cost-saving measure and benefit to the program, the Core Network is designed to assess additional State waters that are monitored by other sources. Thirdly, as benchmark stations, they will provide comprehensive information about the natural range in variability of waterbodies that is expected to occur over the wet and dry seasons. The data will be essential in dealing with water quality issues and in describing the sources that may cause water quality to exceed State standards.

The sampling objective of the monitoring workplan is to collect long-term ambient data at representative locations throughout the State. The components of water quality will be characterized for three different types of waterbodies: embayment, open coastal and oceanic waters, for which applicable standards are adopted. The bottom depths at these sites range from 30 to greater than 60 meters. Water quality will be sampled at three depths (surface, middle, bottom) at a frequency of either monthly or quarterly for all parameters identified in the State Water Quality Standards. The neighbor island samples will be collected quarterly.

TABLE VII-2
MONITORING PARAMETERS AND WATER QUALITY STANDARDS

Water Quality Parameters	Embayment		Open Coastal		Oceanic
	Wet	Dry	Wet	Dry	
Column Depth[1](m)	n/a	n/a	n/a	n/a	n/a
Temperature[2] (C)					
pH[3] (S.D.)					
Conductivity[1]					
Salinity[4] (PPT)					
Dissolved O2[5] (ppm)					
Turbidity (NTU)	1.5[7]	0.4	0.5	0.2	3.0
	3.0	1.0	1.25	0.5	0.1
	5.0	1.5	2.0	1.0	0.2
Total N (ug/L)	200	150	150	110	50
	350	250	350	180	80
	500	350	250	250	100
NH4 (ug/L)	6.0	3.5	3.5	2.0	
	13.0	8.5	8.5	5.0	
	20.0	15.0	15.0	9.0	
NO3+NO2 (ug/L)	8.0	5.0	5.0	3.5	
	20.0	14.0	14.0	10.0	
	35.0	25.0	25.0	20.0	
Total P (ug/L)	25.0	20.0	20.0	16.0	
	50.0	40.0	40.0	30.0	
	75.0	60.0	60.0	45.0	
Light Extinction[6]	n/a	na/	0.2	0.1	n/a
(K units)	0.5	0.3			
	0.85	0.55			
Chlorophyll-a (ug/L)	1.0	0.5	0.3	0.15	
	4.5	1.5	0.9	0.5	
	8.5	3.0	1.75	1.0	

[1]Standards not applicable (n/a).
[2]Shall not vary more than one degree Celsius from ambient conditions.
[3]Shall not deviate more than 0.5 units from a value of 8.1.
[4]Shall not vary more than 10 percent from natural or seasonal changes.
[5]Not less than seventy-five percent saturation.
[6]Required for discharges with Section 301(h) waivers.
[7]Values are Geometric Mean; Not to Exceed 10% and 2% of the time, respectively.

Discharge monitoring data generated by the NPDES and Zone of Mixing requirements provide both site-specific (outfall areas) and regional water quality characteristics. Monitoring reports submitted by dischargers will be used in making the annual assessment of State waters. Datasets that represent the two areas will be evaluated for water quality standards compliance and long-term trend analysis. The main source of data for the Core Network comes from the City and County of Honolulu. Other sources are from various counties, including private and government facilities.

B. Recreational Bathing Waters Monitoring Program

The bacteria monitoring program focuses on water quality monitoring for the purpose of assuring recreational safety of swimmers at popular bathing beaches throughout the State. It is an on-going program with an established database that covers over 20 years of monitoring. Bacteriological assays have been conducted at nearly 95% of the total number of sampling sites established throughout the State. (Of these sites, nearly 37% were also concurrently analyzed for water chemistry.) Sampling frequencies for recreational waters vary between weekly, bi-weekly, and monthly intervals.

Enterococci and *Clostridium perfringens* are used as indicator organisms which estimate the health risk associated with swimming in marine waters. Although it is not included in the State's water quality standards, *C. perfringens* is used as a choice indicator for several reasons. Studies in Hawaii have shown that enterococci occur naturally in Hawaiian soils and most outdoor environments, making it a less reliable indicator of water pollution. In contrast, *C. perfringens* is more closely associated with sewage contamination. *C. perfringens* is also known to have a longer environmental survival time in seawater, and their presence, therefore, resembles many of the pathogens that they index.

(1) Sampling Objective and Data Quality: The purpose of sampling is to quantify levels of bacteria to determine the potential human health risks associated with swimming in recreational waters. The regulatory objective is to identify water quality violations. Since nonpoint sources are primarily responsible for water quality impairment in recreational waters, the relationship between rainfall events and water quality impacts can be identified. The long-term objective is to detect trends in bacteria levels. Samples are drawn uniformly at the shoreline in a manner that keeps sampling error to a minimum by adhering to quality assurance protocols. As part of the QA/QC Plan, the sampling protocols are described in the field manual issued to the monitoring staff. The sampling protocols require that the specified sampling method be implemented at the highest level of effectiveness.

The data quality objective is to ensure that the monitoring data are adequate and reliable in making informed decisions on the potential health risk associated with point and nonpoint source contaminants. Routine data checks are required as part of the data screening and validation process. In addition, periodic checks are performed by visual examination and plotting techniques (use of statistical software) for data consistency. Data are compared with historical records for a given location. Spot checks and comparison of data sets provide for identification

of individual values that fall outside the normal range. Historical consistency can be maintained by this process.

The use of multiple indicators facilitates making assessments and decisions on when to clear beaches that are closed for swimming after sewage spill events. Water samples tested for *C. perfringens* reduce the risk of making incorrect decisions, due to the inherent weakness of enterococci as an indicator for sewage contamination. Background data from fixed stations are compared before and after spills for added assurance in making informed decisions. Once background levels are reliably attained, an "all-clear" notification is then declared.

(2) Network Design Criteria: The sampling design is based on a space-time framework, with water samples taken at pre-defined locations (fixed-stations). The locations are considered representative of the target population, although some compromise is necessary with regard to sampling time due to sampling logistics (*i.e.*, cost effectiveness, imposed conditions on sample holding time, site accessibility, and resource constraints). In addition, the design considerations include sources and patterns of contamination (*e.g.*, storm drains, fresh water streams, circulation and current patterns).

As a result of the latest DOH-CWB cut-backs, the monitoring program has revised the monitoring design to reflect existing resources and monitoring priorities. As part of the monitoring strategy, a set of criteria will be used to further modify the sampling network if further cuts are required. Although a few fixed-stations will be archived in the event of further cutbacks, in most cases sampling frequencies will be reduced, using the criteria as follows:

- Chronic Violations: sampling sites with high visibility and historically-elevated bacteria levels will be retained while others will be temporarily de-activated or sampling frequencies reduced;
- Popular Bathing Beaches: sampling sites at areas with high recreational use among both local and visitors will be retained;
- Nonpoint Source Pollution: sampling sites in recreational waters that are heavily impacted by nonpoint sources will be kept;
- Benchmarks: only certain established benchmark stations that reflect long-term status and trend will remain active; and
- Logistical Consideration: the site selection and/or sampling frequency will be evaluated and travel and time factors that significantly reduce monitoring cost will be taken into consideration.

(3) Maps of Sampling Stations: The locations of sampling stations will be shown on attached maps of each island and identified to their general locations. The STORET data system has been updated to identify each station by its latitude and longitude grid coordinates. This information can be down-loaded at any time. Sampling site survey and documentation (hard copy file) with photographs is now 85% completed for the State. This file contains information unique to the sampling site or land characteristics that may influence sampled data or reflect a particular water quality condition. As with all STORET data and any water quality information, this file is available for inspection by the general public.

C. Toxic Contaminants Screening Monitoring Program

Toxic contaminants screening is included in the monitoring strategy to identify site-specific areas in the State where concentrations of chemical contaminants in fish and shellfish may be potentially harmful to human consumers. Screening surveys have been done in the past to identify those sites where specific chemicals have been found in bottom sediments and fish tissues.

The toxic contaminants screening program is currently in abeyance due to the budget cuts. However, this component of the monitoring program is considered an important activity in future plans involving public health protection. The general approach has been described earlier as a two-tiered strategy. The first level is to conduct another statewide survey paralleling the work done in 1971. The second and less costly approach is to conduct site-specific studies, for example, as part of the Ala Wai Canal Watershed Project. Although a fish consumption advisory for the Ala Wai Canal was issued four years ago, the present levels of toxic contaminants are unknown. Not only will the current data ensure that the general public is adequately warned, but a determination can be made on whether a toxic management strategy can be an appropriate element of this watershed project.

In addition, this and other parts of the workplan will serve as a guidance document for use by the laboratory in their program management and support functions. Laboratory needs can be adequately met if such a plan is documented in advance for future budget and planning purposes. It is recognized that the Toxic Contaminant Screening Program will require special commitment of resources. Therefore, it is the overall goal of this document to enable the laboratory and other related programs to reasonably allocate and effectively use limited resources.

(1) Data Quality Objectives: Among some of the data quality objectives for toxic contaminants screening are to: (1) quantify levels of target analytes in fish and shellfish; (2) define survey boundaries for an area of concern or determine the target population of the study area; (3) ensure that the sampling design is adequately structured to test statistical hypotheses; (4) collect data that are reliable in making risk-based consumption advisories; and (5) develop sampling designs that are cost-effective without compromising data quality.

The primary aim is to identify significant sources of contaminants and to link the sources with the potential to contaminate target species. The following steps are simplified for this discussion only. A more detailed description will be presented for selected annual workplans. In general, the initial approach will be to test water samples to determine if the target pollutant exceeds the water quality standards. The next target medium of concern will include bottom sediments that may be the actual source or may act as sinks for pollutants. The extent (bioavailability potential) to which the contaminants are associated with sediments (interstitial layer) will be assessed. Generally, the bond between the water layer in contact with the bottom sediment will ultimately lead to biological exposure. The project boundary will be determined by the extent of contamination or distribution of target pollutants. Following this step, actual pollutant

concentrations in target species will be identified. *(It should be noted here that the scope of a sediment contaminant protocol may vary if the project falls under CERCLA or RCRA regulations.)*

(2) Target Species: Some of the target species that will be considered for this screening program are commonly found in the State. These include mullet *(Mugil cephalus)*, aholehole *(Kuhlia sandvicensis),* tilapia *(Tilapia spp.)*, Hawaiian crab *(Podophthalmus vigil*), blue claw crab *(Thalamita crenata)*, and white crab *(Portunus sanguinolentus*). Table VII-3 shows a list of some of the toxic screening undertaken in the past.

The selection of target species is primarily based on the ethnic and cultural preferences of local consumers with respect to fish and shellfish. The listed target species in Table VII-3 are unique to the State, although they may not represent a complete selection of both bottom and predator species that should be among the desired test animals for the screening program. Predator fish species that are not listed include ulua or jack *(Carangiodes sp. and Caranx spp.)*, kaku *(Sphyraena barracuda)* and popular game fishes such as the Pacific blue marlin (Au). For bottom feeders, the screening program may select weke or goatfish species such as weke pueo *(Upeneus arge*), weke ‘ulua *(Mulloidichthys auriflamma)*, moano *(Parupeneus multifasciatus)* or kumu *(Parupeneus porphyreus).*

TABLE VII-3
DOH TOXIC CONTAMINANTS SCREENING for 1991

Sampling Site	Target Species	Target Analyte[1]
Ala Wai Canal #1	*Thalamita creanata*	Metals and Syn. Org.
Ala Wai Canal #2	*Thalamita creanata*	Metals and Syn. Org.
Ala Wai Canal #3	*Thalamita creanata*	Metals and Syn. Org.
Ala Wai Canal #4	*Thalamita creanata*	Metals and Syn. Org.
Manoa Stream, Oahu	*Tilapia mosambique*	Metals and Syn. Org.
Kaneohe Bay, Oahu	*Elops hawaiiensis*	Metals and Syn. Org.
Kalihi Stream, Oahu	*Tilapia sp.*	Metals and Syn. Org.
Kaelepulu Stream, Oahu	*Albula sp.*	Metals and Syn. Org.
Waikele Stream, Oahu	*Tilapia sp.*	Metals and Syn. Org.
Waikoloa Pond, Kona	*Halocardina rubra*	Metals and Syn. Org.
Kukio Pond, Kona	*Halocardina rubra*	Metals and Syn. Org.
Maunalani Pond, Kona	*Halocardina rubra*	Metals and Syn. Org.
Waiakea Pond, Hilo	*Mugil cephalus*	Metals and Syn. Org.
Hilo Bay	*Portunus sanguinolentus*	Metals and Syn. Org.

[1] Metals include Ag, As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn.
Synthetic organic compounds include chlordane isomers, chloropyrifos, dieldrin, DDT isomers, heptachlor, PCBs.

DOH fish tissue analyses have been performed in the past by the California Department of Fish and Game Laboratory. DOH anticipates that all future analyses for the Toxic Screening Program will be conducted at the new laboratory facility on Oahu, pending sufficient funding and resources.

D. Ala Wai Canal Watershed Monitoring Program

The following is a proposed monitoring plan that is meant to augment activities related to the Ala Wai Canal Watershed Plan. This monitoring workplan for the Ala Wai Canal Watershed is meant to serve as a model for the details required for watershed monitoring within the State.

(1) Background: The Ala Wai Canal watershed covers the Makiki-Manoa and Palolo drainage areas of approximately 4,300 hectares (10,060 acres). The various land uses in the drainage area include: conservation, forest and residential lands in Manoa and Palolo Valleys; various multi-residential and business districts in Makiki, Kaimuki, McCully; and the resort district of Waikiki. Surface runoff from these areas has a major influence on the water quality of the Ala Wai Canal. DOH monitoring of the canal since 1971 has shown high levels of bacteria, nutrients, and turbidity, including chlorophyll a, that exceed State Water Quality Standards. DOH also found elevated levels of metals and synthetic organic compounds in bottom sediments and biota tissues. The major cause of pollution in the Ala Wai Canal is polluted runoff.

The Ala Wai Canal is used primarily for non-contact water recreation such as canoe paddling and kayaking, although at times recreational fishing and crabbing occurs. DOH has issued pollution warnings, with signs posted on land where canoes and kayaks are launched.

(2) Purpose and Goal: The existing ambient water quality monitoring program has recorded water quality data for the Ala Wai Canal since 1971. The primary goal of this program is to report the status and trends in water quality. As part of the monitoring workplan for the Ala Wai Canal watershed project, the data will serve as a benchmark from which to identify measurable changes in water quality and assess the relative effectiveness of land management and pollution control practices.

The short-term goal of the workplan is to quantify in-stream components of water quality and identify reaches of streams that contribute the most pollutants. Each reach of stream may be grouped by size (*e.g.*, percent of total area) in each hydrologic sub-unit (3 to 4). This approach may be used as the basis for determining where effective land-based management policies or pollution control measures are most desirable. Another method of defining boundaries would be to group areas by the total linear miles of storm drains within hydrographic sub-units. This process will also allow polluted runoff control programs to select and evaluate solutions that are most appropriate and practical for the targeted area.

(3) Hypotheses: The in-stream monitoring data from each reach will be assessed to determine if there is a significant relationship between water quality and the

hydrologic pathways of pollutants. It is reasonable to assume that the more conduits (drainage systems) in any part of the stream, the greater the impact of in-stream pollutants on water quality.

Hypothesis A: A test hypothesis, for example, is that in-stream waters in the watershed where natural (permeable) hydrologic pathways occur are less contaminated than in areas with manmade conduits. The key parameters of interest are turbidity, total suspended solids, total nitrogen and bacteria (enterococcus and *Clostridium perfringens*).

Also, the assumption is that the benchmark ambient sampling statistics are acceptable population parameter estimates. The implications are that future water quality will be improved as a result of efforts to mitigate water pollution by whatever means selected. A past study performed for the State on the Ala Wai Canal has proposed flushing the canal as one of the remedial options to reduce excessive phytoplankton growth. A way to determine whether the long-term goal for the Ala Wai Canal has been met is to implement water quality monitoring specifically for this purpose.

Hypothesis B: A hypothesis to be tested will be that the ambient phytoplankton population in the Ala Wai Canal is significantly lower after management practices have been implemented. DOH-CWB will continue monitoring the canal to provide long-term monitoring data for this purpose. The results, of course, will not be available until several years later.

In addition to its current sampling sites, three benchmark sites in the Ala Wai Canal will be selected to monitor specifically for water clarity. The parameters that will be measured are chlorophyll-a, light extinction, turbidity and suspended solids. Secchi disk readings will also be made. Limited resources are a major constraint in carrying out some of these and other laboratory analyses. Since the laboratory is already performing at a maximum workload, some tradeoff will be necessary. This tradeoff will mean that certain fixed sampling stations (Core Network) will be dropped and/or sampling frequencies adjusted.

(4) Data Quality Objectives: In order to assess the inherent variability of in-stream parameters, certain critical factors will be considered in the sampling design. The workplan will take into account the dynamic variables and factors that influence data quality. It is therefore imperative that samples at each station are collected under uniform wet/dry conditions, with particular attention to the following:

- Antecedent dry days prior to sampling.
- Precipitation (duration and intensity).
- Stream flow (total volume of runoff).
- Frequency and time of sampling.
- Location and number of sampling points.

Due to the randomness of storm events, the data quality goal is to achieve maximum uniformity of precision. Sampling stations with high variation will

have low precision in contrast with stations with low variation. Hence, sampling frequencies will be increased in cases with high variation in order to obtain uniform precision. The decisions to be made, therefore, will be to select between proportional sampling frequencies (*i.e.*, to obtain uniform levels of information) and equal or constant sampling frequencies that are more practical in regulatory monitoring (*i.e.*, to determine violation in water quality standards). A third option is a statistical compromise between the previous two options. The data quality objective is to obtain the most statistically-sound information as possible. Improper sampling design and analysis will invalidate sampling results that are critical in making valid conclusions.

(5) Methods: Water samples will be tested for various water quality parameters that are found in the State Water Quality Standards, as well as other useful markers. The monitoring parameters are: temperature, salinity, pH, dissolved oxygen, turbidity, total suspended solids, chlorophyll a, and dissolved nutrients (silicate, phosphate, ammonia, nitrate-nitrite nitrogen). Both dissolved and particulate phosphates will be tested to determine how much of the phosphate is unavailable. No attempt will be made to quantify the relationship between phosphorus and phytoplankton growth due to the many possible variables of the canal environment.

Sampling frequencies will vary with the monitoring option selection and subject to change according with the variability of individual samples as discussed earlier. Since the watershed sampling work of the monitoring plan requires a substantial commitment of laboratory resources, the laboratory's final approval will be needed.

(6) Monitoring Sites: The following locations in the watershed are identified as possible monitoring sites where samples will be collected. Each selected site will be described in more detail in the final report. Thirty sampling stations are identified for various streams and tributaries within the watershed. Numbers in parenthesis indicate the number of stations at each site.

Palolo Stream - *Kaoli Road, St. Louis Drive, Palolo Ave., Kalua Rd., Kiwila St.(5)*
Tributaries:
Pukele Stream - *10th Ave. , End of Ipule Place*. (2)
Waiamao Stream - *10th Ave. Place. (1)*

Manoa Stream - *Pinao St., Kahaloa Dr., Lowrey Ave., Woodlawn Ave., Dole St., King St., Date St. (7)*
Tributaries:
Waihi Stream - *Waaloa Pl. (1)*
Aihualama Stream - *Manoa Falls Trail, Lower Waakaua (2)*
Waiakeakua Stream - *Middle Waakaua (1)*
Waalua Stream - *Upper Waakaua (1)*
Naniuapo Stream (0)

Makiki Stream - *Fern St., King St., Wilder Ave. (near Foodland) (3)*
Isenberg/Hausten St. Drainage Canal - *Kapiolani Blvd., Lime St., Date St. (3)*
Ala Wai Canal - *Library end, Golf Driving Range, McCully St., Ala Moana St. (4)*

(7) Quality Assurance: The sampler will implement the methods and procedures described in the field protocol, Water Quality Monitoring Program Basic Water Chemistry, Sampler's Manual, prepared by DOH. (Laboratory QA/QC procedures will not be described in the workplan. Specific methods and procedures for laboratory analyses are detailed in DOH's QA/QC Manual.)

(8) Monitoring Plan Options: A major constraint in the Monitoring Plan is the additional workload for the chemistry laboratory. A concession will be made by dropping some of the existing Core Network stations to make up for the additional sampling and analyses. However, the monitoring tradeoff by itself is not sufficient without additional laboratory support to implement one of the four monitoring options that are being proposed. The final acceptance and approval will be made between the DOH Clean Water Branch and Laboratories Division.

Option 1: This option will include a sampling program for all the tributaries of Manoa and Palolo Streams, including Makiki Stream, Apukehau Stream and the Ala Wai Canal. Both in-stream chemical and physical-chemical properties will be tested. The frequency of tests will vary between weekly physical-chemical measurements for all stream segments and the Ala Wai Canal. Samples for water chemistry will be collected monthly at all stream stations and twice per month at the Ala Wai Canal.

Option 2: Rather than taking samples at all in-stream stations, Option 2 will include only water chemistry measurements at all stations identified in Option 1. No physical-chemical properties are included. Sampling frequencies remain the same as in Option 1.

Option 3: The third option includes monitoring of the Ala Wai Canal only. Both water chemistry and physical-chemical properties are included; sampling frequencies are the same as in the other options. This is the recommended option, if the workload is acceptable to the laboratory. A modified version of Option 3 would reduce the sampling frequency to monthly.

Option 4: The last option may include only physical-chemical measurements in the Ala Wai Canal. Only laboratory analyses for total suspended solids (TSS) and chlorophyll-a would be required. This option may be modified by changing sampling frequency from weekly/bi-weekly to bi-weekly/monthly field and laboratory analyses, respectively.

(9) Field Sampling: Hydrographic boundaries and stream segments will be identified on maps that specify stream sampling locations. Water samples will be collected and tested at fixed stations using identical methods and procedures. Field instruments will be calibrated each sampling day to ensure accuracy of measurements. Grab samples for tests required in the laboratory will be collected, stored in ice chests, kept cold with blue ice, and transported as soon as possible to prevent degradation. If required, composite samples will be taken at time intervals with automatic samplers that are calibrated on flow rated basis.

(10) Chain of Custody: The official record of sample custody will be processed for

each sample collection. The record will indicate the project ID., sampler ID. (with signature), station location, date, collection time, type of sample, container, and the required analyses. When samples are transferred to the next custodian, two signatures (deliverer/receiver) will be necessary for the record, including the date and time of transfer. Appropriate copies will be kept on file.

4. Tracking Management Measure Implementation

The tracking of management measure implementation is the second goal of the coastal nonpoint pollution control program monitoring component. EPA and NOAA have provided guidance to ensure that management measures are implemented, inspected, and maintained properly. Under their coastal nonpoint pollution control programs, states will apply management measures to a wide range of sources including agriculture, forestry, urban activities, marinas and recreational boating, and hydromodification. Water quality monitoring will look at long-term trends to see if management measure implementation has had a positive effect on water quality. States must also track the implementation of management measures.

For the planned control of polluted runoff to be successful, a mechanism needs to be developed to ensure land users are properly implementing BMPs that address the applicable management measures in the Hawaii coastal nonpoint pollution control program management plan. By tracking management measure implementation and water quality simultaneously, Hawaii will be in a position to evaluate the performance of management measures implemented under its program.

One method for ensuring implementation of management measures is the use of "site inspectors" or "extension agents." The site inspector's duties may include making random site visits to a particular land use area to identify implementation of appropriate best management practices consistent with the type of land use activity. These "inspectors" would work as extension agents and try to cooperatively work with the land user to properly install and maintain particular BMPs. This "inspector" would be part of the agency that has oversight or enforcement authority over a particular management measure. Such personnel would be costly, but may provide better compliance and assist land users in meeting water quality goals. Given restricted State and county budgets it seems this approach may not be possible at this time. Rather, the alternative, initially, may be to inspect initially only where persistent water quality violations are occurring.