SECTOR C

MODULE NO. 3: AMBIENT WATER QUALITY MONITORING

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1.1 River Water Quality

(1) Overview

Rivers in the Project Area may be largely divided into regional rivers flowing through local areas in the Municipalities of Canelones, Lavalleja, Florida and San José and urban rivers through large urban areas located in the Municipality of Montevideo. The former are represented by the Santa Lucía River and its tributaries in the Santa River Basin and rivers belong to the La Plata Basin, and the latter are the Pantanoso, Miguelete, Carrasco, Pando Rivers, etc.

(2) Regional Rivers

General Organic Pollution

Precise assessment of current water qualities of each regional river is difficult, since periodical and systematic ambient water quality monitoring by DINAMA has been suspended recently. Based on the water quality data measured by OSE in 1999, it is assessed that main courses of the Santa Lucía River and its tributaries are largely maintained to be less than BOD_5 5 mg/l, as shown in **Figure 1.1.1**. These water qualities are almost correspondent to the value of the Class 1 specified in the environmental standard of water quality in Uruguay, which is applicable for the raw water of potable water. Therefore, the water of regional rivers in the Santa Lucía basin is not affected significantly in terms of general organic pollutants.

In the La Plata Basin, however, most rivers appear significantly to be influenced by the artificial activities like wastewater discharged from industries, urban areas and agricultural lands. The Pando and Sauce rivers, for example show the BOD value beyond the one specified in the Class 1 of the environmental standard.

Apart from main courses of regional rivers, sections of rivers passing through local urban centers, like the capital centers of the Municipalities, show the tendency of water pollution. Such pollution is caused by wastewater generated in urban and industrial activities, though the degree of pollution varies depending on the locations.

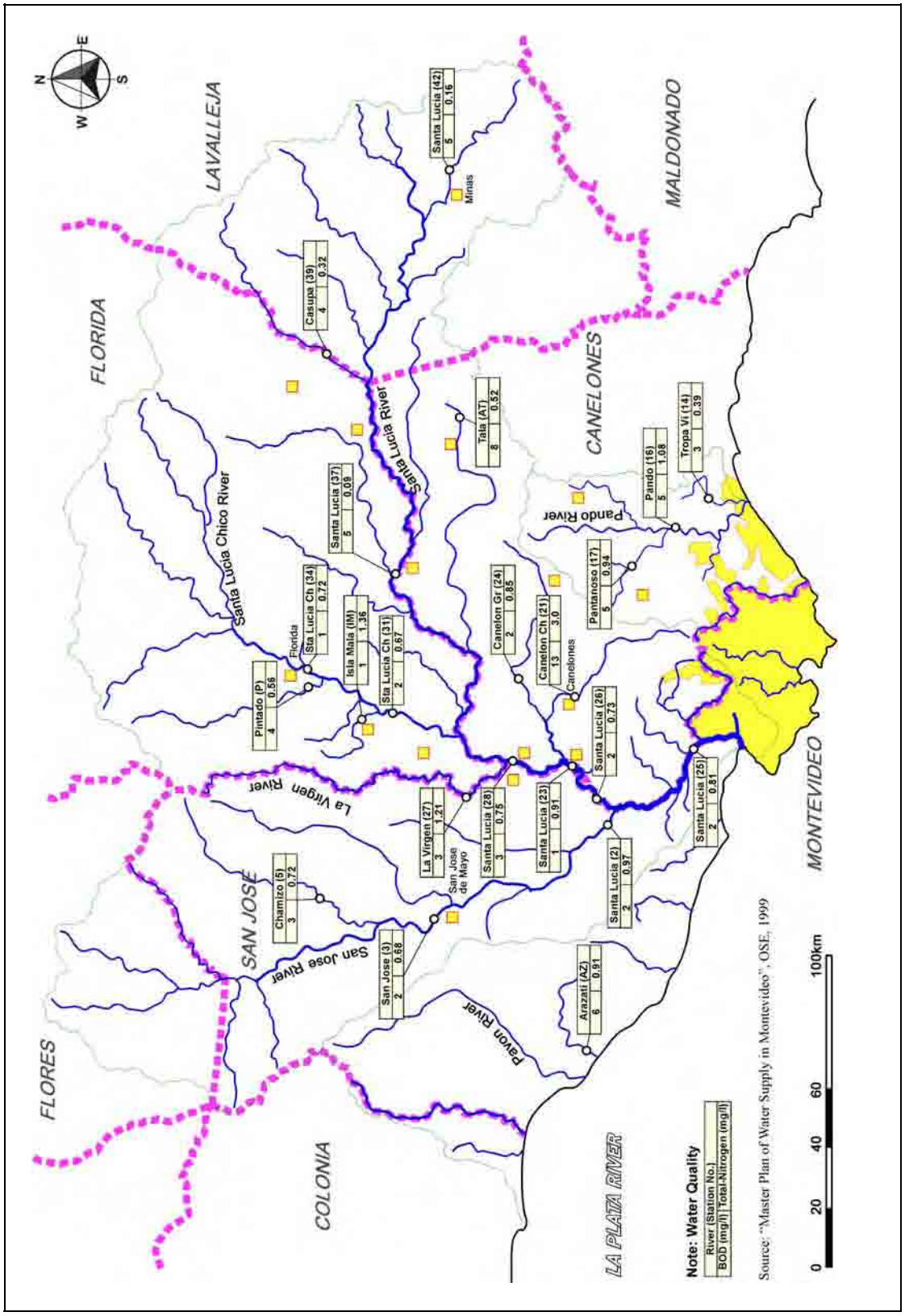

Figure 1.1.1 Water Quality of Regional Rivers

Eutrophication

The environmental standard of water quality in the Decree 253/79 prescribes that the nitrate expressed as nitrogen and phosphorus concentration should be kept under less than 10 and 0.025 mg/l, respectively. Although these limitations for nutrient constituents are applied for rivers, they are giving lax values, if river water is stored in various reservoirs for drinking water intake.

As seen from **Figure 1.1.1**, the upstream of the Santa Lucía River in Minas and Chamizo is still maintained to be lower nitrogen. After the middle stream, however, the nitrogen concentration is increased in places. This is mainly because tributaries such as the Santa Lucía Chico, La Virgen, Canelon Grande and Canelon Chico are polluted by high-level nitrogen. The above-mentioned status of nitrogen indicates that the middle stream of the Santa Lucía River indicates the possibility that might cause the eutrophication phenomena in reservoirs installed in streams.

The Decree 253 does not set the water quality standard for reservoirs and lakes. Just for reference, **Table 1.1.1** compares them with the environmental standard of Japan for lakes.

Table 1.1.1 Comparison of Nutrient Concentration in Environmental Standards

Parameters	Decree 253	For lakes in Japan
Nitrate (mg/l as N)	Less than 10	Less than 0.1 to 1.0[1)] (TN as mg/l of N)
Phosphorus (mg/l as P)	Less than 0.025	Less than 0.01 to 0.1[1)]

Note: 1) The standard values of Japan for lakes are depending on the Classes set for water utilization.

Although the causes for this have not been verified yet, it is almost certain that major sources of nitrogen are wastewater discharged from urban area, industrial activities and agricultural lands. Fortunately, though remarkable eutrophication phenomena have not been reported as of today, it is a possible threat for raw water sources which are predominantly used for the potable water of the metropolitan area.

OSE measured precisely the nitrogen concentrations of the Santa Lucía Chico, at the downstream of Florida City. The measurement results over the time as seen in **Table 1.1.2** show that the increase in nitrogen concentration had been caused for the past ten years, currently exceeding by far the values set in the environmental standard of Japan in both nitrogen and phosphorus.

Table 1.1.2 Nutrient Concentration in Paso Severino Reservoir

Locations / Nutrients	Inlet of Reservoir		Inside of Reservoir		Outlet of Reservoir		Environmental Standard of Japan for lakes
	1989	1997	1989	1997	1988	1996	
Total Nitrogen (mg/l)	0.85	5.49	1.44	2.14	1.27	1.90	0.1 to 1.0
Total Phosphorus (mg/l)	0.17	0.38	0.13	0.31	0.13	0.21	0.01 to 0.1

Source: "Master Plan of Water Supply in Montevideo", OSE, 1999.

(3) Urban Rivers

Surface Water Quality

The Pantanoso, Miguelete and Carrasco rivers are typical urban rivers, flowing the center area of Montevideo and pouring into the Montevideo Bay and the La Plata River. All urban rivers flowing in the Municipality of Montevideo are heavily influenced by domestic wastewater, industrial wastewater and other pollution sources. This is due to heavily concentrated population and industrial activities, and insufficient mitigation against pollution effluent.

As shown in **Figure 1.1.2**, these rivers are suffering from serious pollution. The BOD exceeds by far the allowable standard 15 mg/l for the Class 4 in almost all sections, deteriorating the urban amenity in the capital city in Uruguay. According to the investigation made by the Municipal Government of Montevideo, untreated domestic wastewater, industrial wastewater and illegal dumping of solid waste into rivers from informal solid waste separation are mainly responsible for general organic pollution. Nevertheless, the "Environmental Report" issued by the Municipal Government states that current situation is the indication of being improved year by year as the result of recent interventions.

On the other hand, incompletely treated wastewater discharged from tanneries has been identified as the cause of heavy metal (mainly chromium) pollution. The water quality survey conducted by the Municipal Government of Montevideo indicates the fact that the total chromium concentration is beyond the standard (0.05 mg/l) at nearly half of monitoring stations. Likewise, lead concentration exceeds the standard (0.03 mg/l) at many measurement points, too.

Sediment Quality

The sediment quality measured by the Municipal Government of Montevideo is shown in **Table 1.1.3**. Although particular quality standards for evaluating sediment quality are not available in Uruguay or other countries, these results are expediently compared with the standard of Japan applied for soil pollution. According to this, the level of accumulated lead appears rather high. There is no explanation besides the industrial discharge containing heavy metals over a long period.

Table 1.1.3 Sediment Quality in Montevideo Bay

Parameters	Sampling Points				Standard of Japan[1)]
	B1	B2	B3	B4	
Chromium (mg/kg-Dry)	110	110	-	35	250[2)]
Lead (mg/kg-Dry)	180	196	145	35	150

Source: Water Basin Monitoring Program/Final Report 2002, The Government of Montevideo, 2003

Note: 1) The standard is applied to the soil pollution.
2) The value is applied to not total chromium but hexavalent chromium.

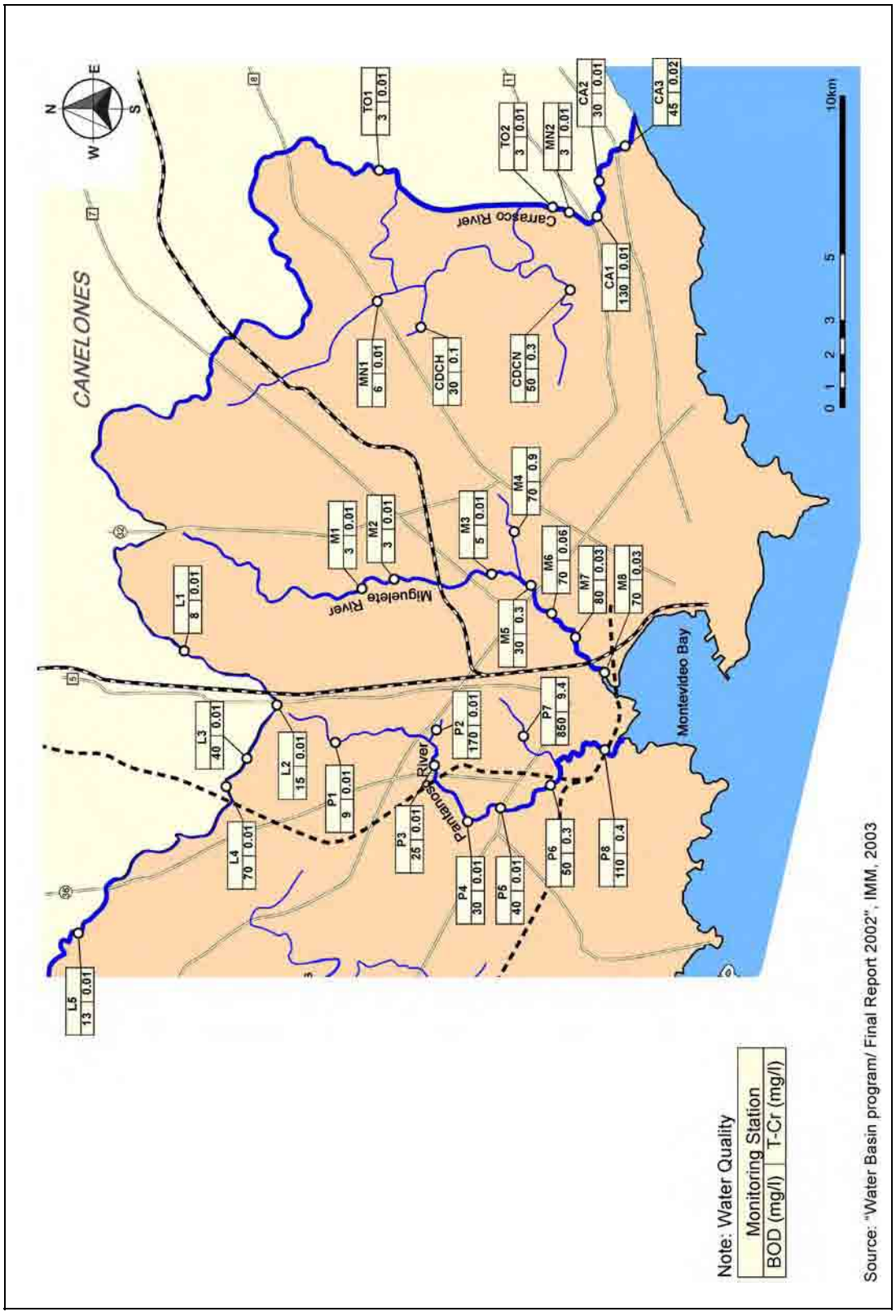

Figure 1.1.2 Water Quality of Urban Rivers

1.2 Coastal Water Quality

(1) Tendency of Coastal Water Quality

Beaches along the coast of the La Plata River are very popular with citizens and tourists for recreation and tourism, especially in the summer season. These beaches become improper conditions with the increase of fecal coliform caused by sewage discharge from Montevideo, depending on various conditions.

Coastal water is kept suitable conditions for bathing at the beaches located away from the center zone of Montevideo. However, coastal water shows the sign of pollution in the zones that are located in the estuaries of the Pantanoso, Miguelete and Carrasco rivers, indicating that total coliform is sometimes near to the environmental water quality standard, as shown in **Figure 1.2.1**.

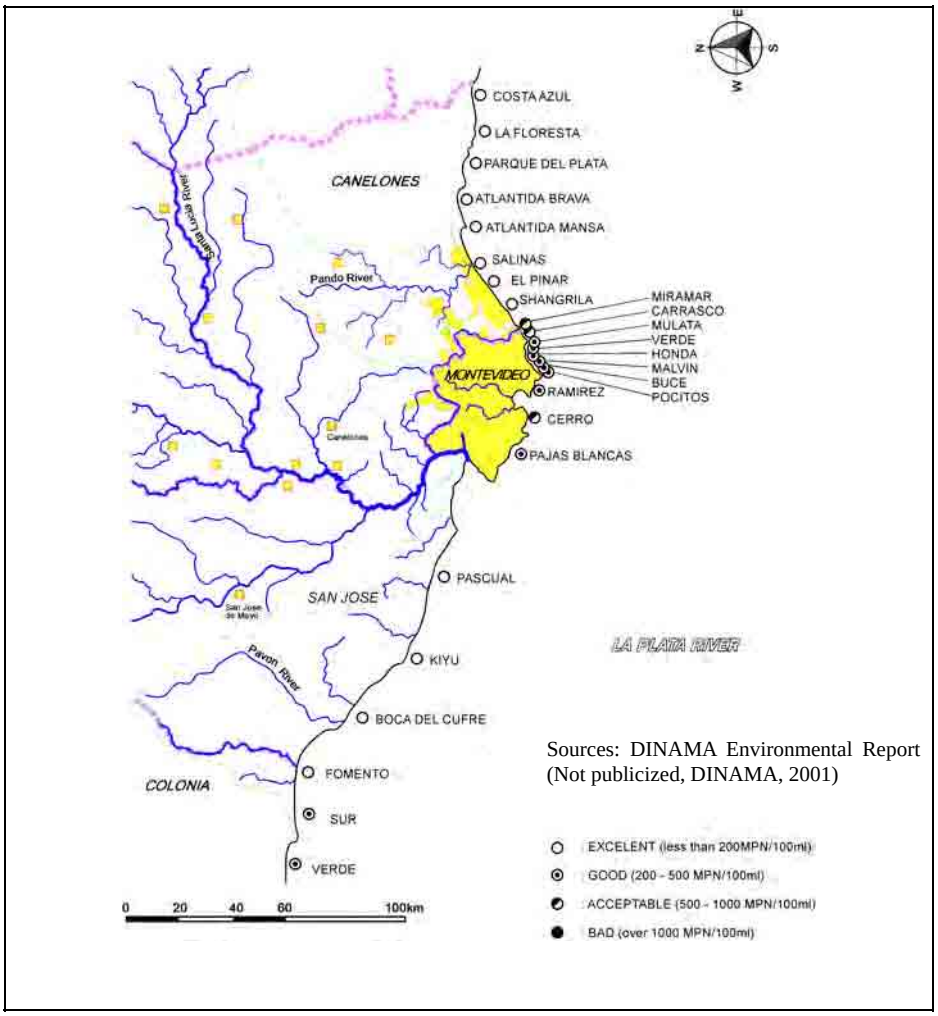

Figure 1.2.1 Coastal Water Quality

Meanwhile, it is known that the total coliform of coastal water becomes extremely high, after raining. This is partly because sewerage system applied in the center area of Montevideo is largely of the "combined type" which collects domestic wastewater and rainwater together with same pipes and, therefore, domestic wastewater may reach the watercourses due to the overflows of the pipelines

especially in the event of heavy precipitation. Uncollected domestic wastewater directly flowing into rivers is also another reason for this pollution.

(2) Possible Influence of Direct Sewage Discharge

Most of sewage generated in the center of Montevideo is discharged into the bottom of the La Plata River through the discharge pipe with 2.2 km long. Applied treatment before the discharge is only the removal of coarse substances and greases. According to the survey of the Municipal Government of Montevideo, there is no possibility that discharged sewage returns and pollutes beaches. Considering the additional installation plan of sewage discharge pipes in the future, the Government is now conducting the computer model simulation on the water quality of the La Plata River.

The La Plata River where a mixing with fresh and seawater is formulated has received the occurrence of "green tide" and "red tide" recently, causing a hindrance to bathing several times a year. Though the pollution discharge form many areas in other countries as well as Montevideo might be responsible for, this phenomena is calling for a scientific research cooperated over the regions and countries benefited from the La Plata River.

1.3 Pesticide Pollution

The contamination of pesticides in the water environment has been little surveyed and clarified up to now. The survey result on the La Plata River[1], which is only available information now, indicates that the amounts of pesticides such as aldrin, dieldrin and DDT exceed established limit to aquatic life but all the values are lower for human health criterion.

Despite the production, import and usage of chlorate insecticides except dodecachlor and endosulfan were prohibited by Ministry Resolution in 1997, concerns about the pesticides pollution of water resources are voiced in Uruguay. Because the measurement and analysis require sophisticated equipment and technology, only LATU and a few other institutions are capable of this task at present. Given that the environmental standard of water quality in Uruguay lists numbers of pesticides, necessary monitoring becomes the issue from now on.

1.4 Groundwater Pollution

The Raigon aquifer is the most extensive and promising groundwater source in Uruguay, stretching the southern zone of the country. While the possibility of saline intrusion in a certain degree is in existence, this aquifer is used widely for irrigation water, industrial water and, also, potable water in the areas where the OSE's piped water service is not reached in the municipal area of San José. A main concern about groundwater is the possibility of pollution to be caused by the intrusion of wastewater discharged from industries and solid waste dumping but little information is available on this matter.

[1] : "Presence of organochlorates pesticides in exterior Rio de La Plata", Maritime Front, 11, 1987.

In other areas of the Project Area, groundwater is often used for various purposes. There are many cases that low-income people living in the periphery of urban centers tend to take living water from shallow wells. While groundwater contaminations caused by leachate from solid waste dumping site and by the intentional infiltration as industrial wastewater treatment are concerned, the water quality observation in this regard has little been in place, yet.

2. CURRENT ACTIVITIES FOR AMBIENT WATER QUALITY MONITORING

2.1 Monitoring by DINAMA

(1) Overview

Generally, the wording of "water quality monitoring" is used for a serial activity consisting of: monitoring networks design, data generation (water sampling and transportation, measurement and analysis in laboratory, data processing) and information generation including the interpretation. The final output of ambient water quality monitoring is to generate information containing the interpretation for the updated status of the water environment. This is essential for the decision/policy-making in the establishment of policies and strategies.

DINAMA had implemented ambient water quality monitoring under various projects or programs since its creation in 1990, but its activities have been very constrained in recent mainly for the financial reason of DINAMA. Ambient water quality monitoring is originally to be conducted continuously at certain frequencies and at specified points of watercourses. In DINAMA, however, water sampling and quality analysis had been carried out in specific period, so-called campaign, but not periodically. According to the definition of water quality monitoring, most of activities undertaken by DINAMA are of the character different from original water quality monitoring.

Apart from the above-mentioned, weekly-based monitoring of coastal water quality is undertaken by DINAMA, only in summer season, in order to provide holidaymakers with information on suitability for bathing as a result of bacteriological analysis.

(2) Water Quality Goal Project 2000

Monitoring in the "Water Quality Goal Project 2000" had been implemented by DINAMA for the period between 1990 and 2001, and a total of 76 locations (34 in the Santa Lucía Basin and 42 in the La Plata Basin) had been selected in the Project Area in representative rivers and creeks. Numbers of measured samples over 12 years were 297 in total (190 in the Santa Lucía Basin and 107 in the La Plata Basin).

Parameters measured in this Project were 43 in total, as detailed below. Data obtained from the measurement are stored in the form of spreadsheet, almost without being interpreted and used. A part of obtained data was used in the "DINAMA Environmental Report 2001" that was suspended and not completed. The locations of monitoring station are shown in **Figure 2.1.1** and **Figure 2.1.2**.

- Physical: Temperature, Transparency, Color, Turbidity, Total solid, Volatile solid, Total suspended solid, Soluble suspended solid
- Physico-Chemical: Conductivity, Salinity, TDS, Dissolved oxygen, pH, Oxidation, Reduction Potential, Alkalinity, Calcium, Ortho phosphorus, Nitrite nitrogen, Nitrate nitrogen, Ammonia nitrogen, Total phosphorus, Silicon, Sulfur, Chloride, Manganese, Magnesium, Sodium, Potassium, BOD, COD, Oil and grease, Chlorophyll
- Heavy Metals: Iron, Lead, Nickel, Cupper, Chromium, Cadmium, Mercury, Arsenic
- Bacteriological: Total coliform, Fecal coliform

(3) Other Monitoring Programs

Water quality programs partly involving DINAMA are described below and their profiles are summarized in **Table 2.1.1**.

Table 2.1.1 Monitoring Stations in Programs Involving DINAMA

Project	River/Creek Basin	Number of Stations	Sampling Date
ECOPLATA	Santa Lucía	13	Nov. 2 and 23, 2000
	Carrasco	9	Mar. 3 and 7, 2000
	Pando	8	Dec. 2 and 6, 2000
FREPLATA	Cufré	2	Aug. 22, 2003
	Mauricio	1	Aug. 22, 2003
	Carrasco	2	Sep. 1, 2003
	Pando	2	Sep. 2, 2003
	Solis Chicos	4	Sep. 4, 2003
	Solis Grande	2	Aug. 3, 2003
	Santa Lucía	3	Sep. 10, 2003
	Miguelete	1	Sep. 15, 2003
	Pantanoso	1	Sep. 15, 2003

APRAC (Recovery Association of Carrasco River)

APRAC is a non-governmental organization established in April 1988 to protect natural environment in the Carrasco River Basin, with carrying out water quality monitoring. It consists of 35 members including a number of commissions of local communities, schools, sport clubs, hotel associations, etc. DINAMA was once a member of the association but left a few years ago.

ECOPLATA

An Agreement was concluded on November 17, 1997 between DINAMA and other relevant organizations such as MGAP, SOHMA, and University of Republic, to coordinate activities for "Integrated Management of Coastal Zone of Uruguay along the La Plata River". The project commenced in March 1998 with the financial support from DINAMA, UNDP, UNESCO and CIID. DINAMA was in charge of water quality monitoring and sediment analysis for the selected 3 rivers, namely, the Santa Lucía, Carrasco and Pando Rivers as a pilot project.

FREPLATA

The project commenced in 2001 to conduct proper management of common water area of the La Plata River in collaboration with SOHMA and the Faculty of Science of the University of the Republic. A total of 20 rivers or creeks have been selected for the monitoring of water quality, and basically 3 samples are to be taken from each river/creek (river water, sea water off the estuary and brackish water). Sampling was carried out in August-September 2003.

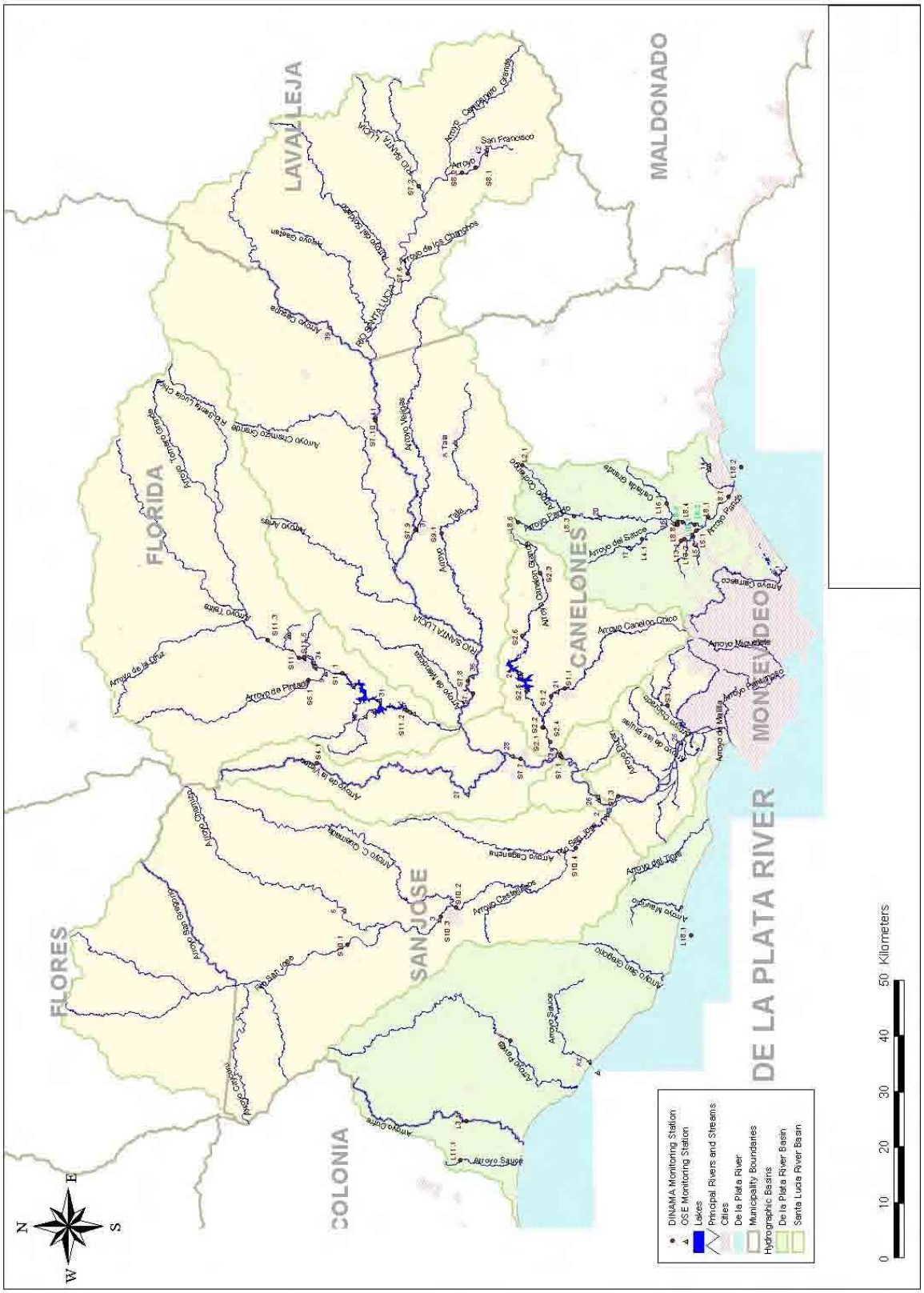

Figure 2.1.1 Location of Monitoring Stations (Regional Rivers)

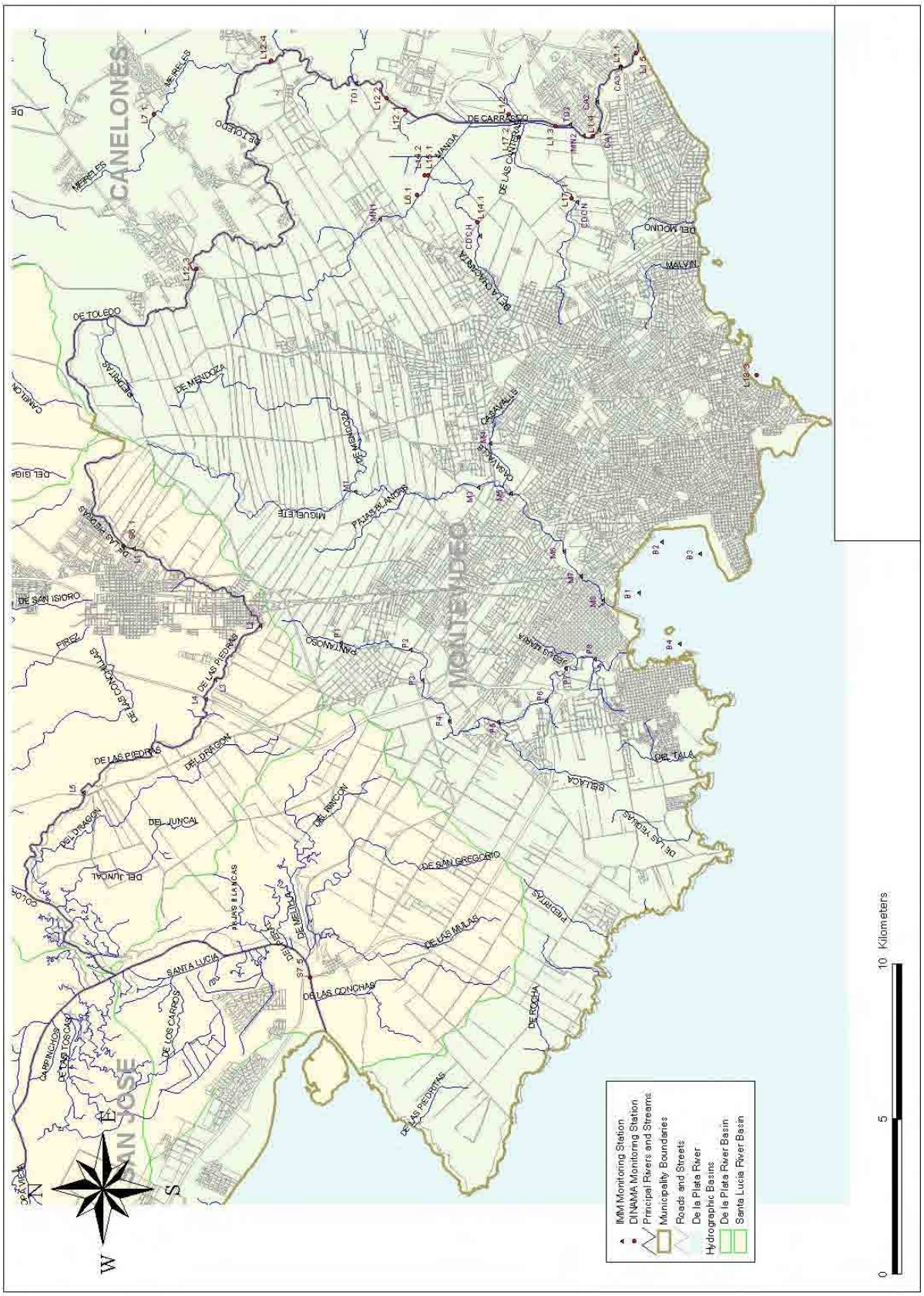

Figure 2.1.2 Location of Monitoring Stations (Urban Rivers)

2.2 Monitoring by Municipal Governments

(1) Montevideo

The water quality monitoring program carried out by the Government of Montevideo, one of the components of the Urban Sanitation Plan, was commenced early in 1999 by the consortium of consultants. The program continues from the summer 2002 under the responsibility of the Government of Montevideo. It consists of 6 campaigns a year (3 in summer and 3 in winter). In addition, river discharges are measured in the campaign of summer and winter respectively. During the period 1999-2001, sampling has been conducted at 33 monitoring stations in four selected rivers (Pantanoso, Miguelete, Carrasco, and Las Piedras) and Bahia de Montevideo. The Government added one more station in the Carrasco River Basin in 2002 to evaluate impact on water quality by industrial wastewater. All analysis work is carried out in the laboratory of the Government located at Punta Carretas.

Information on existing monitoring stations of the Municipal Government of Montevideo is summarized in **Table 2.2.1**. The results of the monitoring are publicized in the "Environmental Report" issued yearly.

Table 2.2.1 Monitoring Stations of Government of Montevideo

River/Creek Basin	Number of Stations	Monitoring Frequency
Miguelete	9	Bi-monthly
Pantanoso	7	Bi-monthly
Carrasco	9	Bi-monthly
Las Piedras	5	Bi-monthly
Montevideo Bay	4	Bi-monthly

Source: "IMM Environmental Report 2002", The Municipal Government of Montevideo, 2003

(2) Other Municipal Governments

The Government of Canelones takes 15 water samples every week from the beach of the La Plata River. The river coast is divided into three blocks and samples are taken from five (5) selected beaches at each block, and sampling points are scheduled to change every week according to a five-week rotation plan. Collected samples are analyzed in the laboratory of the Government for such parameters as pH, DO, BOD and coliform. With respect to the creek, the estuaries of the Carrasco, Pando, Solis Chico and Solis Grande River are the focus of the water quality monitoring.

The other municipal governments of San José, Lavalleja and Florida are expressing interest in water quality. However, due to the small capacity of their own laboratory, parameters are limited only to pH and coliform, which may be useful for the people's health care about bathing in the creek.

2.3 Water Quality Measurement by OSE

OSE has around 10 monitoring stations in the Santa Lucía River Basin. These are located within 50 km upstream from the water intake weir of Aguas Corrientes. Monitoring is conducted every week for the analysis of 11 parameters. Water quality at the intake is analyzed at 6 times a day for 6 physical and chemical parameters in the laboratory at the treatment plant. For the first time of sample of the day taken at 7 a.m., the analysis of 36 parameters is defined.

In addition, OSE is currently undertaking nationwide campaign to secure the quality of drinking water, so that sampling and analysis works are now underway in the laboratory of OSE headquarters. The total numbers of samples are supposed to be 700, of which 600 samples will be taken from the groundwater and the remaining 100 will be from the treatment plant. This campaign will last two years.

2.4 Water Quality Monitoring Status by Water Quality Parameter

In order to grasp the present status of the water quality monitoring by relevant organizations, water quality parameters monitored by each program or campaign are checked as shown in **Table 2.4.1** and **2.4.2**. From the table together with the present status as discussed above, the following are confirmed as the status of the present water quality monitoring.

- The campaign ECOPLATA covers a variety of water quality parameters including those of heavy metals and pesticides. Effective use of the monitoring results or feedback of the monitoring results to environmental policy, however, is not realized.
- "Coliform bacteria" is monitored by various organizations and campaigns, and effectively used to judge suitability of bathing. Monitoring of Lavalleja, San José and Florida is summer season campaign for this purpose.
- Heavy metals are covered but it is not clear it is enough or not.
- Monitoring by OSE concentrates to the source water for water intake.
- Pesticides as environmental water quality are monitored only in ECOPLATA.
- Parameters for industrial wastewater compliance monitoring by DINAMA and IMM cover those of basic ones. The results are used for penalizing, though it is not very successful.
- RENARE covers only basic item of parameters

Table 2.4.1 On-going Monitoring Activities and Measuring Parameters Defined by the Decree 253/79 (Surface Water) (1/2)

Organization & Program	DINAMA			IMM		OSE	
Frequency	ECOPLATA	FREPLATA	Beaches	Creeks & Bay	Beaches	A.Corrientes (Intake)	10 sites upstream
Parameters	Campaign	Campaign	Weekly (Summer)	Bi-monthly	Daily	Daily	Weekly
Odor		Sampling was carried out in August-September 2003, and data is available but report is not available					
Floating substances and Form							
Color						○	○
Turbidity (NTU)	○					○	○
pH	○			○		○	○
DO (mg/l)	○			○		○	○
BOD_5 (mg/l)	○			○		○	○
Fats and oils (mg/l)				○			
Detergent (mg/l)							
Phenol (mg/l) as C_6H_5OH							
Ammonia (mg/l) as N	●			○		○	○
Nitrate (mg/l) as N	○●						
Total phosphorus (mg/l) as P	○●			○		○	
SS (mg/l)	○					○	
Sodium Absorption Ratio	○						
Coliform bacteria (MPN/100ml)	○		○	○	○	○	
Cyanide (mg/l)						Total 21 parameters including those with ○.	
Arsenic (mg/l)	●						
Boron (mg/l)							
Cadmium (mg/l)	●						
Copper	●						
Total Chromium (mg/l)	●			○●			
Mercury (mg/l)	●						
Nickel (mg/l)	●						
Lead (mg/l)	●			○●			
Zinc (mg/l)	●						
Pesticides (µg/l)	●						

Note: Pesticides listed in decree 253/79 are described as Aldrin+dieldrin, Chlordane, DDT, Endosulphan, Endrin, Lindane, Heptachlor+Heptachlor Epoxy, Mirex, Metoxychloro, 2,4 D, 2,4,5 T, 2,4,5 TP, Parathion, Poliaromatics compounds.

Santa Lucía River and Carrasco and Pando creeks are selected in ECOPLATA. Meanwhile, there are 6 more creeks (Cufre, Mauricio, Solis Chicos, Solis Grandes, Miguelete and Pantanoso) involved in FREPLATA.

IMM is undertaking water quality monitoring for 4 creeks (Miguelete, Pantanoso, Carrasco and Las Piedras) and Montevideo Bay.

Parameters measured for surface-water are marked with ○ and those for sediment are with ●

No information is available about kinds of pesticide measured under ECOPLATA.

Table 2.4.2 On-going Monitoring Activities and Measuring Parameters Defined by the Decree 253/79 (Surface Water) (2/2)

Organization & Program	Canelones		Lavalleja	San Jose	Florida	RENARE	LATU
Frequency	4 creeks (estuary)	Beaches	Creeks		Creeks	Upon request	Upon request
Parameters		Weekly	Campaign (Summer)		Campaign (Summer)		
Odor						○	
Floating substances and Form						○	
Color						○	
Turbidity (NTU)							
pH	○	○	○		○	○	
DO (mg/l)	○	○				○	
BOD_5 (mg/l)	○	○				○	
Fats and oils (mg/l)							
Detergent (mg/l)							
Phenol (mg/l) as C_6H_5OH							
Ammonia (mg/l) as N							
Nitrate (mg/l) as N							
Total phosphorus (mg/l) as P							
SS (mg/l)							
Sodium Absorption Ratio							
Coliform bacteria (MPN/100ml)	○	○	○		○	○	
Cyanide (mg/l)							All possible
Arsenic (mg/l)							
Boron (mg/l)							
Cadmium (mg/l)							
Copper							
Total Chromium (mg/l)							
Mercury (mg/l)							
Nickel (mg/l)							
Lead (mg/l)							
Zinc (mg/l)							
Pesticides (µg/l)							

Note: Pesticides listed in decree 253/79 are described as Aldrin+dieldrin, Chlordane, DDT, Endosulphan, Endrin, Lindane, Heptachlor+Heptachlor Epoxy, Mirex, Metoxychloro, 2,4 D, 2,4,5 T, 2,4,5 TP, Parathion, Poliaromatics compounds.

Canelones is undertaking water quality monitoring for the estuaries of Carrasco, Pando, Solis Chico and Solis Grande. Monitoring frequency is not informed.

Lavalleja has 4 monitoring stations, each established at Santa Lucía River and 3 creeks (La Plata, San Francisco and Campanero).

2.5 Identification of Issues by Water Quality Parameter

In this section, identification of issues by water quality parameter is conducted to confirm the present condition from the different point of view. **Table 2.5.1** presents parameters for water quality and sediment quality covered by laws, covered by laboratory of relevant organizations, and covered by present monitoring work.

From **Table 2.5.1**, the following characteristics in the water quality management in Uruguay have been extracted.

- Fecal Coliform is widely monitored water quality parameter in Uruguay. Every Municipality can analyze fecal coliform. This is considered to be the result of higher concern about bathing in rivers and children' playing in rivers.
- The pH that is a basic parameter of water quality and measurement is easy also is commonly monitored and every Municipality is capable of this.
- Some Municipalities do not cover BOD_5 that is commonly used in the world for the evaluation of river water quality.
- Total Chromium and lead are the representative parameters for heavy metals.
- Monitoring of pesticide is limited to campaigns of ECOPLATA and FREPLATA. Present condition of pesticide pollution cannot be evaluated due to the lack of data.
- Amendment of Decree No.253 proposes new inclusion of Chloride, Hexavalent Chromium, etc. Excluded from the present Decree No. 253 is only Boron. Other heavy metals and pesticides are presently under study for the amendment. Amendment of wastewater discharge standards is presently under study.
- With regard to the ambient water quality monitoring by Municipality, Municipality of Montevideo is quite different from the other Municipalities in implementing status and in monitoring capacity. Planning of the future monitoring should consider this status.
- The laboratory that belongs to DGSA (General Directorate of Agricultural Services), MGAP, does not conduct regular water quality analysis, and only conducts residual pesticide for agricultural crops. It accepts analysis upon request with approximately US$55 per sample.
- LATU is an organization that conducts analysis upon request. Tariffs are 8-kind of heavy metals at US$170/sample and chloric pesticides at US$77/sample.
- Regarding number of sampling locations and frequency of sampling by each Municipality, Municipality of Montevideo conducts sufficient periodical ambient water quality monitoring. Municipality of Canelones follows this with monitoring of relatively long period of river water quality including BOD_5. San José follows this with periodical river water quality monitoring and summer campaign for beaches. Municipalities of Florida and Lavalleja only conduct summer campaign analyzing fecal coliform.
- With regard to industrial wastewater monitoring, DINAMA conducts better monitoring when compared to river water quality monitoring. Of the Municipalities, Municipality of Montevideo conducts better industrial wastewater monitoring rather than DINAMA. Industrial wastewater monitoring by other Municipalities is almost not conducted and also they do not have capacity for this.

Table 2.5.1 Identification of Issues by Water Quality Parameter

Analytical Parameters \ Water Quality Management Approach and Organization			Establishment of Policy and Strategies				Pollution Source Management						Ambient Water Quality Monitoring																										Dissemination/Education and Public Participation		
				Present Decree 253		Amendment of Decree 253							Previously/Presently Conducted Monitoring															Laboratory Capacity														
													DINAMA				OSE		IMM		IMC		IMSJ		IMF	IML			RENARE													
			Use in Policy Formulation	Environment Standard	Effluent Standard	Environment Standard	Effluent Standard	DINAMA	IMM	IMC	IMSJ	IMF	IML	ECOPLATA	FREPLATA	Beaches	Regular monitoring	Intake (Daily)	Upstream 9 sites (Monthly)	Creeks/Bay (Bi-monthly)	Beaches (Daily)	5 Creeks (Estuary)	Beaches (Weekly)	3 Creeks	Beaches (Weekly)	Creeks (Summer campaign)	Creeks (Summer campaign)	DINAMA	OSE	RENARE	Labo. of DGSA	SOHMA	LATU	IMM	IMC	IMSJ	IMF	IML	Infomation Sharing		
General, physicochemical and bacteriological	Flow Rate			○			○	○																			○	○			○	○	○							
	Temperature			○			○	○					○	○	○		○										○	○	○		○	○	○	○	○	○	○			
	Odor		○		○		○	○						○			○										○	○	○		○	○								
	Color		○		○		○	○									○	○									○	○	○		○	○	○	○	○	○	○			
	Floating Substances		○		○									○													○	○			○	○								
	Turbidity		○		○								○				○	○									○	○			○	○	○							
	Conductivity												○	○	○												○				○	○	○							
	Salinity												○	○	○												○				○	○	○							
	pH	Basic parameter	○	○	○		○	○					○	○			○	○	○		○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○			
	DO		○		○								○	○				○	○		○	○					○	○	○		○	○	○	○						
	BOD		○	○	○		○	○					○	○				○	○		○	○	○				○	○	○		○	○	○	○	○					
	COD												○														○				○	○	○	○	○	○				
	Chloride				○																						○	○			○	○								
	Sulfide			○			○	○																			○				○	○	○							
	Fats and Oil		○	○	○		○	○											○								○	○	○		○	○	○							
	Detergent		○		○													△									○	○			○	○	○							
	Phenol		○	○	○																							○			○	○								
	Ammonia-N		○	○	○			○					●	○			○	○	○				○				○	○			○	○	○		○					
	Nitrate-N		○		○								○●	○			○										○	○			○	○	○							
	Nitrite-N				○									○													○				○	○	○		○					
	Phosphorus		○		○								○●	○					○								○	○			○	○	○							
	Suspended Solid		○	○	○		○	○					○	○													○	○			○	○	○				○			
	Solid Deposit			○																							○				○	○	○							
	Total Solid			○									○														○				○	○	○							
	Sodium Absorption Rate		○										○														○	○			○	○								
	Fecal Coliforms	Indicator for bathing	○	○	○		○	○					○	○	○				○	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○		
	Total Coliforms														○												○	○	○		○	○	○	○	○	○	○			
Heavy metals	Aluminum				○																						○				○	○	○*1							
	Arsenic		○	○	○								●														○	○			○	○	○*1							
	Boron		○																									○			○	○								
	Cadmium		○	○	○								●	○●													○	○			○	○	○							
	Chromium	Representative of heavy metals	○	○	○		○	○					●	○●					○●								○	○			○	○	○							
	Hexavalent Chromium				○																						○				○	○	○							
	Copper		○	○	○								●	○●													○	○			○	○	○							
	Cyanide		○	○	○																						○	○			○	○								
	Lead	Representative of heavy metals	○	○	○		○	○					●	○●					○●								○	○			○	○	○							
	Mercury		○	○	○								●														○	○			○	○	○* 2							
	Nickel		○	○	○								●														○	○			○	○	○							
	Selenium				○																						○				○	○								
	Zinc		○	○	○									○													○	○			○	○	○							
	Other metals				under study																												Si *1								
Pesticides		Few data exist and difficult to evaluate the present situation	○ Total 14-kind		under study								●	○●													They have G.C.	○ with G.C.-MS		8 parameter in Stockholm Convention with GC-HPLC	○	○	atracina simazinea									
Volume of available water quality data																																								
Number of station													30-point	18-point	Sponta-neous	23	1-point	9-point	34-point	21-point	5-point	15-point	3-point	4-point	few	few														
Monitoring frequency								Annually	Quarterly or Bi-annually or Annually by kind of industry	Rarely conducted.			1-time in 2000	1-time /year for 2003-	Sponta-neously in summer	2-5 time for 1990-2001	Daily	Monthly	Bi-monthly	Daily in summer	Monthly	5-week continu-ously in summer	3-time /year	Weekly in summer	Summer	Summer				Responsi-ble for agricultural food import/ export (residual pesticides)		Private analytical organiza-tion							
Others																																								

Note ○: Applied/Applied for water, ●: Applied for sediment, △: To be conducted but not conducted actually *1: Equipment available but no actual implementation *2: Can be done but nobody want to do because of less safeness

IMM: Montevideo, IMC: Canelones, IML: Lavalleja, IMSJ: San Jose, IMF: Florida

Heavy metals are case by case.

All under study

Regular monitoring of heavy metals in ambient water is conducted only by IMM.

Labo. of DGSA covers only pesticides and no other parameters are covered.

3. PROPOSED PLAN OF AMBIENT WATER QUALITY MONITORING

3.1 Background

In this Project, ambient water quality monitoring encompasses: i) measurement of water quality; and ii) maintenance and use of ambient water quality. In this section, series of works associated with measurement of water quality like network design, sampling, transportation, preservation, laboratory measurement, etc. are expediently called ambient water quality monitoring (AWQM).

The objective of AWQM is to scientifically clarify and assess the status of water quality through periodical and systematic observation of river water quality. Periodical and continuous ambient water quality monitoring for river basins had not been conducted before the Project. Thus, scientific clarification and assessment of the status of water quality as declared by the Decree No. 253/79 for the task of DINAMA has not been performed. This is one of the weak points in the water quality management in Uruguay.

Major problems identified in the present activities of AWQM in Uruguay are summarized hereunder:

- Lack of strategic water quality monitoring

  EQED of DINAMA had experienced some sporadic water quality monitoring in a certain area in the past. At present, however, the implementation of the periodical and systematic monitoring which is planned strategically has been not in place without an adequate plan thereof.

- Weak organizational capacity for water quality monitoring

  EQED and Technical Normalization Department (DINAMA Laboratory) of DINAMA are deprived of capacity in various aspects (individual ability, human resources, laboratory facilities, etc.) for managing periodical monitoring. Likewise, Municipalities are also constrained in the capability of water quality monitoring.

- Lack of collaboration between DINAMA and other units

  Besides DINAMA, Municipalities have responsibility to conserve the hygiene environment condition in their territory. Furthermore, OSE has the responsibility of water quality monitoring for source water of drinking. At present, the collaboration among them has not been in place.

To address problems mentioned above, the strengthening of AWQM in the Santa Lucía River Basin is proposed in the Project, hereunder.

3.2 Needs of Capacity Development

The problems in AWQM in the Santa Lucía River Basin were thoroughly analyzed from various aspects, comparing with the envisioned water quality management ultimately to be attained in Uruguay. As a result, it has been clarified that DINAMA itself as the leading agency in AWQM needs strongly to address the deprived human resource (especially numbers of staffs concerned) which is a common underlying problem.

Based on the result of the problem analysis, the needs of capacity development to strengthen the AWQM were identified as follows:

- Strengthening of individual capacity and human resources

  Human resources in terms of individual capacity and allocated numbers of staffs are not enough in DINAMA and related units. In many aspects of monitoring techniques (like network designing, sampling, site measurement, transportation, laboratory analysis, etc), staffs' capacity of DINAMA and Municipalities should be strengthened. DINAMA laboratory should be provided with appropriate skills and management system especially for more advanced measurement. In addition, both EQED and DINAMA Laboratory need more staffs to secure the sustainable execution of periodical and systematic AWQM.

- Reinforcement of laboratory equipment and materials

  To realize the collaborated AWQM, laboratories in DINAMA and Municipalities need to be reinforced by additional equipment and materials in line with the measurement and analysis of allocated parameters.

- Development of water quality monitoring manual

  AWQM is a series of activities to obtain scientific data. Thus, manuals related with AWQM needs to be developed to secure appropriate network planning and QA and QC of measurements and analyses.

- Development of water quality monitoring plan

  Development of the feasible plan of water quality monitoring which prescribes monitoring stations, sampling timings, measured parameters, etc. is needed to carry out actual monitoring in the Santa Lucía Basin.

- Establishment of collaboration among DINAMA and relevant units

  AWQM has the character of manpower-consuming work, thereby making it difficult for only DINAMA to carry out it. Thus, the collaboration between DINAMA and Municipalities which have almost the same purpose should be established to enforce AWQM, effectively.

3.3 Proposed Strategies of Capacity Development

The approaches of the capacity development for the strengthening of AWQM in the Santa Lucía River Basin were thoroughly discussed and studied employing PCM method. Based on this, the plan of the capacity development for AWQM was designed,

thereby coming to series of "Outputs" and "Activities" required for attaining "Project Purpose".

JICA Project Team, as detailed in the Main Report, proposes the "Outputs" and "Activities" (which signify the "Strategies" and "Actions", respectively) for the capacity development in line with the identified needs. The proposed plan encompasses the development of the capacity of individual level, organizational level and society/institutional level, aiming at the strengthening of AWQM until the year of 2013, as shown in **Table 3.3.1**.

Table 3.3.1 Proposed Plan for Strengthening of Ambient Water Quality Monitoring for Santa Lucía River Basin

Strategies (Outputs)	Actions (Activities)
Strengthening of capacity of individuals, laboratories and organization (Output 3.4)	<Provision of Equipment and Technology Transfer by JICA> 1.[1] JICA provides DINAMA with the technical training in Japan for AWQM. 1.[2] JICA provides DINAMA laboratory with technology transfer for pesticide analysis through JCPP. 2. JICA provides DINAMA and Municipalities with laboratory equipment necessary for basic analyses. <DINAMA Laboratory> 3. DINAMA Laboratory checks the capability of pesticide analysis. 4. DINAMA conducts pesticide monitoring. 5. DINAMA Laboratory obtains ISO/IEC 17025 (under the assistance of JICA). 6. DINAMA laboratory maintains laboratory equipment and skills properly. 7. DINAMA Laboratory raises the capacity to meet the strategies and action plans. <Municipalities' Laboratories> 8. Municipalities receive technology transfer for water sampling and field measurement from DINAMA. 9. Municipalities receive technology transfer for laboratory analysis from DINAMA. 10. Municipalities raise the capacity to measure BOD_5 analysis at every laboratory. <Branch Laboratory of OSE> 11. Branch laboratories of OSE in each Municipality raise the capacity to measure BOD_5. < Human Resources of DINAMA> 12. DINAMA reinforces the human resources of EQED for sustainable AWQM. 13. DINAMA maintains necessary numbers of staffs necessary for securing sustainable AWQM.
Development of manuals related with water quality monitoring (Output 3.1)	1. DINAMA and JICA Project Team jointly develop (and DINAMA modifies, when necessary) water quality monitoring manual. 2. DINAMA Laboratory updates the manual of laboratory

Strategies (Outputs)	Actions (Activities)
	measurement and analysis.
Development of the plan of AWQM in the Santa Lucía River Basin (Output 3.2)	1. DINAMA and JICA Project Team jointly develop (and DINAMA updates) water quality monitoring plan in the Santa Lucía River Basin.
Establishment of collaboration system for AWQM (Output 3.3)	1. The consensus for AWQM among related units is reached. 2. DINAMA and Municipalities conclude the Agreement for the collaborated AWQM. 3. DINAMA and Municipalities jointly carry out (and continue) AWQM.

3.4 Planned Actions and Achievement in JICA Project Period

Specific actions were designed to produce the respective Outputs. Among necessary activities proposed, some of actions have been already undertaken in the Pilot Project (April of 2004 to March of 2005) and the Phase III (April of 2005 to March of 2006). Planned actions and major achievement during this period are described below:

(1) Strengthening of Capacity of individuals, laboratories and Organization (Output 3.4)

(1a) Provision of Equipment and Technology Transfer by JICA

(a) Technology transfer in Japan (Action 1.[1])

<Planned Action>

Strengthening of individual capacity of staffs is required to plan and implement AWQM. Thus, the technical training in Japan for the staffs of DINAMA and related units was planned.

<Achievement>

The technical training in Japan specifically aiming at this field has not been realized.

(b) Technology transfer for pesticide analysis (Action 1.[2])

This Action is described in the section 3.4-(1)-(1b).

(c) Provision of laboratory equipment by JICA (Action 2)

<Planned Action>

According to the "Execution Plan of Trial Water Quality Monitoring" formulated in the Project, it was planned that general and basic parameters (like temperature, pH, electrical conductivity, COD and coliform bacteria) was supposed to be covered by the municipalities. Based on the survey results on the present availability of equipment and materials in the municipal laboratories, equipment and materials necessary for the measurement

abovementioned were provided by the Government of Japan. Meanwhile, it was identified that the capacity of DINAMA laboratory in the BOD analysis required the strengthening to handle the sample numbers assumed in the trial monitoring. Thus, it was planned that component equipment for BOD analysis was provided to the DINAMA laboratory.

<Achievement>

During the Pilot Project, equipment and materials necessary for AWQM, as shown in **Table 3.4.1**, were provided to Municipalities and DINAMA by the Government of Japan.

Table 3.4.1 Provided Equipment and Materials for Laboratories

Items	Quantities	Users
pH meter in Lab.	1	IMSJ
Digester with digital display for COD	1	IML
BOD analysis equipment	1	DINAMA
Field equipment (pH, temp.)	4	IMC, IMSJ, IMF, IML
Field equipment (TDS, EC, salinity)	4	IMC, IMSJ, IMF, IML
Consumables	1 lot	Each Municipality

(1b) Strengthening of DINAMA Laboratory

(d) Checks of DINAMA laboratory's capability of pesticide analysis and trial measurement (Action 1.[2], 3 and 4)

<Planned Action>

The pollution caused by pesticides is a possible concern in the Santa Lucía River Basin. While DINAMA Laboratory owns a GC, staffs have little experienced the measurement of pesticides at that time. In order that staffs of DINAMA Laboratory acquire technologies necessary for pesticide analysis, it was planned that the check of the present capability, the trial analyses and technology transfer through JCPP were conducted.

<Achievement>

In the Pilot Project, DINAMA Laboratory checked its capability of pesticides analyses by means of GC, purchasing a set of standard solution. Then, DINAMA actually measured pesticides (myrex, methyl parathion and ethyl parathion) on the samples of 96 for water and 42 for sediment in the water quality monitoring of the Santa Lucía River Basin.

In the Phase III, the technology transfer for pesticide analysis took place through the JCPP, between October 24th and November 1st in 2005. Two specialists from SAG (Agriculture and Livestock Service) and INIA (Institute of Agriculture and Livestock Investigation) in Chile visited the DINAMA Laboratory for that purpose, under the scheme of JCPP. Staffs of DINAMA received the technical training on the extraction and determination by GC

(ECD and NPD) for pesticide analysis (like mirex, ethyl parathion, methyl parathion, heptachlor, endrin, aldrin, DDT and chloroprifos). During the training, useful advices (like separation of equipment analysis room, necessity of additional equipment, etc.) were given. The result of the technology transfer were shared in the workshop on November 3rd , attended by related units (IMM, IML, LATU, private laboratory, etc.) as well as DINAMA members.

Through the trial analysis and the technology transfer abovementioned, it has become clarified that auto-sampler set for GC and even GC-MS are required for a full-scale monitoring of pesticides.

(e) Obtaining of ISO/IEC 17025, maintaining of laboratory equipment /skills and further raising of capacity (Action 5 and 6)

This Action is separately described in the section 5 of the Sector C.

(f) Raising the capacity of DINAMA Laboratory meeting the strategies and action plans (Action 7)

<Planned Action>

The water quality monitoring to be made by EQED and industrial wastewater management to be made by EnCD should be strengthened along with the implementation of the proposed Integrated Master Plan. So, the numbers of samples which requires the laboratory work of DINAMA Laboratory will increase in the future. Thus, DINAMA Laboratory should raise the capacity concerning laboratory equipment and human resources.

<Achievement>

This Action will be taken after the completion of the JICA Project.

(1c) Strengthening of Municipalities' Laboratories

(g) (a)Technology transfer to Municipalities' staffs by DINAMA (EQED and Laboratory) (Action 8 and 9)

<Planned Action>

The collaborative work between DINAMA and Municipalities on AWQM for the Santa Lucía River Basin was planned. The survey clarified that the Municipalities' capabilities of sampling and analysis of water were not enough to implement it. Thus, it was planned that DINAMA (EQED and Laboratory) provided Municipalities' staffs with the technology transfer in the correspondent fields.

<Achievement>

EQED provided for the technology transfer for field works (like water sampling, field measurement, etc) through technical trainings in the workshop and OJT. Together, DINAMA Laboratory rendered several inter-calibrations

for QA and QC in the laboratory analyses. As a result, it is judged that the Municipalities' laboratories have been strengthened steadily. This improved capacity of Municipalities' laboratory was proved in the water quality incident in 2005, when the Municipality conducted prompt monitoring upon the request of DINAMA.

(h) Raising of capacity of municipalities' laboratories for measuring BOD_5 (Action 10)

<Planned Action>

This action aimed the further strengthening of the capacity of Municipalities' laboratories with the provision of equipment by Uruguayan side.

<Achievement>

Initially, it was planned that the provision of equipment for BOD_5 measurement was in the first priority. However, after studying the needs of laboratories, DINAMA decided to buy and provide Municipalities (IMC, IMSJ, IMF and IML) with the following equipment:

DO meter;

Sediment sampler; and

Water sampler.

DINAMA is now processing the purchase order for this purpose. In addition to this, IMF purchased an incubator for BOD_5 by itself.

(1d) Strengthening of OSE's Branch Laboratory

(i) Raising of branch laboratories' capacity of OSE for measuring BOD_5 (Action 11)

<Planned Action>

It was planned that OSE participated in the collaborative work for AWQM in the Santa Lucía River Basin. In this plan, it was considered that branch laboratories of OSE located in municipalities needed the capacity strengthening in measuring BOD_5.

<Achievement>

In reality, the participation of OSE in water quality monitoring has not been realized yet up to today, due to OSE's own reason. Therefore, this Action will discuss again in conjunction with OSE participation.

(1e) Human Resources of DINAMA

(j) Reinforcement of human resources of EQED (Action 12)

<Planned Action>

EQED is in the position to lead and supervise all things (monitoring network design, sampling and field measurement, data management, etc.) necessary for AWQM in the Santa Lucía River Basin. However, despite such large tasks, the numbers of EQED' staff were only two (2) as of the beginning of 2004. Thus, it was suggested that the implementation of water quality monitoring required the reinforcement of human resources of EQED.

<Achievement>

The staff numbers of EQED increased from two (2) to three (3) in the late 2004, and more increase of about four staffs is scheduled in the future.

(k) Maintaining of human resources of DINAMA (Action 13)

<Planned Action>

The AWQM established during the JICA Project period should be further improved and expanded in the future. To do so, more incremental numbers of DINAMA (both EQED and Laboratory) are required to manage it, in the future.

<Achievement>

This Action will be taken after the completion of the JICA Project.

(2) Development of Water Quality Monitoring Manual (Output 3.1)

(a) Development of Water Quality Monitoring Manual (Action 1)

<Planned Action>

The water quality monitoring manual was required to carry out the monitoring in a unified procedure and to secure QA and QC throughout a series of monitoring activities. So, it was planned to introduce a unified procedure and practices that DINAMA and the JICA Project Team jointly prepared a manual.

<Achievement>

The contents of planned manuals are summarized in **Table 3.4.2**. The JICA Study Team first made the draft of manuals and then both sides discussed and reviewed it several times. Final version of water quality monitoring manual, **Supplementary Project Document (3.1)**, was completed in both English and Spanish in the Phase III, and they are now being used in actual works.

Table 3.4.2 Contents of Water Quality Monitoring Manual

Sections	Contents	Remarks
Designing of Water Quality Monitoring Network	To design a proper monitoring network, practical approach and ways for selection of sampling	This is used mainly by the EQED of DINAMA that leads the whole monitoring

	stations, parameters to be monitored, sampling schedule, etc. are described.	activities.
Methods of Field Work and Sampling	To secure a good practice and QA/QC in field working and sampling, relevant explanations are given for water containers and samplers to be used, sampling procedures, preservation method, and transportation, etc.	This is used by both the municipalities and the EQED of DINAMA assigned to field work.
Field Testing Methods	To secure a good practice and QA/QC in the field-testing, relevant explanations are given for pH, conductivity, DO and faecal coliform measurement.	This is used mainly by the municipalities assigned to field-testing.
Processing and Interpretation of Water Quality Data	Explanations relevant for data processing, interpretation of data, reporting, etc are addressed as guidance along with necessary data and information concerned.	This is used mainly by the EQED of DINAMA that leads the whole monitoring activities and interprets collected data.

(b) Updating of Laboratory Measurement and Analysis Manual (Action 2)

<Planned Action>

DINAMA Laboratory is in a position to lead the measurement and analysis related with the environment in Uruguay. One of its tasks is to set up and maintain measurement and analysis manuals that are commonly used in Uruguay. So, it was planned that DINAMA Laboratory updated the manual of laboratory and analysis being used currently.

<Achievement>

The existing manual contains a total of 58 items for the measurement and analysis covering water, sludge, soil, air and oil. It is mainly based on the 1995 version of the Standard Methods for the Examination of Water and Waster established by APHA (American Public Health Association). During the JICA Project period, DINAMA Laboratory updated this manual by itself, in response to mainly the 1999 version of APHA and the latest version of EPA. The Second Version of the manual was completed in December 2004.

(3) Development of AWQM Plan in Santa Lucía River Basin (Output 3.2)

(a) Development of AWQM Plan in Santa Lucía River Basin (Action 1)

<Planned Action>

The systematic plan of AWQM was not in place in DINAMA in the past. So, it was planned that a systematic and realistic plan was developed to initiate the AWQM in the Santa Lucía River Basin.

<Achievement>

First, the executive plan was prepared for the trial water quality monitoring as the first step of periodical and systematic monitoring in the Pilot Project. This plan covered selected sampling points, measured parameters, sampling frequencies, demarcation of measurement works and preparatory works for monitoring, etc. The summarized information is as follows:

Selection of Sampling Points

DINAMA and the JICA Project Team surveyed thoroughly candidate sampling points that were used in the past. As a result, a total of 32 locations (except for 33 locations in IMM) were selected as sampling points in the trial monitoring, considering opinions of Municipalities.

Sampling Work and Frequency

Sampling frequency (once a month, as a rule) was set, taking into account the present capacity of measurement in DINAMA and Municipalities. Together, the demarcation of sampling work between DINAMA and Municipalities were arranged, based on the accessibility to the respective sampling points and the availability of equipment in Municipalities.

Demarcation of Measurement Work

Based on the evaluation on the present capacity of the laboratories in both DINAMA and Municipalities, the work sharing in water quality measurement has been arranged. This demarcation was subject to the review for the subsequent work after the trial monitoring, depending on the laboratories' capacity.

Preparatory Work

Basic schemes were arranged in the executive plan to secure QA and QC in monitoring activities. These were comprised of the technical training for sampling work, field-testing and the inter-calibration of laboratory measurement, which are oriented for Municipalities' staff.

Up to date, the plan of AWQM has been updated several times by EQED, in line with the actual scheme of water quality monitoring. The latest plan of AWQM is shown in **Annex (1)**.

(4) Establishment of Collaboration for AWQM in Santa Lucía River Basin (Output 3.3)

(a) Consensus and Agreement for collaborative AWQM (Action 1 and 2)

<Planned Action>

Implementation of all the proposed AWQM solely by DINAMA is not realistic, even though the capacity of DINAMA is raised. Municipalities, on the one hand, are declared to conserve the hygiene environment condition in their territory, thus it is expected that Municipalities have the basic capacity for ambient water quality monitoring. Meanwhile, OSE has been conducting water quality monitoring for source water of drinking, and the data could be utilized for ambient water quality evaluation.

Thus the collaborated work between DINAMA, OSE and Municipalities was proposed. This collaborative work was expected to realize the reduction of workload concentration to DINAMA and effective utilization of data/information maintained by OSE. It was also expected that this collaborative work also raise the ownership of Municipalities for the conservation of hygiene environment condition in their territory.

<Achievement>

The work to be conducted by each organization in this collaborative work is as follows.

- DINAMA acts as the leading agency for the overall AWQM, conducts monitoring network designing, sediment sampling, laboratory analysis that could not be covered by Municipalities, data storing, analysis and evaluation; and
- Municipalities conduct sampling of water and laboratory analysis of basic parameter.

Based on the consensus confirmed in the Steering Committee, the first draft Agreement was made in the Pilot Project (in July 2004). DINAMA, however, intended that the Agreement was concluded, after the trial monitoring. Therefore, the Agreement was again discussed in August 2006 after several actual monitorings.

Finally, the Agreement titled “Joint Work Agreement about Water Quality Monitoring between MVOTMA and IMSJ, IMC, IMF, IML and IMM” was concluded and signed by Minister of MVOTMA and Mayors of respective municipalities on September 11th, 2006, as shown in **Annex (1)**.

While OSE does not participate in the collaborative monitoring at this moment from its own reason, it is expected to join in the future.

(b) Joint Implementation of AWQM (Action 3)

<Planned Action>

Based on the consensus confirmed in the Steering Committee, the AWQM in the Santa Lucía River Basin was initiated jointly by DINAMA and 5 (five) municipalities.

<Achievement>

Up to today, AWQM has been carried out eight (8) times, including 4 times of the trial operations and 4 times of the actual operation, as shown in **Table 3.4.3**. Of the actual operations, the operation No. 4 (implemented in June 2006) has been not finished yet completely, remaining some parameters not measured. Except for the actual operation No. 4, all monitoring data have been stored in the database of the SISICA.

DINAMA plans to continue periodical AWQM of seasonal bases (4 times a year).

The SISICA with computerized database system has been constructed to store and process the monitoring data obtained through AWQM in the Santa Lucía River Basin. These data and information in the SISICA are used to formulate the Annual Report.

Table 3.4.3 Status of Water Quality Monitoring in Santa Lucía Basin

Campaign	Sampling Period		Work Status		
	From	To	Sampling	Measure-ment	Data Input to SISICA
Trial Operation No. 1	Dec. 21st of 2004	Dec. 29th. of 2004	Completed	Completed	Completed
Trial Operation No. 2	Jan. 18th of 2005	Jan. 25th of 2005	Completed	Completed	Completed
Trial Operation No. 3	Feb. 15th of 2005	Mar. 14th of 2005	Completed	Completed	Completed
Trial Operation No. 4	Apr. 19th. of 2005	Apr. 19th. of 2005	Completed	Completed	Completed
Actual Operation No. 1	Jul. 26th of 2005	Aug. 3rd of 2005	Completed	Completed	Completed
Actual Operation No. 2	Nov. 18th of 2005	Nov. 16th of 2005	Completed	Completed	Completed
Actual Operation No. 3	Mar. 9th of 2006	Mar. 21st of 2006	Completed	Completed	Completed
Actual Operation No. 4	Jun. of 2006	July of 2006	Completed	On the way	Not yet completed
Actual Operation No. 5	Sep. of 2006		Planned		

3.5 Required Actions toward 2013

3.5.1 Issues toward 2013

During the Pilot Project and the Phase III, the capacity of water quality monitoring has been drastically strengthened, as summarized below:

- The individual capabilities of staffs concerned of both DINAMA and Municipalities are strengthened in terms of monitoring-related techniques;
- Equipment and materials for monitoring and laboratory have been reinforced by both the provision from the Government of Japan and the purchase made by DINAMA;

- Manual for AWQM and actual monitoring plan have been developed; and
- Collaborative monitoring mechanism between DINAMA and Municipalities has been established and operated.

As a result, the AWQM have been already carried out eight (8) times and come to be a routine activities of DINAMA and Municipalities.

Major issues to be tackled by DINAMA and concerned units after the completion of the JICA Project are:

- To continue the periodical monitoring with the expansion of the monitoring network (like monitoring frequencies, incremental stations, incremental measured parameters, etc.); and
- To maintain the sustainable strengthening of the capacity to support the incremental activities.

Required actions for that purpose are described specifically, hereunder.

3.5.2 Required Actions

(1) Strengthening of Capacity of individuals, laboratories and Organization (Output 3.4)

(a) Pesticide analysis by DINAMA Laboratory (Action 4)

DINAMA Laboratory continues the pesticide measurement in the AWQM of the Santa Lucía River basin. In this respect, the auto-sampler for GC and/or the GC-MS are required to more efficiently measure pesticides.

(b) Raising of the capacity of DINAMA Laboratory (Action 7)

Raising the capacity of DINAMA Laboratory is required in terms of equipment and human resources, to meet incremental activities to be generated in the future expansion of water quality monitoring and industrial wastewater management.

(c) Technology transfer of monitoring-related techniques to Municipalities (Action 8 and 9)

For field and laboratory works, sustainable technology transfer of DINAMA (EQED and Laboratory) to Municipalities concerned is requested to secure QA and QC in water quality monitoring.

(d) Raising the capacity of BOD_5 measurement in Municipalities (Action 10)

BOD_5 is fundamental parameters representing the status of water pollution. Thus, laboratories of every Municipality are requested to acquire the equipment and skills for its measurement and to fulfill respective tasks in the AWQM in the Santa Lucía River Basin.

(e) Raising the capacity of BOD_5 measurement in branch laboratories of

OSE (Action 11)

In the future, OSE is expected to join the AWQM for the Santa Lucía River Basin. In this expanded monitoring, laboratories of OSE are requested to render the results of BOD_5 measurement. To do so, the branch laboratories of OSE are requested to acquire the equipment and skills for BOD_5 measurement.

(f) Incremental human resources of DINAMA (Action 13)

The water quality monitoring should be improved and expanded in the future. While the staff numbers of DINAMA (EQED) were increased during the period of the JICA Project, more efforts of DINAMA (both EQED and Laboratory) are required in this respect, in the future.

(2) Updating of Water Quality Monitoring Manual (Output 3.1)

(a) Modification of water quality monitoring manual (Action 1)

During the period of the JICA Project, the water quality monitoring manual was developed under the joint work. Necessary modifications to arise in the course of actual monitoring should be made by DINAMA.

(b) Updating of the manuals for laboratory measurement and analysis (Action 2)

During the period of the JICA Project, DINAMA Laboratory updated the manuals for laboratory measurement and analysis in response to the amendment of referential manuals used commonly. This updating is required to pursue international trends, when appropriate.

(3) Updating of AWQM Plan in Santa Lucía River Basin (Output 3.2)

(a) Updating of water quality monitoring plan in Santa Lucía River Basin (Action 1)

During the period of the JICA Project, the water quality monitoring plan was developed under the joint work. The water quality monitoring should be expanded in terms of monitoring frequencies, incremental stations, incremental measured parameters, etc., thereby reviewing and modifying the water quality monitoring plan.

(4) Continuous Collaboration for AWQM in Santa Lucía River Basin (Output 3.3)

(a) Continuous implementation of water quality monitoring in Santa Lucía River Basin (Action 3)

During the period of the JICA Project, the collaborative mechanism between DINAMA and Municipalities on AWQM was established, and, as a result, the periodical monitoring has been realized. This should be continued in a sustainable way. To realize so, DINAMA and Municipalities should jointly

make efforts in securing appropriate required resources, based on the Agreement concluded.

4. PROPOSED PLAN OF INFORMATION SYSTEM AND REPORT

4.1 Background

At the begging of the JICA Project, there was no system of water quality information with neither DINAMA nor other organizations. Therefore, it was crucial to establish a water quality information system, which has three basic functions i) Water Quality Data/Information, ii) Filing of Data/Information and iii) Dissemination of Information.

Each role of the main problems and issues are as follows:

Water Quality Data/Information

- Water quality data of monitoring works is insufficient with items, period and monitoring points (locations)
- Classification of river sections in terms of water quality is not carried out for the rivers/creeks in the Project Area; therefore water quality standards of effluents of industry as well as discharges of sewerage treatment plant are not unified.
- No data/information of geographic condition, precipitation, river discharge, etc. are collected and filed, therefore study and analysis on water pollution may not be carried out.
- Prediction on water pollution in rivers/creeks and shore areas are not conducted, therefore neither prediction of water quality nor formulation of management plan could be made.

Filing of Data/Information

- Data/information of water quality monitoring works are not processed and filed in the definite format.
- Construction of a database has been separately undertaken by the respective organizations; therefore it would be difficult that the collected data/information be filed into an integrated data bank.
- The industry database accessible through the web is in operation since year 2000 providing the technical and administrative data of the industries. There is lack of database on water quality except EXCEL template database processed by the Department of Water Quality.

Dissemination of Information

- At present, no information dissemination is implemented for water quality by DINAMA, OSE or IMM, which has conducted water quality monitoring works.
- For the dissemination of water quality information, its objectives shall be clarified and a study for the target, methods, schedules and impact assessment shall be made for actual implementation.

The objective of Establishment of Water Quality Information System is to realize sharing and effective utilization of water quality data obtained in the ambient water quality monitoring.

Expected output is the following:

- Water Quality Information System is established
- Annual Report of Water Quality is published.
-

4.2 Needs of Capacity Development

The problems in water quality information were thoroughly analyzed from various aspects, comparing with the envisioned integrated Water Quality Information System (SISICA) ultimately to be attained in Uruguay.

Based on the above understandings, the needs of capacity development to improve Water Quality Information (SISICA) were identified as follows:

- Insufficient Water Quality Data Compilation

  In DINAMA, the water quality data are maintained personally, and not effectively utilized. Also, the water quality data is stored in access database internally in RENARE as well as MGAP. The water quality data is still not effectively used for the stakeholders in Uruguay.

  The main reason why there are very few technicians to design useful water quality information system and to maintain the system.

- Lack of Systematization of Filing of Water Quality Information.

  Water quality information is not systematized for filing, access nor disseminated by DINAMA and other organizations. The information is separately filed among the organizations related to water resources development and water works projects. In order to formulate and implement an integrated master plan of water quality management in the Project Area, information to be required includes, not only for water quality data themselves, but also geographic conditions, precipitation, water discharges of rivers and groundwater, sources of pollution loads, and pollution control facilities.

- Lack of Skills for Dissemination of Water Quality Information

  DINAMA would disseminate information to the public for their awareness of and participation in water quality management. With the existing and available information in the respective organizations, there are presently three methods for DINAMA to collect or exchange the information, as follows:

  - **Access to Open Information**: Even the information is limited, as filed into the web-site (home page) and the periodic publications (such as annual reports) of the respective organizations; those are easily accessed and collected.
  - **Request Basis**: Through an official channel, the request shall be made to acquire the necessary information.
  - **Through Project Implementation**: Joining in the same projects, the information required for project implementation is inevitably provided or exchanged.

4.3 Proposed Strategies and Actions

The approaches of the capacity development were thoroughly discussed and studied employing PCM method. Based on this, the plan of the capacity development for Establishment of Water Quality Information System was designed, thereby coming to series of "Output" and "Activities" required for attaining "Project Purpose".

JICA Project Team, as detailed in the Main Report, proposes the "Outputs" and "Activities" (which signify the "Strategies" and "Actions", respectively) for the capacity development in line with the identified needs. The proposed strategies and actions encompasses the development of the capacity of individual level, organizational level and society/institutional level, aiming at the strengthening of Information System and Annual Report until the year of 2013, as shown in **Table 4.3.1**.

Table 4.3.1 Poposed Strategies and Actions for Information System and Annual Report

Strategies (Outputs)	Actions (Activities)
Water Quality Information System (SISICA) is established. (Output 3.6)	1. DINAMA promote to develop SISICA in the relevant organizations (OSE, RENARE, IMM, IMC, IMSJ, IMF, IML) 1.a. EQED promotes to develop SISICA in IMM, OSE, RENARE, and assists the installation of the system. 1.b. DINAMA gives necessary training to IMC, IMSJ, IMF, and IML, as well as to promote imputing monitoring data to SISICA DINAMA through internet. 1.c DINAMA promotes to develop SISICA in the relevant organizations. 2. DINAMA establishes Integrated SISICA 3. DINAMA continues to manage Integrated SISICA. < Input > 1. Human resources of DINAMA (system engineers, etc.) 2. Human resources of the relevant organization.
Water quality data are properly evaluated (Output 3.7)	1. DINAMA process and interprets water quality data in a sustainable manner.
Water Quality Annual Report is published. (Output 3.8)	1. DINAMA annually publish Water Quality Annual Report, including water quality data in Santa Lucía Basin as Stage 1, and then the target area and contents will be expanded. 2. DIANAMA annually publish Water Quality Annual Report, interpreting and compiling diverse information like DINAMA's policy/strategies water quality data, and others.

4.4 Planed Activities and Achievement in JICA Project Period

Specific actions were designed to produce the respective Outputs. Among necessary actions proposed, some of actions have been already undertaken in the Pilot Project (April of 2004 to March of 2005) and the follow-up of Phase III (April of 2005 to March of 2006). Planned actions and major achievements during this period are described below:

(1) Establishment of Water Quality Information System (SISICA) (Output 3.6)

(a) DINAMA promote to develop SISICA in the relevant organizations

(OSE, RENARE, IMM, IMC, IMSJ, IMF, IML)

<Planned Action>

DINAMA and JICA Team jointly establish a computerized Water Quality Information System inside DINAMA considering the full use of the Internet environment for the use of various kinds of users. Relevant agencies will join to discussions held in technical committee level.

EQED of DINAMA promotes to develop SISICA in IMM, OSE, and RENARE as well as to assist the installation of the system. DINAMA gives necessary training to IMC, IMSJ, IMF, IMM, and IML.

<Achievement>

SISICA DINAMA has almost been completed and presented in the Seminar on December 1, 2005. The condition before the start of the Project was that DINAMA's historical water quality data is maintained personally and no other person could use them. The establishment of SISICA DINAMA provides a significant change in the system of ambient water quality management.

(2) Water Quality Data are properly evaluated (Output 3.7)

(a) DINAMA process and interprets water quality data in a sustainable manner.

<Planned Action>

ECD DINAMA will conduct technical trainings concerning water quality data evaluation and interpretation methods for basic water quality parameters for the staff of the relevant municipalities.

The chief of ECD DINAMA intend that JICA Project Team member could assist the training courses during the 7th fieldwork at Uruguay.

<Achievement>

Main technical staff of ECD DINAMA conducted technical trainings concerning water quality data evaluation and interpretation methods for basic water quality parameters for the staff of the relevant municipalities. The participants of the training could improve concerning the technical understanding for water quality evaluation methods.

(3) Water Quality Annual Report is published (Output 3.8)

(a) DINAMA annually publish Water Quality Annual Report, including water quality data in Santa Lucía Basin as Stage 1, and then the target area and contents will be expanded.

<Planned Action>

DINAMA staff prepare Water Quality Annual Report, which is based on the water quality monitoring data. The water quality monitoring and their analyses had been conducted the data sampling and analyses by DINAMA and the relevant municipalities in 2005.

<Achievement>

Water Quality Annual Report 2005 Provisional version (for Santa Lucía River Basin and a part of La Plata River Basin) was prepared by DINAMA under cooperation of the JICA Project Team on September 2006.

This provisional version of the Annual Report is the product as one of components of a comprehensive environmental report to be published by DINAMA. It is expected that DINAMA start the whole area of Uruguay as comprehensive Water Environment Annual Report.

(b) DIANAMA annually publish Water Quality Annual Report, interpreting and compiling diverse information like DINAMA's policy/strategies water quality data, and others.

<Planned Action>

DINAMA staff will prepare Water Quality Annual Report, which is based on the water quality monitoring data. The water quality monitoring and their analyses have been conducted by DINAMA and the relevant municipalities. And the target areas will be expanded to the whole Uruguay Region.

<Achievement>

DINAMA will prepare the plan for preparation of the Water Quality Annual Report based on the achievement of the provisional version of the year 2005.

4.5 Required Actions toward 2013

During the Pilot Project and the Phase III, the capacity of the SISICA has been developed and the SISICA has been utilized gradually among the relevant organizations.

However, the present SISICA still need the improvement of their functions. Also the operations of the SISICA could be more user friendly. Theses are mainly due to the following situations:

- DINAMA and the relevant municipalities are still suffering from insufficient human resources for supporting the users for technical supports of the SISICA and for disseminating the SISICA functions and their merits,
- DINAMA shall promote the use of the SISICA to the relevant organizations through the improvement and distribution of present users manual of the SISICA; and
- More collaborative information sharing mechanism among DINAMA and the relevant organizations shall be improved.

Major issues to be tackled by DINAMA and concerned units after the completion of the JICA Project are:

- DINAMA shall allocate the human resources such as system engineers for improving the SISICA
- DINAMA shall consider necessary computer equipment for expanding the coverage areas of the SISICA ultimately to the entire Uruguay country; and
- To maintain the sustainable strengthening of the capacity to support the incremental activities.

5. LABORATIORY MANAGEMENT AND SISILAB SYSTEM

5.1 Background

The laboratory management system is indispensable for producing the quality assured water quality monitoring data, however, the capacity development for the laboratory management system has not been highlighted despite the importance so far. Therefore, DINAMA requested to dispatch an expert specialized in the laboratory management fields.

In this chapter, activities regarding development of laboratory management conducted by the expert are mentioned.

5.2 Needs of Capacity Development for Laboratory Management

Laboratory service originally consists of measuring and analysis, however, the international standard, ISO/IEC 17025 recently established prescribes the requirements to assure the quality of tests and calibration results based on the whole laboratory management system as illustrated in **Figure 5.3.1**. To produce the quality assured mentoring data, the laboratory has to consider the whole laboratory management system including various sorts of procedures to cope with the request of clients. ISO/IEC 17025 prescribes such requirement for each item of procedure; however, it seems to be very ambitious to satisfy the entire requirement. Because such laboratory management includes not only the development of documentation system but also the actual analytical skill for achievement.

Under these circumstances, technical transfer on this fields were needed to develop the laboratory management system conducted by DINAMA Laboratory and local laboratories that are conducting periodical river water quality monitoring.

5.3 Activities regarding Technical Transfer on Laboratory Management

5.3.1 Presentation and Discussion of the Work Plan

In line with the project purposes, an expert in the laboratory management system was assigned and dispatched by GOJ to the DIMANA Laboratory to implement related activities. The work plan was presented to DIMANA Laboratory, and the work items, work schedule and methodology of the works were discussed. Since the agreement of both parties was required on the work plan. Further, after arriving the project site, through the discussion with the C/P necessary items for the relevant activities were identified.

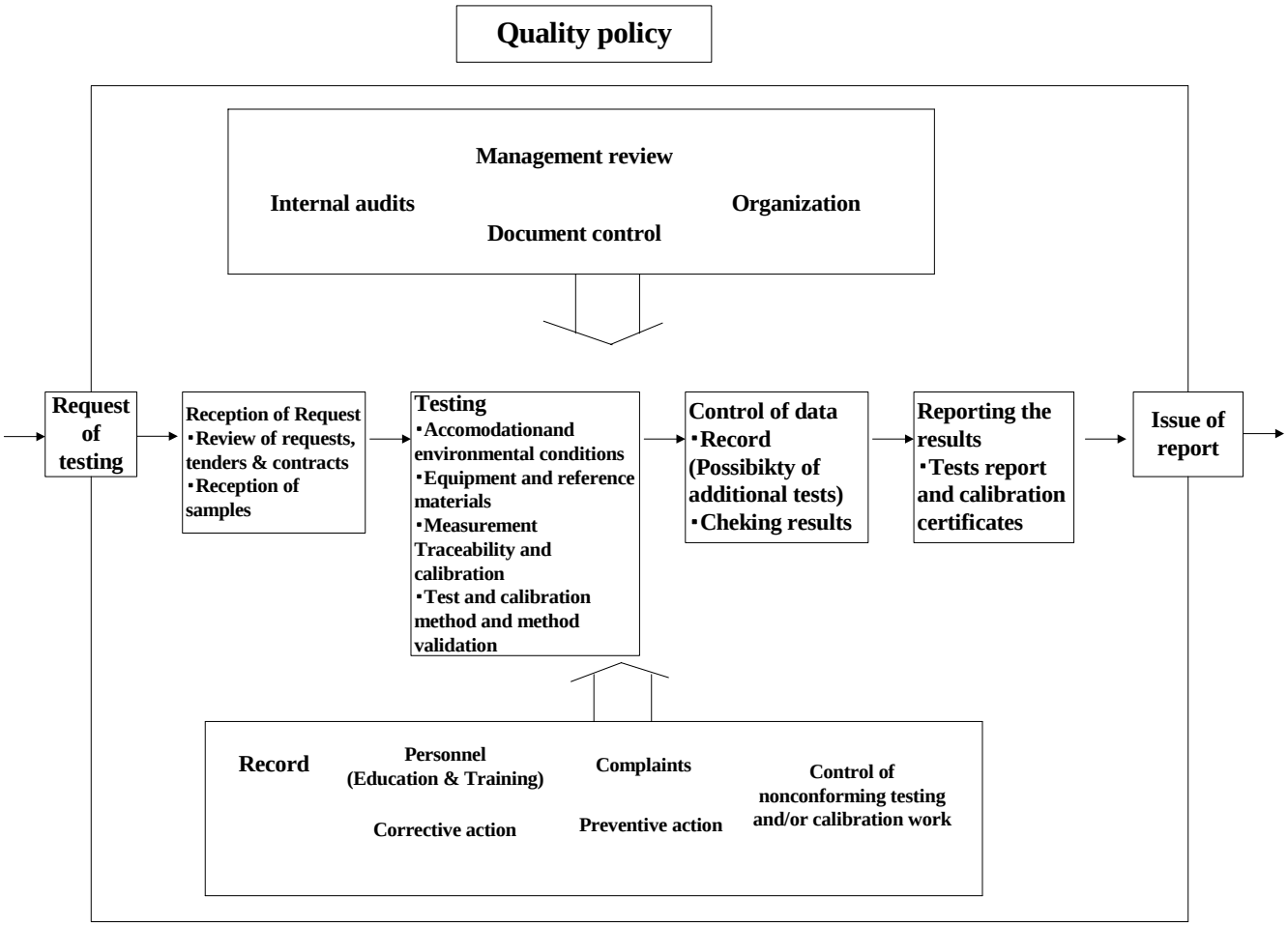

Figure 5.3.1 Element of Laboratory Service

5.3.2 Selected Items for Technical Transfer

The expert conducted tasks related to the activities and outcomes made by the expert, as follows:

(1) To provide guidance on QA/QC system of analytical data base on the Japanese case;

(2) To provide lecture on how to estimate the uncertainty of measurement;

(3) To provide guidance on preparation of the necessary information regarding accreditation of ISO/IEA 17025;

(4) To provide guidance on laboratory wastes management. and

(5) To provide guidance on the analytical key-points for the basic parameters.

The objective of the project (Dispatch of JICA Expert) was thus to reinforce the environmental management capabilities of DIAMANA Laboratory through the above-mentioned guidance.

5.3.3 Related Information & Data Collection

Related information & data, which are necessary for the laboratory management, was collected as follows:

(1) Existing Analytical Equipment

(2) O&M of Analytical Equipment

(3) Reference Manual for Basic Parameters

(4) Various Guidelines and Manuals

(5) Existing QA/QC System for Analytical Data

(6) Existing Lab. Wastes Treatment System

(7) Possible Parameters

5.3.4 Opening of the Workshop Regarding Project Achievement

Workshop titled "Outline of Laboratory Management System" on the whole activities and outcomes was scheduled for all C/P at 4th September 2006.

5.4 Technical Transfer on QA/QC System

5.4.1 Current Status on QA/QC System of DINAMA Laboratory

DINAMA Laboratory already prepared "Accuracy Control Manual for Analysis Data" in September 2004. Contents of the manual are shown below:

(1) Introduction

(2) Basic Concepts – Glossary of the terms and Definition

(3) Procedure for the Validation of the Technique

(4) Procedure to Control the Recovery Percentage

(5) Procedure for the Preparation of Control Solutions

(6) Table for the preparation of the control Solutions

(7) Procedure for the Determination of the Precision and The Control of Normalized Ranges

(8) Procedure for the Determination and Control of the Precision for BOD_5 Analysis

(9) Quality Control Procedure for Bacteriological Analysis with Filtering Membranes

(10) Control Cultures

(11) Procedure for the Control of Analysis Whites

(12) Procedure to determine the detection Limit and the Practical Quantification of the Method

(13) Quality Control Procedure for the Determination of the Acute Toxicity through the Microtox System

(14) Procedure to Check the Consistency of the Analytical results

Actual procedures for accuracy control of analytical data were implemented according to the above-mentioned manual.

5.4.2 Improvement of Accuracy Control System

(1) Implementation of Internal Presentation

Presentation titled "Outline of Accuracy Control System (QA/QC) for Environmental Monitoring Data in Japan" was implemented by the expert for all of the DINAMA Laboratory staff on 17-18th August 2006. Main purpose of this presentation is to introduce the accuracy control system as follows:

- General requirement for accuracy control system including precision control, accuracy control, management of detection limit control, proficiency test and error control management; and
- Evaluation on performance of analytical equipment and operation and maintenance including conditioning of analytical instruments, instrument detection limit (IDL) and method detection limit (MDL).

(2) Actual Technical Transfer

Based on the outcome of presentation, actual technical transfer on the accuracy control system necessary for development in DINAMA Laboratory was conducted for the selected items as follows: (i) how to consider the frequency of duplicates samples, (ii) allowable range of precision, (iii) utilization of coefficient of variation, (iv) practical use of x-R control chart, and so on. Among these items, frequency of duplicates samples are the most crucial point, because too many duplicates samples affect all the laboratory work with the limited manpower and glassware. DINAMA Laboratory conducts too many duplicates samples compared to the Japanese cases. For example, COD and SS tests are analyzed with duplicates at every sample, and BOD test is analyzed with duplicates at every three (3) samples. Contrary to the manner of DINAMA Laboratory, the manual prepared by Japanese Ministry of Environment recommends that recommendable frequency of double analysis be once per 10 samples regardless of parameters. Hence, it is possible to reconsider the frequency of the duplicates samples in DINAMA Laboratory for reducing workload.

5.5 Technical Transfer on Estimation of Uncertainty of Measurement

5.5.1 Background

Based on International Vocabulary of Basic and General Terms in Metrology, ISO, definition of the uncertainty; A parameter associated with the result of a measurement, that characterizes the description of the values that could reasonably be attributed to the measurand."

ISO/IEC Guide 25 prescribes in provision 10.2 as follows; "A calibration laboratory, or a testing laboratory, or a testing laboratory performing its own calibration, should have and shall apply a procedure to estimate the uncertainty of measurement for all calibrations and types of calibrations." Besides it prescribes in provision in 13.2 as follows; ", therefore, laboratories that intend to have an accreditation of ISO/IEC 17025 shall have own procedure to estimate the uncertainty of measurement. However, in certain cases the nature of the method may preclude rigorous, metro logically and statistically valid, calculation of uncertainty of measurement In these cases the laboratory shall at least attempt to identify all the components of uncertainty and make a reasonable estimation, and shall ensure that the form of reporting of the results dose not give a wrong impression of the uncertainty. Reasonable estimation should be based on knowledge on the performance of the method and on the measurement scope and shall make use of, for example, previous experience and validation data.

On the other hand, despite the participation of training course on the estimation of measurement held in foreign country, DINAMA Laboratory has not been officially estimated the uncertainty of measurement for the basic parameters so far.

Under theses circumstances, DINAMA Laboratory strongly requested JICA Study Team to give a technical transfer on how to estimate the uncertainty of measurement. In response to the request, the expert conducted the actual technical transfer on estimation of the uncertainty of measurement in DINAMA Laboratory.

5.5.2 Technical Guidance for Actual Estimation

(1) General Information on the Uncertainty of Measurement

To formulate the procedure regarding the estimation of the uncertainty of measurement, at first general information on the uncertainty of measurement was needed for the selected C/P of DINAMA Laboratory.

Therefore, technical guidance on general information on the uncertainty of measurement was conducted on 16th August 2006 using materials including following items: reason for calculation of uncertainty, meaning of uncertainty, uncertainty in the chemical analysis, procedures for estimation, and so on.

(2) Methods of Estimation

Estimation process of the uncertainty of measurement is shown in Fig. 5.2. All the estimation should be conducted through such process without any exception. Complexity of estimation varies depending on the number of uncertainty components to be considered.

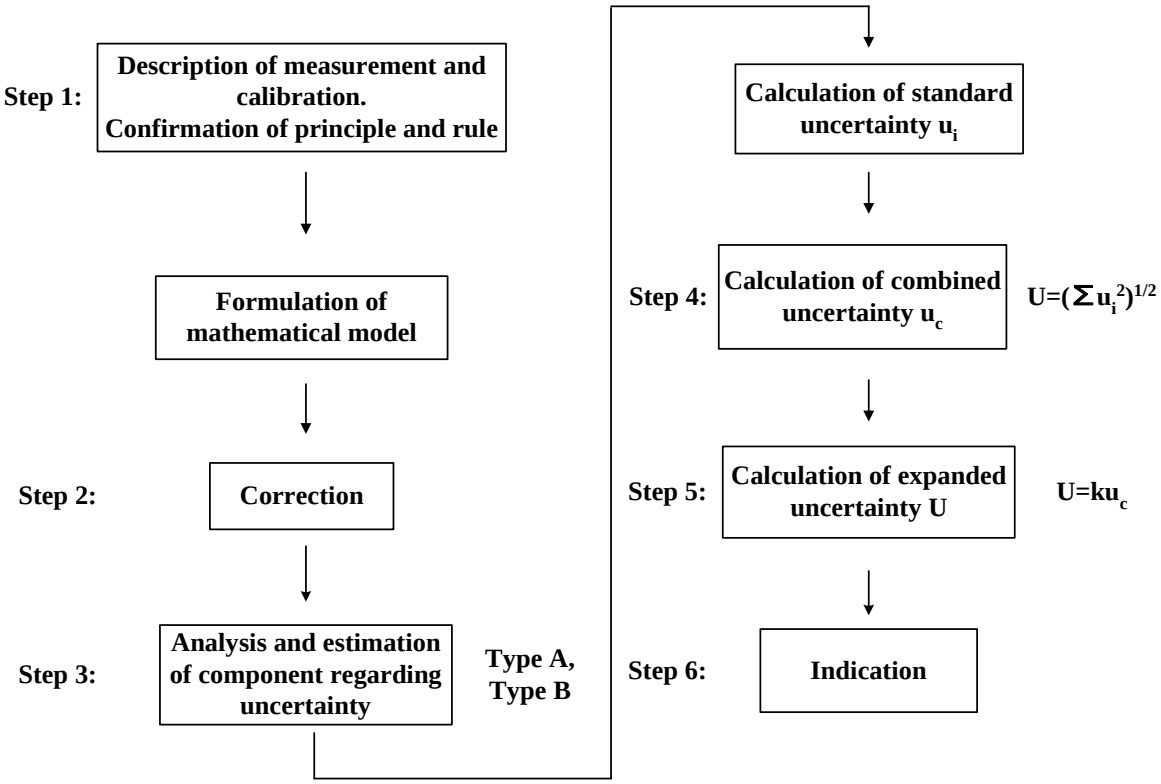

Figure 5.5.1 Estimation Process of Uncertainty of Measurement

To understand the methods of estimation, sequential technical guidance was conducted on 21th August 2006 using materials including actual process and methods of estimation. Selected parameters for instruction were pH and Electro-conductivity, since their procedures are rather simple and understandable. Calculation sheets of these selected parameters are attached in Annex.

(3) Selected Parameter to be estimated the Uncertainty of Measurement

Parameters to be selected were as follows: Suspended solid (SS), BOD, Coliform, Lead (Pb), T-Phosphorus, Sulfate (SO_4^{2-}), Nitrate & Sulfide. Among them, Lead (Pb) was selected to be estimated the uncertainty of measurement as the first priority.

(4) Actual Estimation of the Uncertainty of Measurement

Actual estimation of the uncertainty of measurement targeting Lead (Pb) was conducted in collaboration with both side through the following steps:

(a) Confirmation of the Analytical Method

Using standard operational procedure (SOPs), analytical method was confirmed, and each analytical process of Lead (Pb) was identified in the flow chart.

(b) Identification of Uncertainty Sources

Using fishbone diagram, uncertainty sources were identified.

(c) Quantification of Uncertainty Components

Among all of the uncertainty sources, significant uncertainty components were identified, and each uncertainty component was quantified.

(d) Calculation of Combined Uncertainty

Based on the results obtained in step (c), combined uncertainty and expanded uncertainty was estimated.

Through all the above-mentioned steps, uncertainty of measurement of lead (Pb) was estimated as shown in the calculation sheet attached in Annex.

(5) Establishment of Procedure

After calculation of uncertainty, it will be possible to apply another parameters in the same manner. To make formats for estimation of the uncertainty of measurement is very important. Because the process indispensable to achieve one of the important requirement for the competence of testing and calibration laboratories, as prescribed in ISO/IEC 17025.

Ordinally, frequency of such estimation of uncertainty of measurement is considered to be once at the preparation of procedure. However, periodical checking system is though to be necessary due to the change of uncertainty factors like change of laboratory staff, standard and equipment.

5.6 Development of Documentation System (SISILAB)

5.6.1 SISILAB Documentation System

(1) General

A documentation system named as SISILAB has been established for one of the laboratory management system.

SISILAB is a web system capable of managing the information that a laboratory handles. In particular, the system offers the possibility of managing the information regarding the record of acceptance of samples, as well as also the regarding the values calculated for the requested parameters. Also, it allows issuing reports of one or several samples, consultations related to receiving samples and analyses realized by the laboratory. Nowadays, the system covers various samples such as

water, soil, industries, solid industrial residues, filters of air, underground waters and effluent of industrial liquids.

(2) Function of the System

(a) Main User

This user is a potential analyst or member belonging to the laboratory. The principal and necessary characteristic of this user is to be suitable in the information regarding the laboratory management.

(b) Main Output

The user can try to realize records of acceptance of samples and then to associate the values calculated for parameters requested in the record. Based on this information, the user will be able to express reports corresponding to samples as well as also to realize consultations regarding the quantity of analysis and samples analyzed by the laboratory.

(3) System Processes

(a) Management of Record of Entry

This function allows registering the entry of a sample in laboratory. The screens of acceptance of the different counterfoils split basically into two field categories; general information and particular information. Inside the general information they are; the number of sample, date of acceptance, references, sampler, date of sampling, the point of sampling, phone, fax, etc. The information corresponds to field parameters associated with the type of sample and requested parameters. Therefore, to register a requested parameter what it is necessary to do is to mark the checkbox of the parameter.

(b) Parameter Management

After having realized the register of a certain sample, the system will allow to input the values of the parameters calculated for the sample as well as also the technique and the unit associated with the parameter. Also, there is offered to the user with problems of estimation, the possibility of indicating if the result of the analysis is equal, major or minor to the incomer value.

(c) Indication of Parameters

To realize the indication of the parameters corresponding to a sample it will have to enter value, techniques, and unit as it was explained in the previous process.

(d) Parameter Modification

To realize the modification of the parameters corresponding to a sample it will have to continue the same steps as for the indication.

(4) Reporting

The function of SISILAB can print out the report of one or several samples analyzed by the laboratory. One of the examples of the output sheet is shown in Annex.

On the other hand, the system offers the possibility of realizing consultations on quantity of analyzed samples as follows: (i) annual sample numbers, (ii) types of samples and so on.

(5) Information Transfer And Linkage with SISICA System

SISILAB system has automatic linkage with SISICA system. This function refers to the consistency of information between the databases of the projects SISILAB and SISICA. The idea is to realize the transfer of information corresponding to samples of soil and sediment deposited into the system SISILAB, towards the database of SISICA. To realize this the point of entry, it will have to select Communications **o**f the Principal Menu (**Figure 5.6.1**), then there will appear the different samples of soils and sediments that still have not been registered. It is necessary to point out that to do to the passage of information on effective form, it will have to enter for every sample, the number of sample of SISICA, which will have to be provided for a user of the above-mentioned system.

Figure 5.6.1 Linkage with SISICA System

5.6.2 Development of Documentation System

Based on the current performance of SISILAB documentation system, DINAMA Laboratory has intent to develop the documentation system of SISILAB as shown in **Figure 5.6.2**.

The SISILAB documentation system finally aims at not only data storage but also function of the laboratory management such as control of data and documentation control, it is necessary to consider additional functions into the current system of SISILAB. Because, current system only consists of functions regarding the data storage, simple analysis of data and providing analysis data to SISICA, additional functions to be considered are as follows:

- All the documentation control and queries systems are very useful for the laboratory management.
- Statistical estimation of analysis data is essential to cope with the requirement of ISO/IEC 17025. Hence such function should be included the system.
- Storage function for technical records such as analysis data and calibration data for equipment.

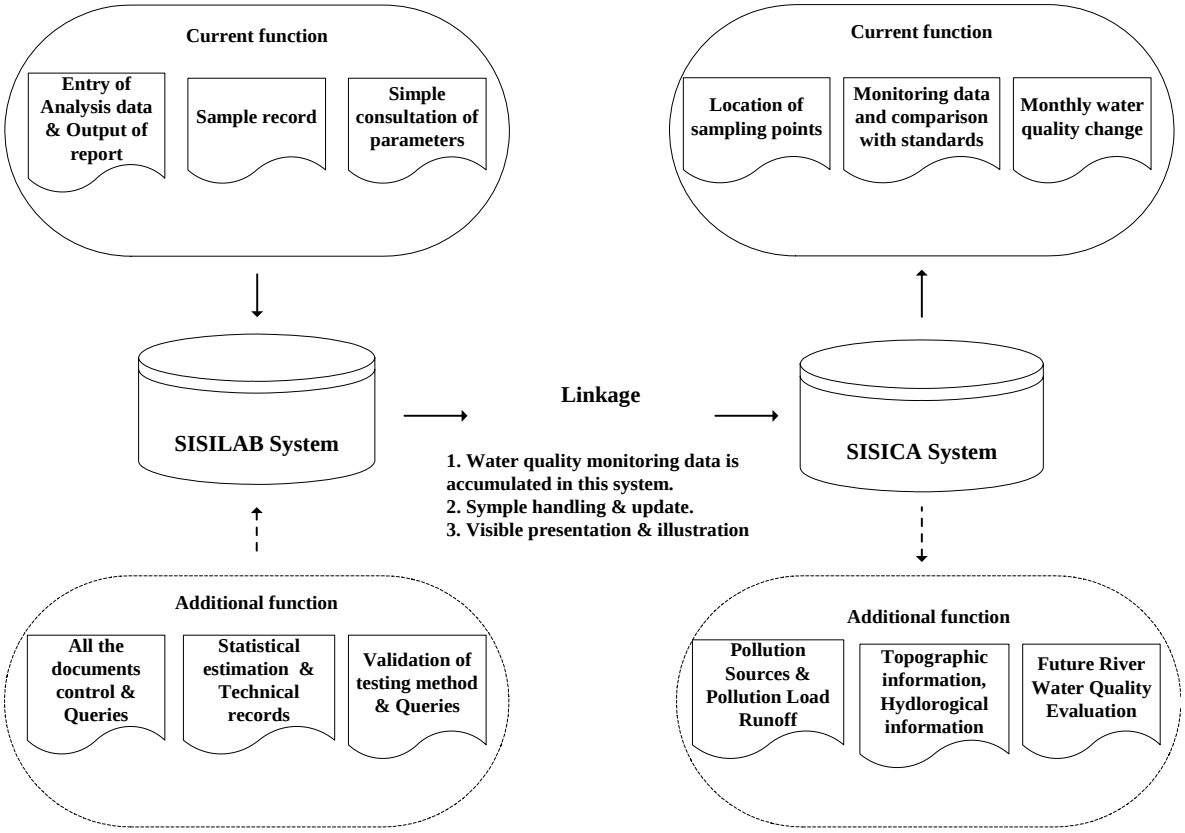

Figure 5.6.2 SISILAB & SISICA System

5.7 Preparation of Accreditation for ISO/IEC 17025

5.7.1 ISO/IEC 17025 Accreditation System

International Laboratory Accreditation Cooperation (ILAC) began work in the 1970s as an informal grouping of laboratory accreditation bodies and was formally established as an international body in 1996. ILAC has published a large number of guidance documents, including guidelines for the application of the international standard for laboratories, ISO/IEC 17025, and the international standard for laboratory accreditation bodies, ISO/IEC Guide 58 (to be replaced by ISO/IEC 17011). It also carries out activities to harmonize the work of different accreditation bodies. Mutual Recognition within ILAC goes back a long way, with the first bilateral agreement being signed in 1979. More recently, ILAC members have established regional and multilateral Mutual Recognition Arrangements. In 2000, the general meeting of ILAC, held in Washington, D.C., USA, agreed to the "ILAC Arrangement". Under this Arrangement, ILAC members agree to: 1 mutually recognize that the accreditation results of individual testing laboratories and calibration laboratories are equivalent; and 2 mutually accept the testing/calibration certificates issued by individual testing laboratories and calibration laboratories accredited by individual accreditation bodies.

ILAC groups accreditation bodies from four regions: Europe - European cooperation for Accreditation (EA); Asia/Pacific – Asia Pacific Laboratory Accreditation Cooperation (APLAC); Latin America - Inter-American Accreditation Cooperation (IAAC) and Southern Africa - Southern African Development Cooperation for Accreditation (SADCA). ILAC aims to enhance the quality of the mutual recognition among the groups of regional accreditation bodies through peer evaluation. Thanks to this ILAC Arrangement, mutual recognition that used to be contained within each regional laboratory accreditation cooperation grouping is now able to develop into a global mutual recognition arrangement, and the test and calibration certificates issued by accredited laboratories are mutually accepted by accreditation bodies throughout the world. The approach to international mutual recognition put into practice by these groupings of accreditation bodies is a major step towards the objective of "one stop testing, accepted worldwide". In the area of laboratory accreditation especially, it is a mechanism by which data obtained by an accredited laboratory are accepted and used in different countries as if they were their own. If this system becomes prevalent worldwide, it will rationalize the testing processes that used to be duplicated multiple times in international transactions. It will enable traders to enjoy many benefits, such as saving costs and cutting lead times for product to in the market.

5.7.2 Current Status on Accreditation System in Uruguay

In Uruguay, Uruguayan Organization of Accreditation (OUA) gives accreditation of ISO/IEC 17025 to the testing and calibration laboratories. In Uruguay, the accreditation activities started with the creation of so-called " Quality System of Uruguay". **SUANCCE** (Uruguayan System of Accreditation, Normalization, Certification, Calibration and Essays), created by the 285 Decree of Executive Power in August 13, 1997. Its intention, to guarantee that the activities of evaluation carried out by national institutions apply to the requirements of the international norms. He recognizes an

Organism of Normalization (Uruguayan Institute of Technical Norms - UNIT) and an Organism of Accreditation.

The accreditation consists of evaluating the technical competition of organizations dedicated to tasks of evaluation of the conformity: organisms of system certification, organisms of certification of products, organisms of examination and laboratories of essay or calibration.

(1) Activities

In the accreditation system of OUA includes following sectors of the national activity:

- Productive Sector
- University Sector
- Scientific-Technical Sector
- Consumer Sector
- Sector of Interest in Management of the Quality

According to the decree of creation of the SUANCCE and its own articles of association, the OUA is enabled for the accreditation of:

- Organisms of System Certification (Quality, Environmental Management and others).
- Organisms of certification of products, services and processes.
- Laboratories of essays and of calibration.

(2) Accredited Laboratories in Uruguay

Currently, OUA has already accredited totally 10 laboratories as follows: 3 organisms of certification of quality systems, 2 organizations of certification of products, 4 test laboratories and 1 laboratory of calibration, among which one (1) laboratory has three (3) kinds of categories of accreditation. Laboratories already accredited are as shown in **Table 5.7.1**.

Table 5.7.1 Accredited Laboratories in Uruguay

Category	Name of Laboratory
Quality	1. INSTITUTO URUGUAYO DE NORMAS TECNICAS (UNIT)
	2. LATU SISTEMAS S.A
	3. SGS URUGUAY LTDA
	4. ONALSY SA-CAB
Environment	5. LATU SISTEMAS. SA..
Products	6. LATU SISTEMAS. SA.
	7.INSTITUTO NACIONAL DE CARNES (INAC)
Testing	9.ECOTECH-ING QCO GUALBERTO TRELLES
	10.LABORATORIO DE BEDIDAS Y ALCOHOLES ANCAP
	11. MICROBIOTICOS ANALISIS LTDA
	12. ZENG LABORATORIO MICROBIOLOGICO.

Most of them are private and might be advanced and well-managed laboratories.

OUA, also it offers training in the subject matter of accreditation in the shape of courses and workshops. At present it is provided with 26 active associates, between them non-profit associations, cameras, public and private universities, companies and both public and private laboratories

5.7.3 Necessary Procedure to be Prepared

Procedure for laboratory accreditation is usually explained in the flow chart shown in Fig.5.5. Further, OUA recommends laboratories to refer following standards for application of accreditation: the regulation (QUADOC005), the procedure of the OUA (QUAPRO002) and the additional criteria established by the OUA (OUADOC014). Then will present the request of accreditation to the OUA in the form (QUAIMP002), enclosing the requested papers and specifying the scope of the requested accreditation.

Also the laboratory of calibration will have to know the regulation (QUADOC005), the procedure of the OUA (OUAPRO002) and the additional criteria established by the OUA

(OUADOC014). Then it must present the request of accreditation to the OUA in the form (OUAIMPO014) enclosing the requested papers and specifying the scope of the requested accreditation.

The organism of certification of quality systems and products will have to know the regulation (QUADOC010), the procedure of the OUA (OUAPRO004) and present the request of accreditation to the OUA in the form (OUAIMP009).

(1) Application of Accreditation

Usually, when the laboratory inquires the accreditation body of application of the assessment on the competence, various services including consultation of necessary procedure and fulfillment for accreditation, can be obtained from relevant accreditation body. First reply for the inquiry is to send the applicant the necessary documents for application such as rules regarding regulation of the accreditation body, general requirement and specific requirement, check list, information on the relevant proficiency test, guide on establishment of quality system, accounting system, information on training course, and other related brochures. Therefore, it is recommendable to inquire the accreditation body of the application, and to ask the necessary consultation for accreditation.

(2) Check List

Check list used for the pre-assessment mainly consists of following items, (i) conformity with the general requirement, (ii) specific information on applicant (Laboratory) and (iii) information on the testing method of target parameters of applicant (Laboratory), as shown in Annex. These check lists are used for the advance self-diagnosis on the conformity and more detail information for the checklist used at the on-site assessment. Therefore, applicant has to preliminary check the conformity tabulated in the list.

It is ideal that all the check for conformity with the requirement prescribed in ISO/IEC 17025 is conducted prior to the application of accreditation, however, the realistic procedure for checking is usually taken step-by-step according to the stage of the application in collaboration with the accreditation body. Especially, actual conformity can be checked under not only the documentation review but also the on-site assessment.

(3) Implementation of Proficiency Test for Accreditation

Under the rapid globalization of international trade and scholarly research, it is required that analysis results obtained from the laboratory should be available with quality assurance anywhere in the world. To cope with these circumstances, analysis results should be compared to other laboratories, and its difference of the results should be investigated as well as the usage of the authorized analytical method and the establishment of the internal quality assurance system.

Thus, application of the proficiency test has become indispensable to obtain the accreditation of ISO/IEC 17025 standard. Recently, implementation of the proficiency test complied with ISO/IEC Guide 43-1 has globally become common as well as the accreditation of ISO/IEC 17025. **Table 5.7.2** shows the example of the global organizations that conduct the proficiency test.

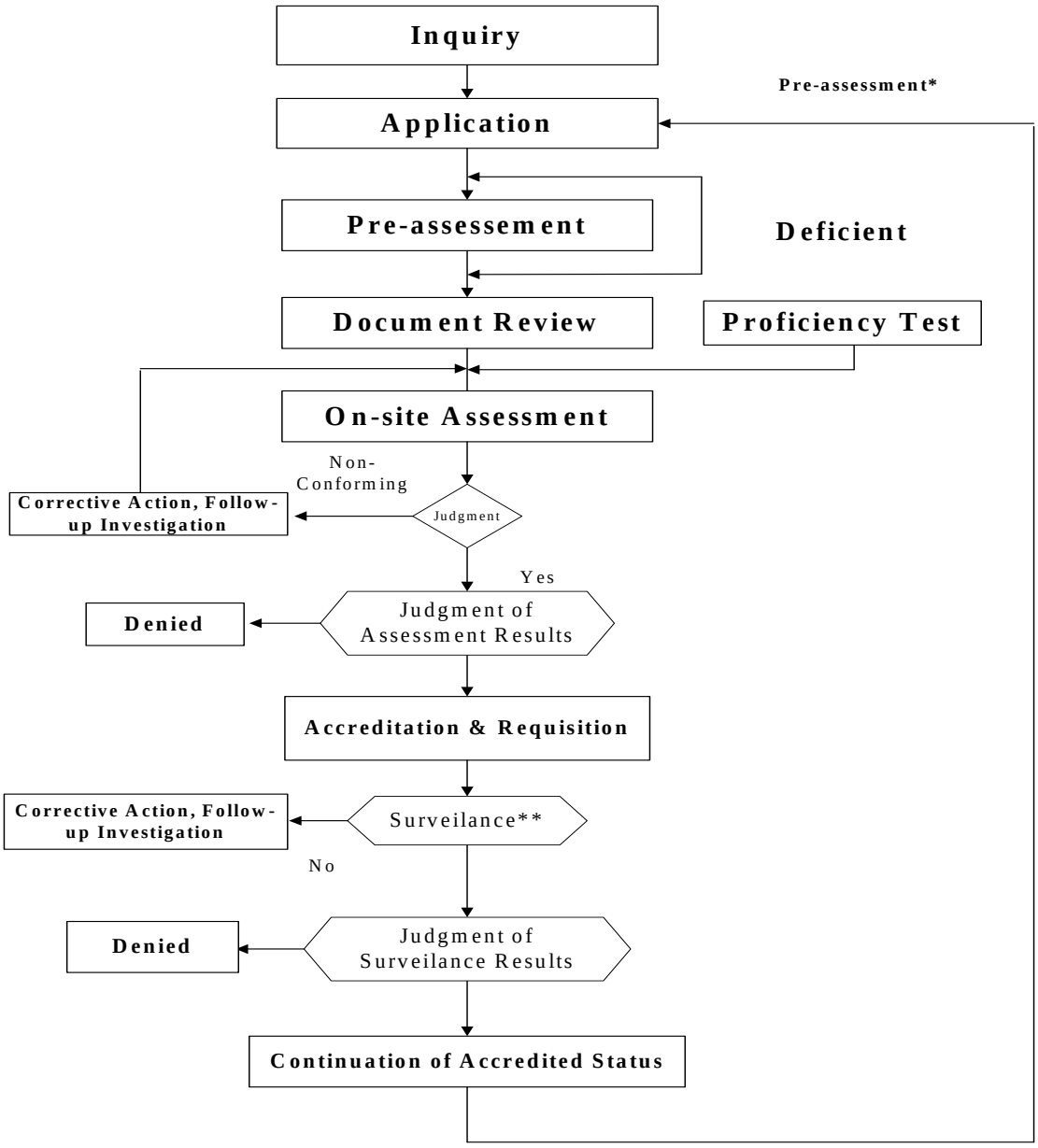

Figure 5.7.1 Flow of Laboratory Accreditation

(4) Documentary Review

Before on-site assessment, documents including mainly quality manual and SOPs for targeting parameters should be submitted to the accreditation body from the laboratory. These documents include various points already mutually confirmed at the pre-assessment. The quality manual is evaluated whether it conforms the demands postulated to the requirement of accreditation body,

On the other hand, SOPs are checked the correspondence with the standard method, if a obvious contradiction is found, investigation for contradiction should be required before the on-site assessment. The results on this documentation review will be the main checkpoints for the on-site assessment.

Table 5.7.2 Proficiency Test conducted by Global Organization

Organization	Target Parameters	Method	Frequency of Test
APLAC	Heavy metals, foods, textile, concrete	ISO/IEC Guide 43-1	Ad libitum
NATA	-Ditto-	-Ditto-	Once – twice a year
IIS	Chemical products, oil products	-Ditto-	-Ditto-
CTS	Metal, slide fastener	-Ditto-	Every two (2) years
ASTEM	Metal	-Ditto-	-Ditto-
CNLA	Metal, slide fastener	-Ditto-	-Ditto-

5.7.4 Activities for Acceleration of Preparation of Application

Preparing the quality manual, DINAMA Laboratory is currently in preparatory stage in order to obtain accreditation of ISO/IEC 17025 for 7 parameters (BOD, COD, Cr, Pb, SS, total coliform and fecal coliform)). Main contents of prepared quality manual are shown in **Table 5.7.3**.

Table 5.7.3 Contents of Quality Manual in DINAMA Laboratory

Chapter	Section
1. Purpose and Scope of Manual	1.1 Purpose, 1.2 Scope of the System, 1.3 Regulatory Reference, 1.4 Management Requirement.
2. Structure of the Documentation	2.1 Quality Manual Management, 2.2 Document Control, 2.3 Controls of Entries, Structure of the Documentation.
3. Structure of the Management System	3.1.Review of requests, agreements and contracts, 3.2 Subcontracting of testing and calibrations, 3.3 Purchases of Services and Supplies, 3.4 Customer Services, 3.5 Feedback from Customers, 3.6 Non-compliance control, 3.7 Corrective Actions, Preventive Actions, 3.8 Preventive Actions, 3.9 Internal Audits, 3.10 Revisions by the Direction, 3.11 Responsibility of the Direction, 3.12 Process Follow-up and Measurement, 3.13 Data Analysis
4. Technical Requirements	4.1 General Aspects, 4.2 Planning of the Product Execution, 4.3 Process related to Customers, 4.4 Laboratory developed methods, 4.5 Service provision
5. Resource Management	5.1 Resource Provision, 5.2 Personnel, 5.3 Accommodation and Environmental Condition, 5.4 Testing method and method validation, 5.5 Equipment, 5.6 Measurement Traceability, 5.7 Sampling, 5.8 Sample Handling, 5.9 Assurance of the Test Results Quality, 5.10 Report on the results
6. Approval and Register of Reviews	

As seen in the quality manual, almost all of the contents were prepared for satisfying the requirement prescribed in ISO/IEC 17025.

Based on the contents of the manual, technical guidance on preparation of application regarding accreditation of ISO/IEC 17025 using the checklist for requirement

prescribed in the Norm. To cope with the satisfactory level of judgment of assessment, it is essential to confirm the validity by clause-by-clause reviewing.

After conducting the guidance, mutual checking the contents and profound discussion, following items were pointed out for development of the quality manual:

(1) Procedure for Estimation of the Uncertainty of Measurement

In the quality manual, procedure for estimation of the uncertainty of measurement that is indispensable for the requirement prescribed in ISO/IEA 17025 is not mentioned. Hence, it must be prepared based on the technical transfer on the actual estimation of the uncertainty of measurement.

(2) Necessary Measures for Preventing Contamination

Norm 5.3.2 prescribes that there shall be effective separation between neighboring areas in which there are incompatible activities, and measures shall be taken to prevent cross-contamination. Based on the current usage condition and prepared quality manual, such measures are considered to be necessary.

(3) Necessary Measures for Preventing Data Missing

Norm prescribes the necessity of prevention of data missing as follows:

- The laboratory shall have policies and procedures to ensure the protection of its client's confidential information and proprietary rights, including procedure for protecting the electronic storage and transmission of results (Norm 4.1.5 c).
- The laboratory shall have procedures to protect and back-up records stored electronically and prevent unauthorized access to or amendment of theses records (Norm 4.12.1.4).
- The laboratory shall ensure that procedures are established and implemented for protecting the data; such procedures shall include, but not be limited to, integrity and confidentiality of data entry or collection, data storage, data transmission and data processing (Norm 5.4.7.2.b).

Under this requirement, DINAMA Laboratory has experience of data missing due to the computer treble caused by the computer virus. Therefore, such measures for preventing data missing should be deliberatively taken and mentioned in the quality manual.

(4) Necessary Policy and Procedure for Education and Training

Norm 5.2.2 prescribes that the management of the laboratory shall formulate the goals with respect to the education, training and skills of the laboratory personnel. However, such contents regarding necessary policy and procedure are not included in the quality manual prepared by DINAMA Laboratory. To develop the contents of the quality manual, it is recommendable to add it.

(5) Application of Proficiency Test for Accreditation

DIMANA Laboratory has not applied the proficiency test conducted by external authorized organization; therefore application should be considered for accreditation. Moreover, such measures for participation of the proficiency test conducted by external organization should be included in the quality manual (Norm 5.4.5 and 5.6.2).

(6) Others

It is recommendable to add the definition of terms in the Chapter I of the quality manual due to absence of the description.

5.8 Current Status on Local Laboratories

5.8.1 Workshop for Local Laboratory Staff

Workshop titled "Outline of Laboratory Management System" was held on 4th September 2006 for providing the technical knowledge on basic accuracy control system, laboratory wastes management and analytical key-points for the basic parameters. Question and interests raised by attendants, and the fact identified in the course of workshop were as follows:

(1) Laboratory wastes generated from chemical analysis has been stored and subcontracted to outside companies. All of the local environmental laboratories as well as DINAMA Laboratory do not manage wastes treatment by themselves.
(2) Items including presentation included very basic and general point of views for the laboratory management; some of attendants needed more detail information for deep understanding.

5.8.2 Environmental Monitoring conducted by Local Laboratories

Compared to the DINAMA Laboratory, many of local laboratories operated by municipalities are facing to the difficulty of routine monitoring activities due to the shortage of the laboratory staff and equipment used as shown in **Table 5.8.1**.

Also individual capacity of staff engaged in water quality monitoring and know-how for laboratory management appears to be limited since they have not been well trained and facing to the lack of actual experience. Therefore, aforementioned workshop is thought to be one of the effective opportunities to obtain the information on the laboratory management. However, continuous technology transfer on the laboratory management including accuracy control system for monitoring data is important for improving the accuracy of the analysis data.

Table 5.8.1 Current Status on Local Laboratory

Municipal Name	Staff Number	Coverage Parameters	Main Equipment
Montevideo	20	Heavy metals, coliform and physical/chemical analysis	AAS, spectrophotometer, Incubator, etc
Canelones	5	pH, DO, BOD and coliform	pH meter, incubator etc.
San Jose	3	Coliform	Incubator
Florida	4	pH, coliform, and physical/chemical analysis	pH meter Incubator, Autoclave, Sterilizer, Conductivity meter, Portable –spectrophotometer, etc.
Lavajjeja	3	pH and coliform	pH meter and Incubator

DINAMA Laboratory conducted the internal proficiency test directed to the local laboratories in 2004 and 2005 totally two (2) times so far. Moreover, the proficiency test will be planed to resume the end of 2006. In the course of the implementation of the proficiency test, issues regarding accuracy and precision can be extracted and pointed out to the local laboratories.

5.8.3 Current Issues regarding Local Laboratories

Site visit was conducted to confirm the current status on the local laboratories as follows: (i) selected local laboratories are Lavalleja, Florida and Canelones, (ii) purpose of filed visit is to comprehend the current status of local laboratory, to discuss the current problems on the laboratory management and to give suggestions to the local laboratory staff. Table 5.6 shows the results of site visit including laboratory- by-laboratory overall evaluation.

Based on the results of site visit, current issues regarding local laboratories are as follows:

- Total working period of laboratory staff is very short-lived, therefore, perpetual education and training are necessary to keep the performance of laboratory.
- Computer system used for the analysis control of the equipment often breaks down. And then relevant equipment becomes inoperative.
- Some of the laboratories have not conducted duplicates analysis, hence, it is recommendable to reconsider the duplicates analysis.
- Some of the laboratories do not prepare the standard weight for microbalance. Hence, it is recommendable to calibrate the microbalance using the standard weight.
- Some of the laboratories do not have purification device of water and purchase the commercial distillated water that is not available quality assurance. To prepare the standard solution, it is necessary to use the quality assured pure water.
- In case of BOD analysis, very low concentration of initial DO is sometimes found based on the calculation sheet. Hence, it is necessary to check the analytical method of BOD.

5.9 Recommendations

Under aforementioned circumstances, in order to develop the laboratory management, it is recommended as follows:

(1) To prepare the necessary procedures for estimation of uncertainty of measurement, it is required to prepare the format for calculation of the uncertainty.
(2) Before the actual estimation of the uncertainty of measurement, it is essential to prepare the flow chart of analytical process for easy understanding.
(3) To estimate the uncertainty of measurement, it is necessary to extract all of the uncertainty sources.
(4) Function of the current SISILAB system is limited for entry of analysis data and simple consultation of samples and linkage with SISICA system. Therefore, to develop the laboratory management system, it is recommendable to reinforce the system by adding the documents control, statistical analysis and so on.
(5) Long-term O&M management is recommended for the sound administration the environmental laboratory. Especially, repairing and renewal of the equipment is very costly, therefore it is very much related to the annual budget allocation and disbursement and strategic plan for improvement of working condition of the equipment is indispensable.
(6) Based on the SISICA spreadsheet in which all the analysis data are tabulated, description method for analysis data seems to be incomplete since the effective digit and under decimal point are lacking in unity. Therefore, it is recommendable to establish the description method. Such difference of description method is seen in Table 5.6.
(7) Similarly, values of the reportable limit of various parameters tabulated in the SISICA spread sheet are considered to be very different from the Japanese cases as follows:
   (a) The values of grease and oil in the spreadsheet are very high compared to the values of total volatile solid. Hence, it is necessary to check the reasons. And its method seems to be unsuitable for analyzing the river water; hence, it is necessary to reconsider the propriety of adopted method.
   (b) Reportable lower limit of DO, BOD and COD is very high compared to the Japanese cases. Moreover, reportable interval is also very high in BOD and COD, and its value is 10. To implement the effective river water quality monitoring, it is essential to indicate more minute values. Otherwise, it is very difficult to depict distinct longitudinal and seasonal changes used for the river water quality management.
(8) Based on the collected quality manual and accuracy control manual prepared by DINAMA Laboratory, almost all of the necessary items for the laborite management have been already included in these manuals. However, to completely satisfy the requirement prescribed in ISO/IEC 17025, some preparation of documentation is needed as mentioned in the previous Chapter.

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