<Appendix> Explanation of the Environmental Information Map on Guanabara Bay and its Basin

1. Reasons for making the Environmental Information Map

"Environmental Information Map on Guanabara Bay and its Basin" contains various information collected in "The Study on Recuperation of the Guanabara Bay Ecosystem" in which the State Government of Rio de Janeiro requested technical and financial cooperation to the Government of Japan. This map intends to be utilized as a basis for the state government to plan and promote the project to improve the environment of the bay and to help the residents to understand the current state of the bay.

The information contained on this map will not always be up to date. Therefore, the contents should be updated and improved on at regular periods by such organizations as "The Guanabara Bay Basin Managing Committee" which is to be established in the future.

2. Climatic Conditions (front, upper left)

This figure shows the annual isothermal lines and annual isohyet lines, the data was prepared by SARSAN, the predecessor of CEDAE. Though the data is old, it represents the characteristics of the climatic conditions of the basin.

The graph on the right shows the monthly average temperature and precipitation in Rio de Janeiro City and the monthly precipitation during the study period (from April 1992 to March 1993) observed at PETROBRAS, Duque de Caxias.

It is possible that the discharge and water-quality of the rivers and the flow regime and water quality of the bay during the study period differ from those in a normal year since the precipitation pattern during the study period differed considerably from normal. Consequently, the monitoring on the rivers and the bay should be continued to accumulate data usable for design purposes.

3. Present Land Use (front, center)

On this map, topography, basin boundaries, administrative boundaries, special areas, main roads and other information is shown in addition to the present land use.

Topographical information is taken from the topographical maps of scale 1:50,000 covering the basin (published between 1962 and 1986). The contour lines on this map are drawn at 100 m intervals, and with 50 m intervals on the flatter areas. The major rivers, the boundaries and numbered sub-basins are also shown.

Of the information on land use, the distribution of urban area, grassland or farmland, mangrove area, forest, swamp and bareland is based on the result of the image analysis of LANDSAT-TM data taken on Nov. 26, 1991. There are many areas where the land use categories on this map differ from its actual state, as a comprehensive ground survey had not yet been carried out.

The distribution of the slums (favelas) is based on data obtained from IPLANRIO (Planning Institute of Rio de Janeiro Municipality) and shows the situation in 1991. The industrial zones were taken from topographical maps of scale 1:50,000. The distribution of the industrial zones on this map may be different from the actual state since the topographical maps are old.

The limits of the special areas (national parks, biological preservation areas and environmental protection areas) were drawn by referring to a map of scale 1:400,000 published by IEF (State Institute of Forest) in 1991.

The contour lines in the sea were drawn referring to a chart (No.1501) published in 1992. Features along the coast and the distribution of tidelands were also shown based on this chart.

4. Area and Population of the Municipalities within the Guanabara Bay Basin (front, lower right)

The table on the right shows the area, population and population density of the twelve municipalities within the Guanabara Bay basin calculated from the 1991 Census by IBGE (Federal Bureau of Statistics).

In the 1991 Census, the population of each municipality is shown according to urban and rural areas. It is desirable to calculate the population in each sub-basin with high accuracy using the data by sector.

The figure on the left shows the limits of the twelve municipalities with the sub-basin boundaries. Great differences in the population density were found among three districts; Eastern district (pink), Western district (green) and Northeastern district (yellow).

5. Observation and Sampling Stations in the Study from 1992 to 1993 (back, upper left)

The information necessary for preparation of the Master Plan was collected during three field surveys: Phase 1 (from March to June, 1992), Phase 2 (from October to December, 1992), Phase 3 (from March to May, 1993).

On this map, the observation and sampling stations used to obtain the data for discharge and water quality of the rivers, tides, tidal current, water quality and aquatic life in the bay are shown. The environment of the rivers and the bay should be monitored continuously, and it is desirable to select the monitoring stations from these points shown here.

6. Main Point Pollution Sources and Water Quality Classification of the Rivers (back side, upper right)

This map shows the distribution of the main point pollution sources in the basin. The areas where the domestic pollution sources are densely gathered are represented by urban areas. The industrial pollution sources are factories with large effluent loads and have been monitored by FEEMA/DCON since 1993. They are classified into nine categories; food, beverage, paper, chemicals, plastics, pharmaceutical, textile, mechinery and others. The sewage treatment plants and the solid waste disposal sites are also shown as influential pollution sources.

The major rivers in the basin were classified into four groups according to average water quality (BOD) on clear days measured from 1992 to 1993. The distribution of the point pollution

sources is concordant with the water quality class of the rivers.

7. Current Use of the Beaches and the Water Areas in Guanabara Bay (back, lower left)

This map is largely based on a chart (No.1501) published in 1992 and shows the current use of the beaches and the water areas of Guanabara Bay. however, some of the fishing ports and sea-bathing beaches on this map are presently not utilized because of the deterioration of water quality in the bay.

The areas reclaimed since 1962 are also shown on this map. In particular, large scale reclamation has been carried out on the west side of Governador Island and around Fundao Island. The flow regime changed due to reclamation and water quality deterioration followed.

8. Water Quality in the Bay on Nov. 10, 1992 (back, lower center)

This map shows transparency, dissolved oxygen concentration in the bottom layer, COD (Mn) and T-P concentrations at the surface and the number of Fecal Coliform; this is part of the data obtained from the simultaneous observations conducted in the ebb tide period on Nov. 10, 1992 (spring tide period).

The runoff load through the rivers increases in the wet season, and water quality in the bay is worse in the ebb tide period than flood tide period because the pollutants from the rivers diffuse over the whole bay. Consequently, this map represents the period when water quality is worst. Transparency is less than 2 m even near the mouth of the bay due to a large quantity of phytoplankton and DO is almost zero in the bottom layer in the inner bay area.

9. Bottom Material and Benthos in the Bay (back, lower right)

The distribution of the bottom material in the bay shown on this map was drawn referring to a thesis by E.S. Amador (1986), a chart (No.1501) published in 1992 and acoustic profiles obtained in this study. Species and numbers of benthos were classified according

to samples collected in October, 1992. Attention should be paid to the fact that benthos were not found in the inner bay area.

ENVIRONMENTAL INFORMATION MAP
ON
GUANABARA BAY AND ITS BASIN

MAPA DE INFORMACAO AMBIENTAL
DA
BAIA DE GUANABARA E SUA BACIA FORMADORA

1994

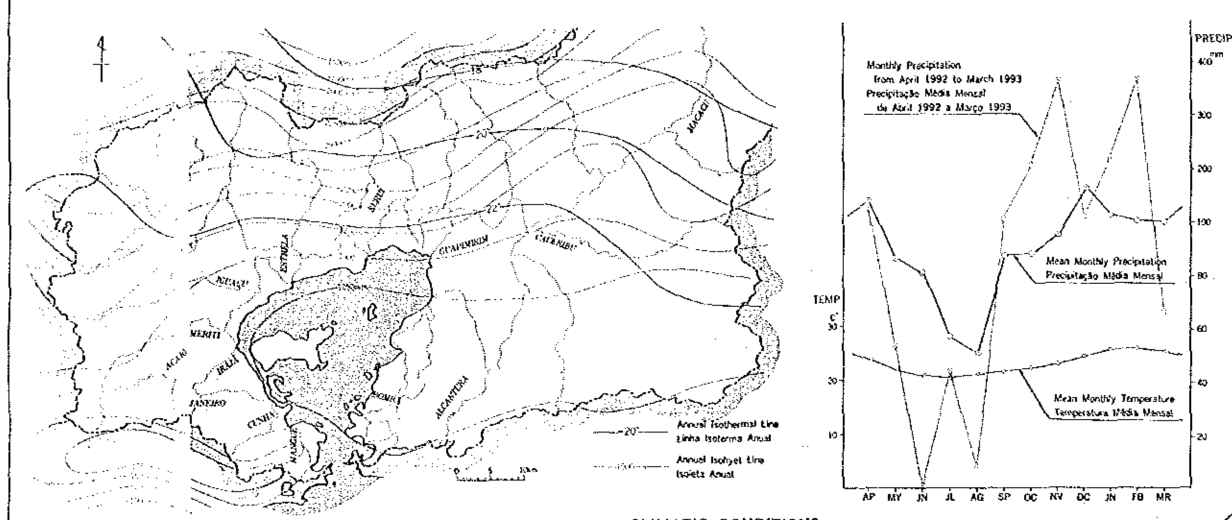
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
KOKUSAI KOGYO CO., LTD. (Consulting Engineers & Surveyors)

ENVIRONMENTAL INFORMATION MAP ON GUANABARA BAY AND ITS BASIN

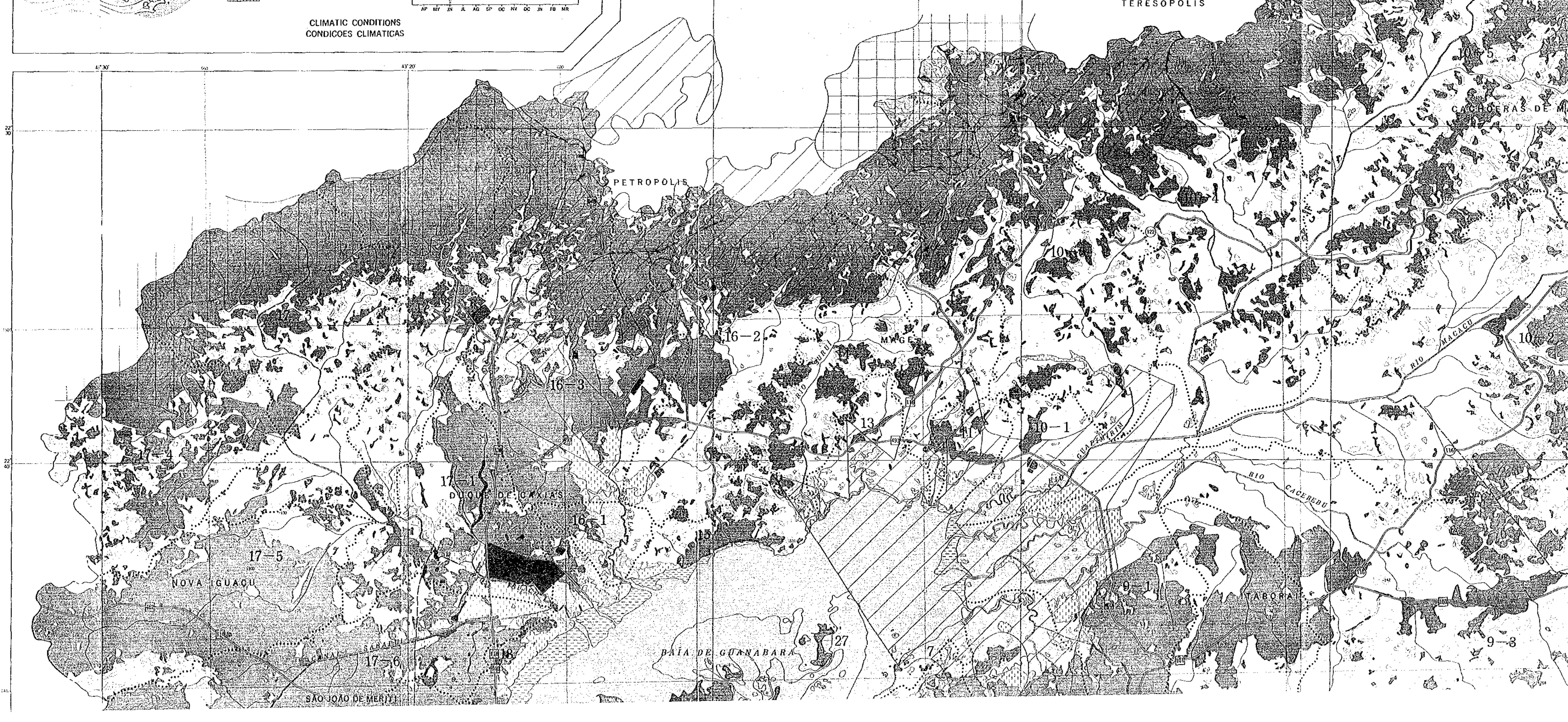
MAPA DE INFORMAÇÃO AMBIENTAL DA BAIA DE GUANABARA E SUA BACIA FORMADORA

The extension of the urban area, decreasing forests and other phenomena accompanied with the development have progressed in the Guanabara Bay Basin during the last half of the 20th century.
Due to the resulting increase in the generation and discharge of pollutants coupled with a delay in the improvement of sanitation facilities, the quality of water and sediments in the rivers and the Bay have deteriorated. The ecosystem of the Bay has also changed remarkably hindering the utilization of the water body.
Therefore, the State Government of Rio de Janeiro requested technical and financial cooperation in making a Master Plan for the water quality improvement and the recuperation of the ecosystem in Guanabara Bay to the Government of Japan.
This map was made by using various information collected in the study and it is expected to be used by governmental staff and local residents to promote the environmental improvement project and to understand the current environmental conditions around the Bay.

A partir principalmente da decada de 50 déste século, vem ocorrendo urbanização em grande escala caracterizada pelo aumento vertiginoso da população e devastação dos recursos naturais na bacia da Baia da Guanabara sem adoção de devidas medidas de saneamento ambiental.
Esse fato tem ocasionado o rápido crescimento da geração de cargas poluidoras, provocando expressiva alteração da qualidade das águas, bem como de sedimentos e, consequentemente, do comportamento geral do ecossistema aquático, comprometendo seriamente o uso múltiplo de suas águas.
Com o lintuido de melhorar tais situacoes nefastas, o Estado do Rio de Janeiro planejou a elaboração de Plano Diretor para recuperação da Baia da Guanabara e buscou junto ao Governo Japonês a colaboração técnica e financeira para sua realização.
O mapa ambiental da Baia da Guanabara e da sua bacia formadora, aqui inserida, representa o resumo das informacoes obtidas através de amplas pesquisas e levantamentos ao longo da elaboraçao desse plano, cuja finalidade é servir de apoio tanto às autoridades governamentais para planejamento e desenvolvimento de medidas mitigadoras como também à comunidade em geral para obtenção de conhecimentos relacionados à atual situação ambiental da Baia da Guanabara.



CLIMATIC CONDITIONS
CONDICOES CLIMATICAS



NVIRONMENTAL INFORMATION MAP ON GUANABARA BAY AND ITS BASIN

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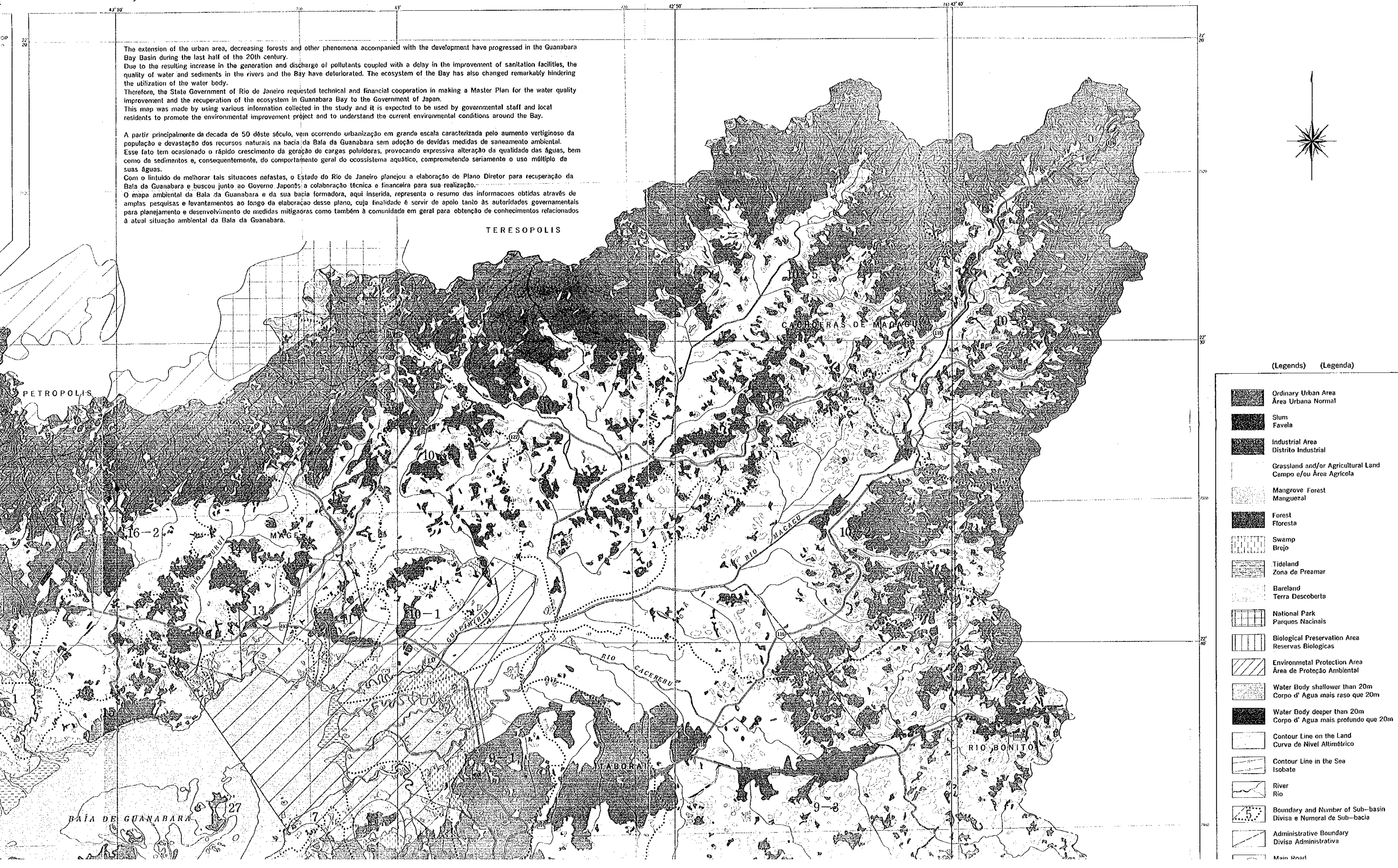

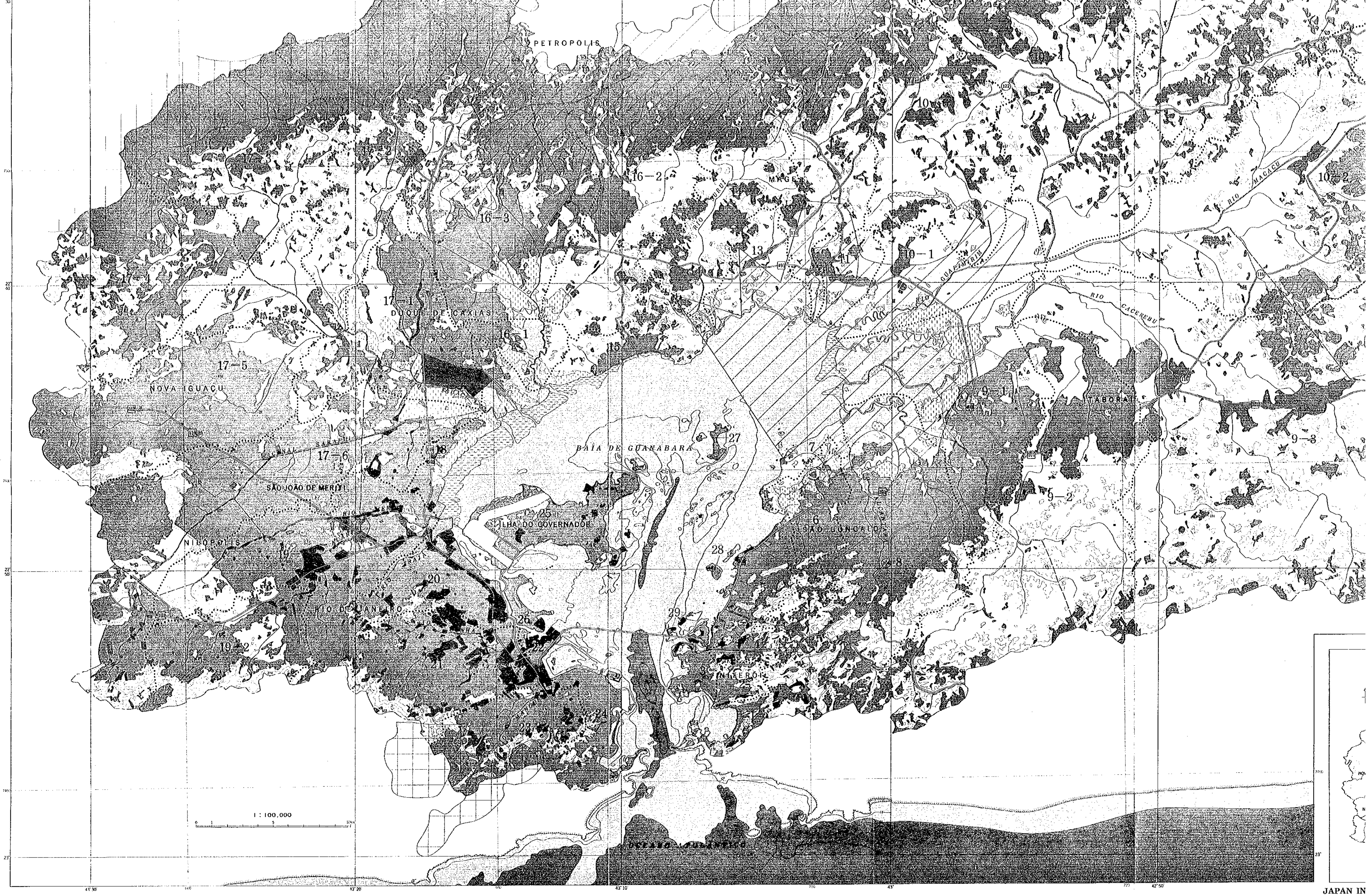
PETROPOLIS
MAGÉ
RIO MACACU
RIO GUAPIMIRIM
RIO CACERIBU
DUQUE DE CAXIAS
NOVA IGUAÇU
SÃO JOÃO DE MERITI
NILÓPOLIS
RIO DE JANEIRO
BAÍA DE GUANABARA
ILHA DO GOVERNADOR
SÃO GONÇALO
NITERÓI
ITABORAÍ
OCEANO ATLÂNTICO
1 : 100,000
10-1
10-2
16-1
16-2
16-3
17-1
17-5
17-6
9-1
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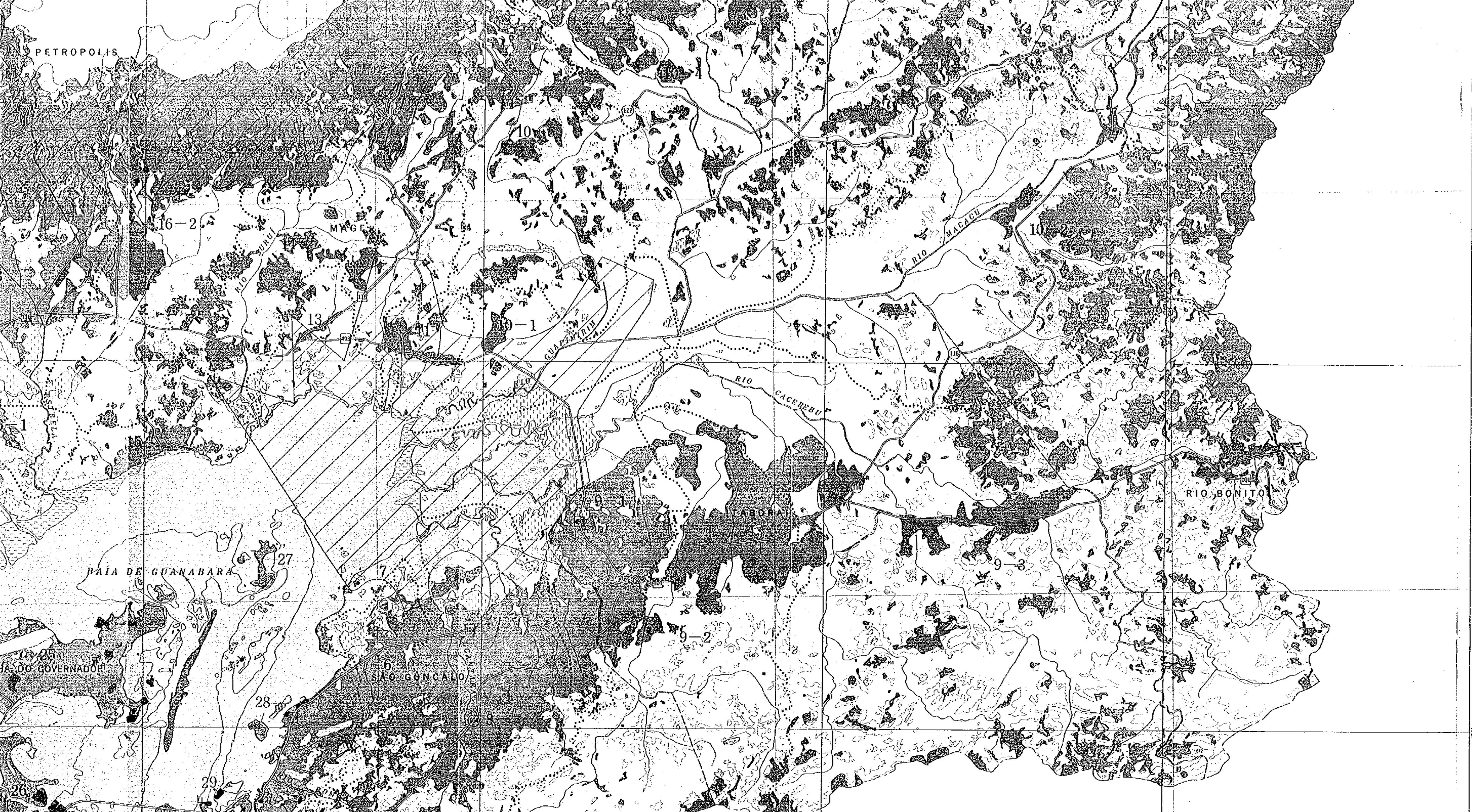
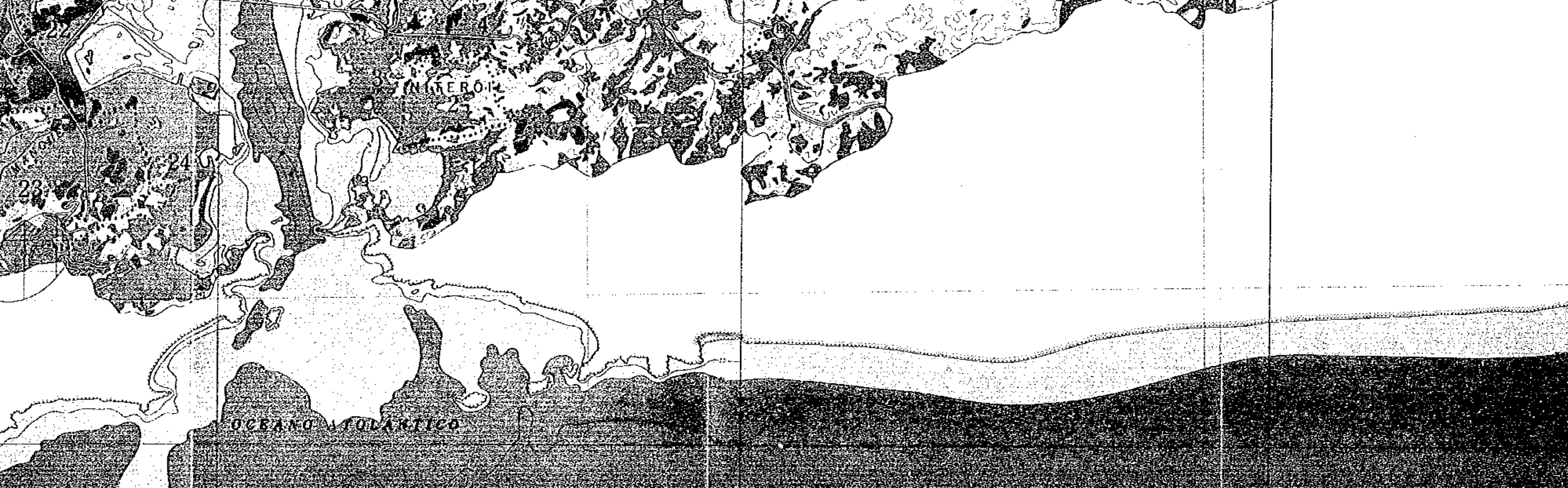
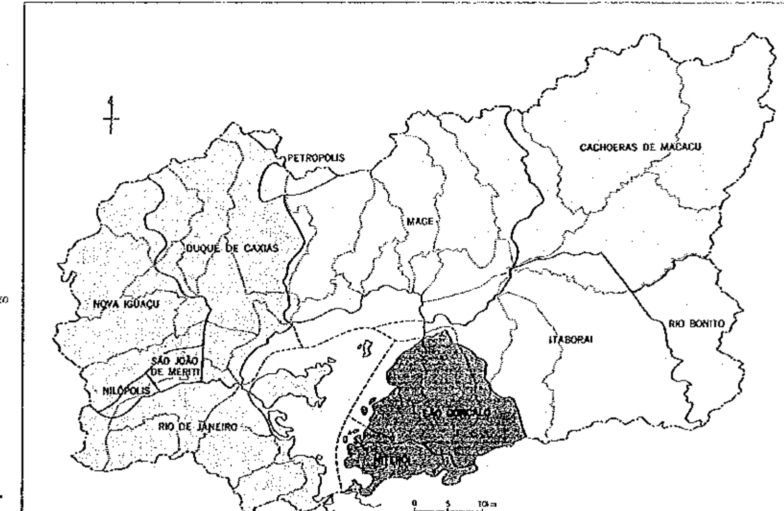
JAPAN IN





(Legends) (Legenda)

- Ordinary Urban Area / Área Urbana Normal
- Slum / Favela
- Industrial Area / Distrito Industrial
- Grassland and/or Agricultural Land / Campo e/ou Área Agrícola
- Mangrove Forest / Manguezal
- Forest / Floresta
- Swamp / Brejo
- Tideland / Zona de Preamar
- Bareland / Terra Descoberta
- National Park / Parques Nacinais
- Biological Preservation Area / Reservas Biologicas
- Environmetal Protection Area / Área de Proteção Ambiental
- Water Body shallower than 20m / Corpo d' Agua mais raso que 20m
- Water Body deeper than 20m / Corpo d' Agua mais profundo que 20m
- Contour Line on the Land / Curva de Nivel Altimétrico
- Contour Line in the Sea / Isobate
- River / Rio
- Boundary and Number of Sub-basin / Divisa e Numeral de Sub-bacia
- Administrative Boundary / Divisa Administrativa
- Main Road / Rodovia Principal
- Runway in Airport / Pista de Aeroporto
- Mud Beach / Costa Lodosa
- Sand Beach / Costa Arenosa
- Rock Beach / Costa Rochosa
- Concrete or Stone Piled Revetment / Costa Revestida com Concreto ou Pedra

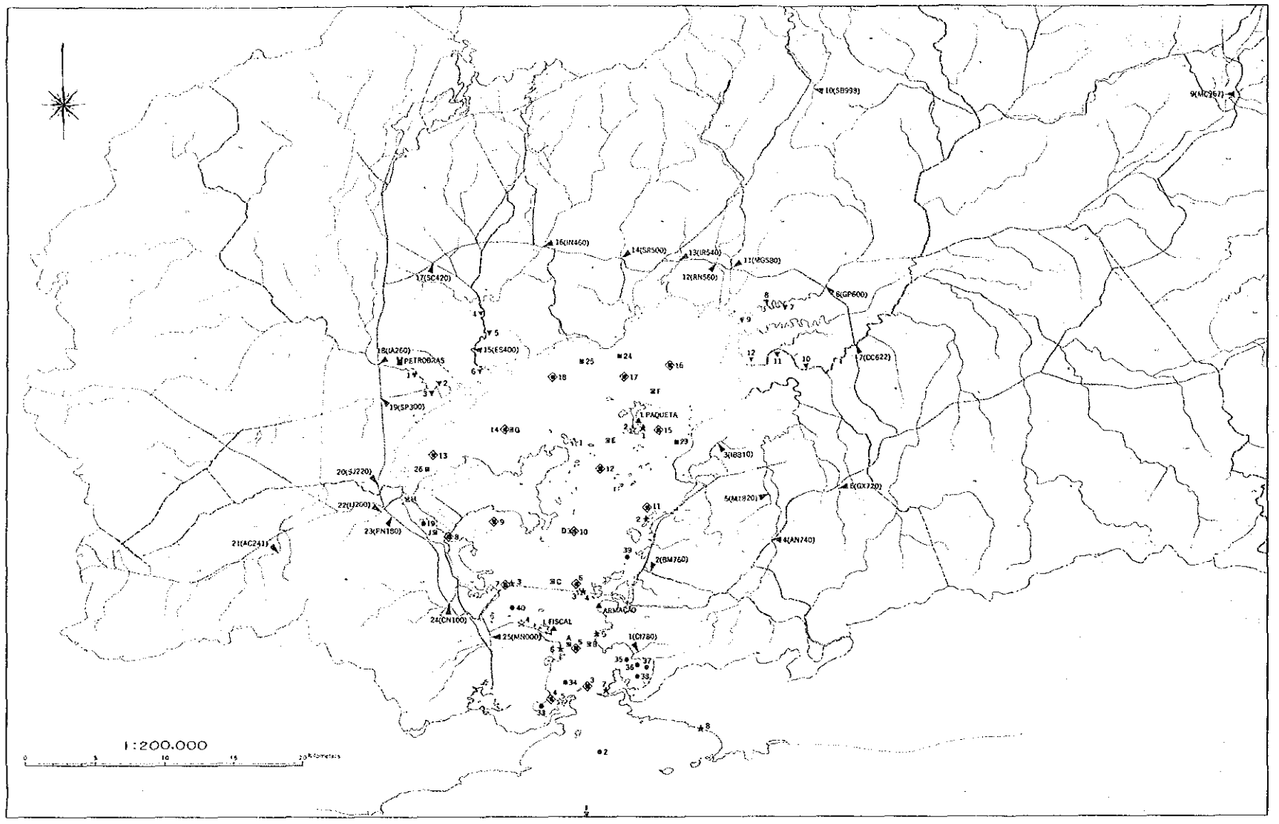


Area and Population of the Municipalities within the Guanabara Bay Basin
Área e População de Municipios Localizados Dentro da Bacia da Baía de Guanabara

Municipality	Area (km²)	Population (×10³)	Population Density
Western District	1,298.6	5,916.9	4,591
Rio de Janeiro	388.2	3,825.3	9,854
Nova Iguaçu	390.2	888.7	2,278
Duque de Caxias	465.5	665.3	1,429
São João de Meriti	35.4	424.7	11,997
Nilópolis	19.3	157.9	8,181
Eastern District	328.0	1,148.7	3,502
São Gonçalo	245.8	778.8	3,168
Niterói	82.2	369.9	4,500
Northeastern District	2,453.8	483.3	197
Mage	745.8	191.2	256
Itaborai	571.5	161.4	282
Cachoeras de Macacu	899.5	39.6	44
Rio Bonito	197.0	43.1	219
Petropolis	40.0	48.0	1,200
Total	4,080.4	7,594.0	1,861

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA) / KOKUSAI KOGYO CO., LTD. (Consulting Engineers & Surveyors) (1994)

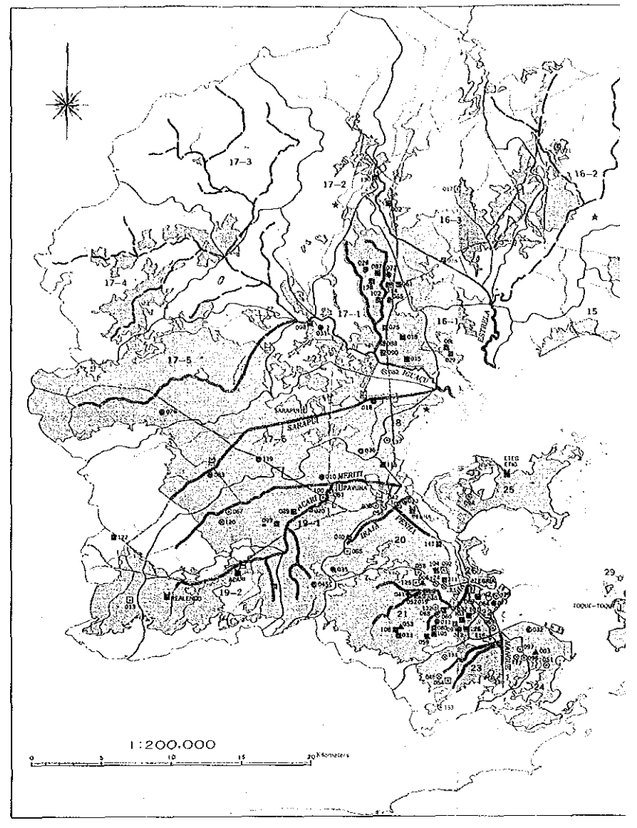
Observation and Sampling Stations in the Study from 1992 to 1993
Estação de Observação e Amostragem em Estudo de 1992 a 1993



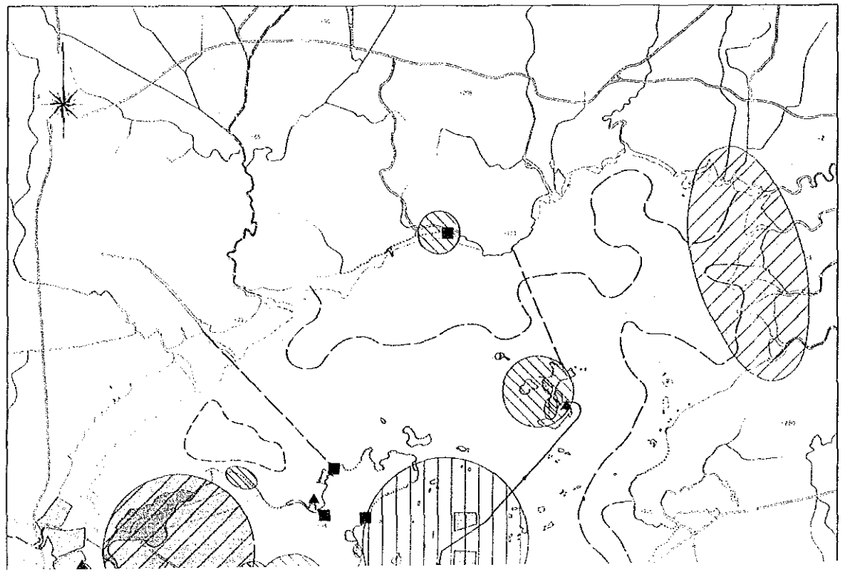
(Legenda) (Legenda)

- Meteorological Observation Station
  Estação Observatória de Meteorologia
- Observation Station of River Discharge and Water Quality
  Estação Observatória de Pluviometria e Qualidade da Água
- Tide Station
  Estação Observatória de Maréa
- Observation Station of Tidal Current
  Estação Observatória de Corrente Marítma
- Observation Station of Water Quality (Sampling Station of Plankton)
  Estação Observatória de Qualidade da Água (Ponto de Amostragem de Plancton)
- Sampling Station of Surface Sediments (Sampling Station of Benthos)
  Estação de Amostragem da Camada Superficial de Sedimentos (Ponto de Coleta de Bentos)
- Sampling Station of Columnar Sediments
  Estação de Amostragem da Coluna de Sedimentos
- Sampling Station of Fouling Organisms (June, 1992)
  Estação de Amostragem de Organismos Incrustantes (Junho, 1992)
- Sampling Station of Fouling Organisms (November, 1992)
  Estação de Amostragem de Organismos Incrustantes (Novembro, 1992)
- Survey Point of Mangrove and Salt Marsh
  Ponto de Estudo no Manguezal e Pântano Salgado

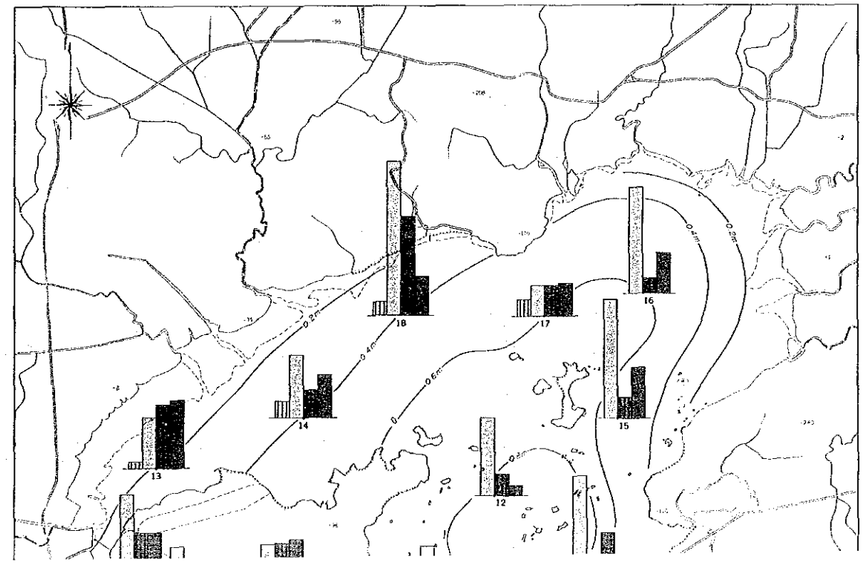
Main Point Pollution Sources and Water Quality Classification of the Rivers
Principais Fontes Poluidoras Pontuais e Classificação da Qualidade da Água



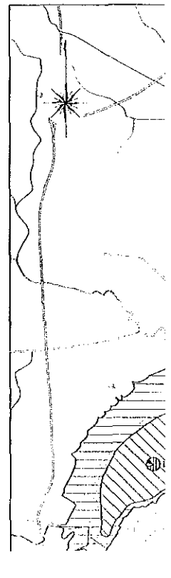
Current Use of Coast and Water Area of the Guanabara Bay
Uso Atual da Costeira e da Espelho da Água da Baia de Guanabara

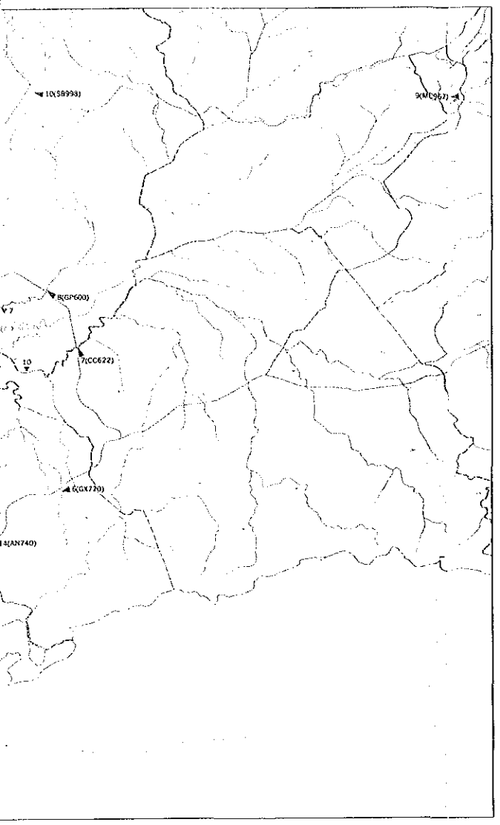


Water Quality in the Bay on Nov. 10, 1992 (Low water time in the spring tide period)
Qualidade da Água da Baia em Nov. 10, 1992 (Na Maré Baixa em Mare Sizigia)



Bottom Materia
Materiais Bentí





(Legenda) (Legenda)

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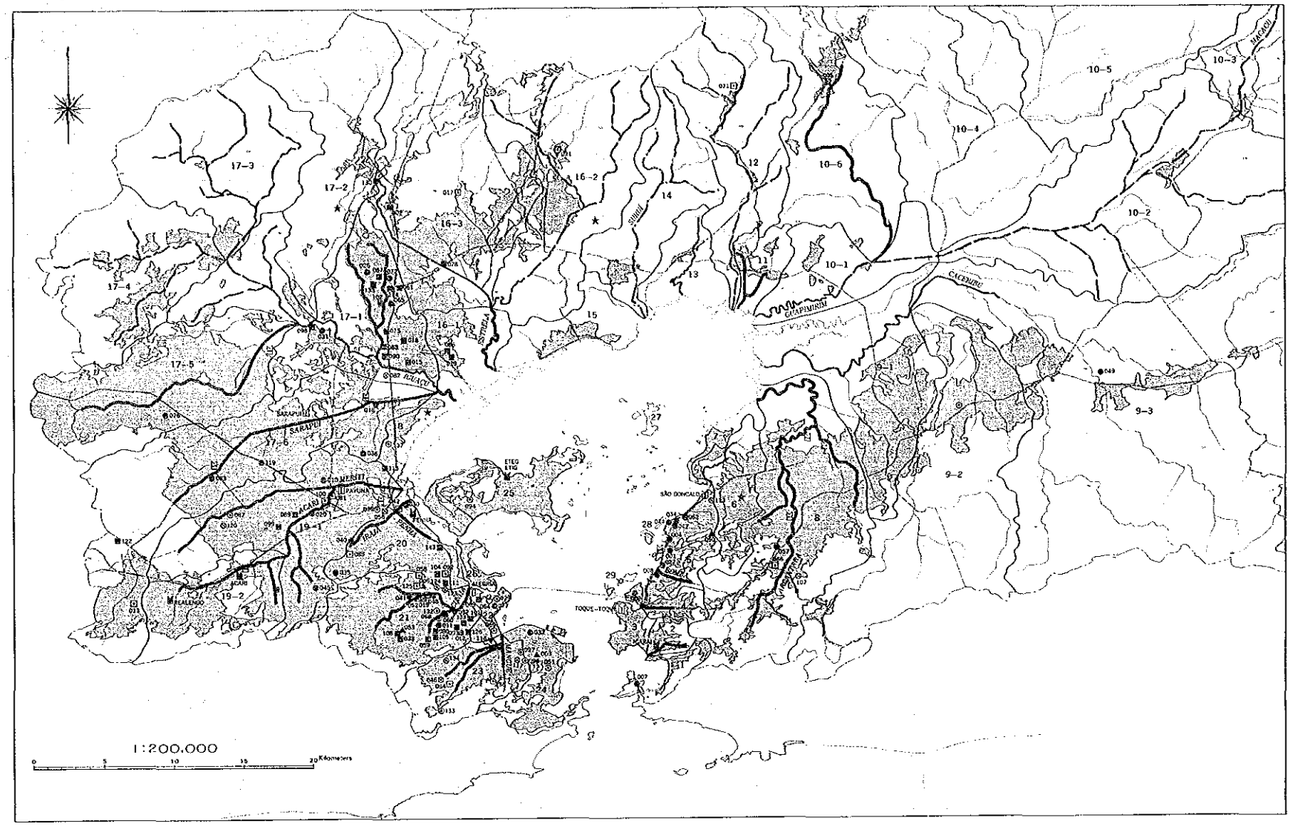
Main Point Pollution Sources and Water Quality Classification of the Rivers
Principais Fontes Poluidoras Pontuais e Classificação da Qualidade da Água dos Rios



(Legenda) (Legenda)

Industrial Pollution Source
Fonte de Poluição Industrial

- Food / Alimento
- Beverage / Bebida
- Paper / Papel
- Chemicals / Química
- Plastics / Plástico
- Pharmaceutical / Farmacêutico
- Textile / Têxtil
- Mechanicals / Mecânica
- Others / Outros

Numerals attached to each symbol show the number in the industrial inventory of FEEMA
Números relacionados a cada símbolo indicam a ordem numérica estabelecida no levantamento industrial da FEEMA

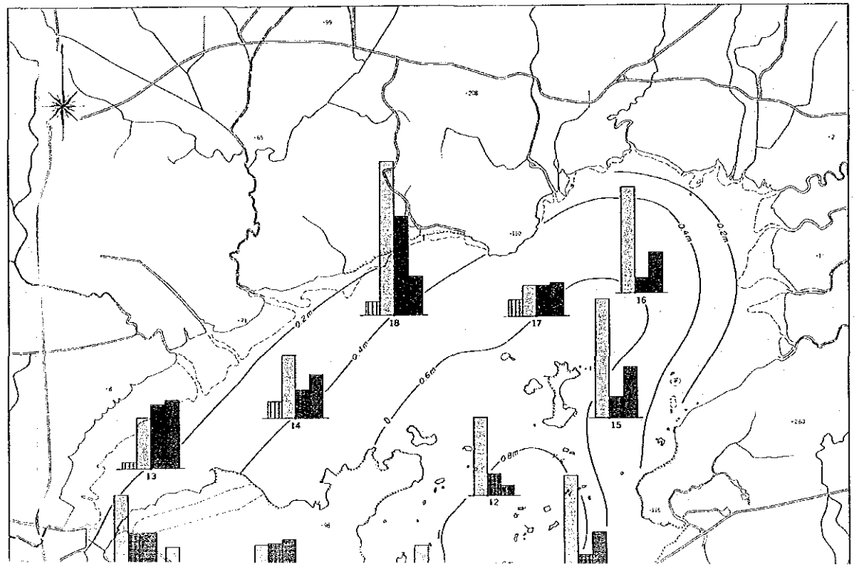
Waste Water Treatment Plant controlled by CEDAE
Estação de Tratamento de Esgotos Residuais Gerenciada pelo CEDAE

- Existing / Existente
- to be constructed by 2000 / a ser construída até o ano 2000
- to be constructed after 2000 / a ser construída depois do ano 2000
- Landfill Site of Solid Wastes / Área de Aterro de Lixo
- Urban Area / Área Urbana

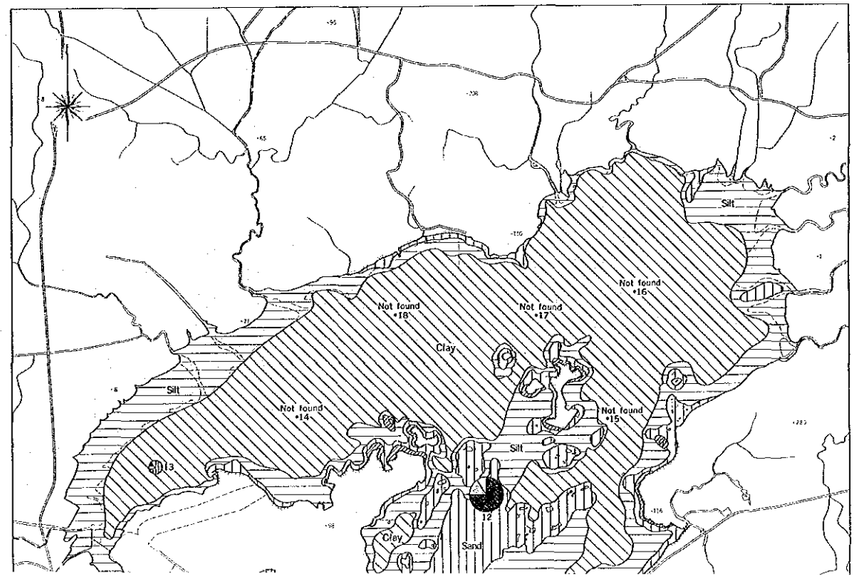
Water Quality Classification of the Rivers
(Mean Value from 1992 to 1993)
Classificação da Qualidade da Água dos Rios
(Valor Médio de 1992 a 1993)

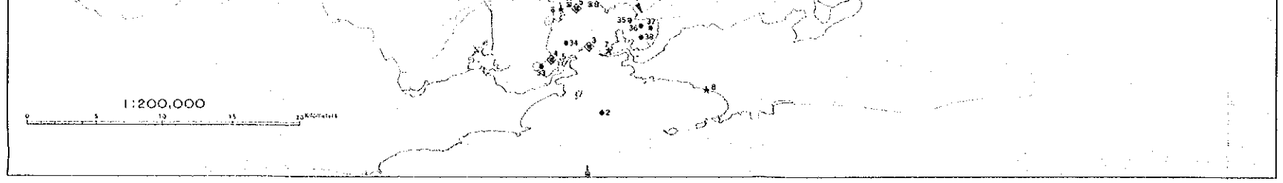
- less than 3 mg/l (Class 1) / menor que 3 mg/l (Classe 1)
- 3~ 5 mg/l (Class 2) / 3~ 5 mg/l (Classe 2)
- 5~10 mg/l (Class 3) / 5~10 mg/l (Classe 3)
- more than 10 mg/l (Class 4) / maior que 10 mg/l (Classe 4)

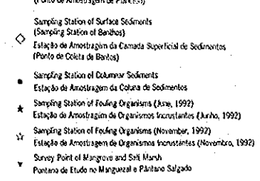
Water Quality in the Bay on Nov. 10, 1992 (Low water time in the spring tide period)
Qualidade da Água da Baia em Nov. 10, 1992 (Na Maré Baixa em Mare Sizigia)

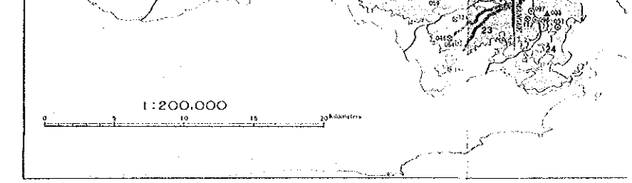


Bottom Materials and Benthic Organisms of the Bay
Materiais Bentônicos e Bentos da Baia









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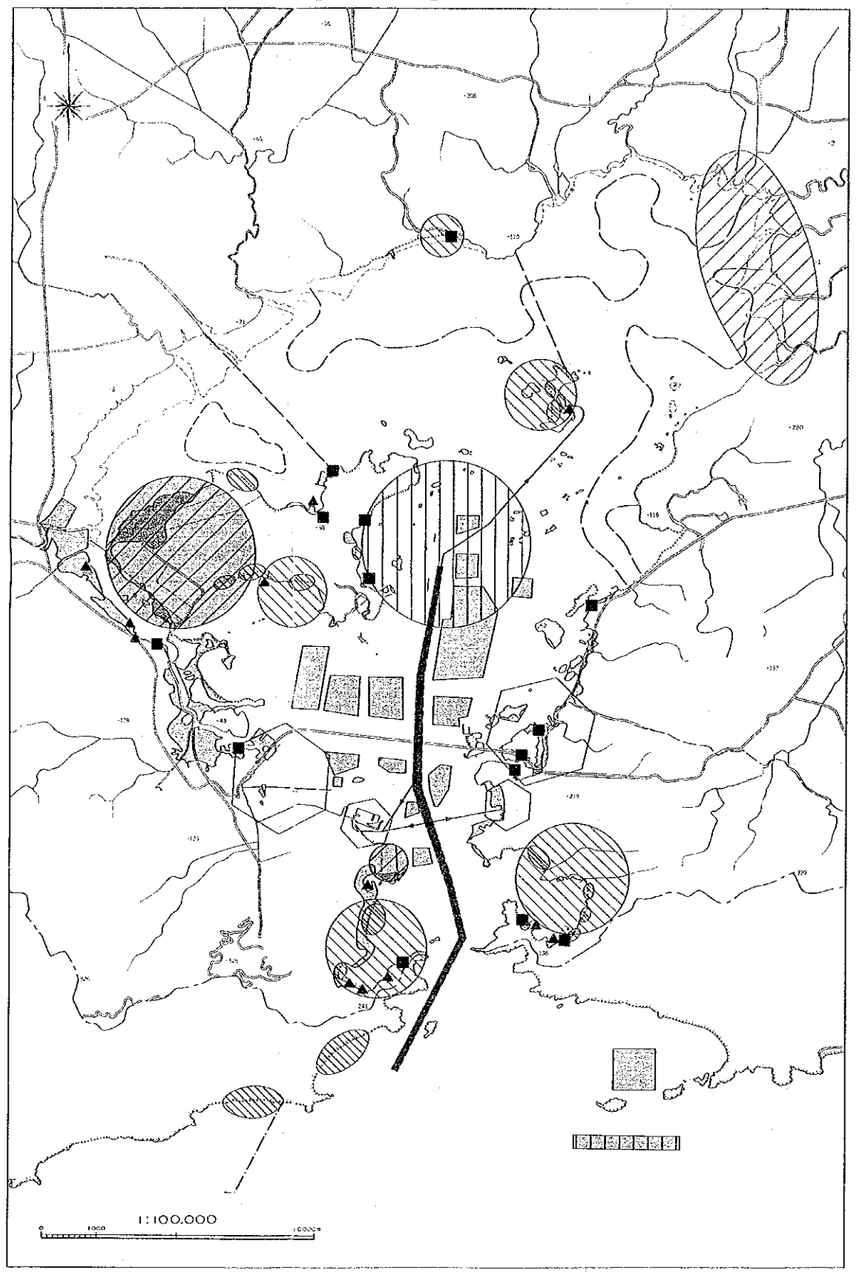

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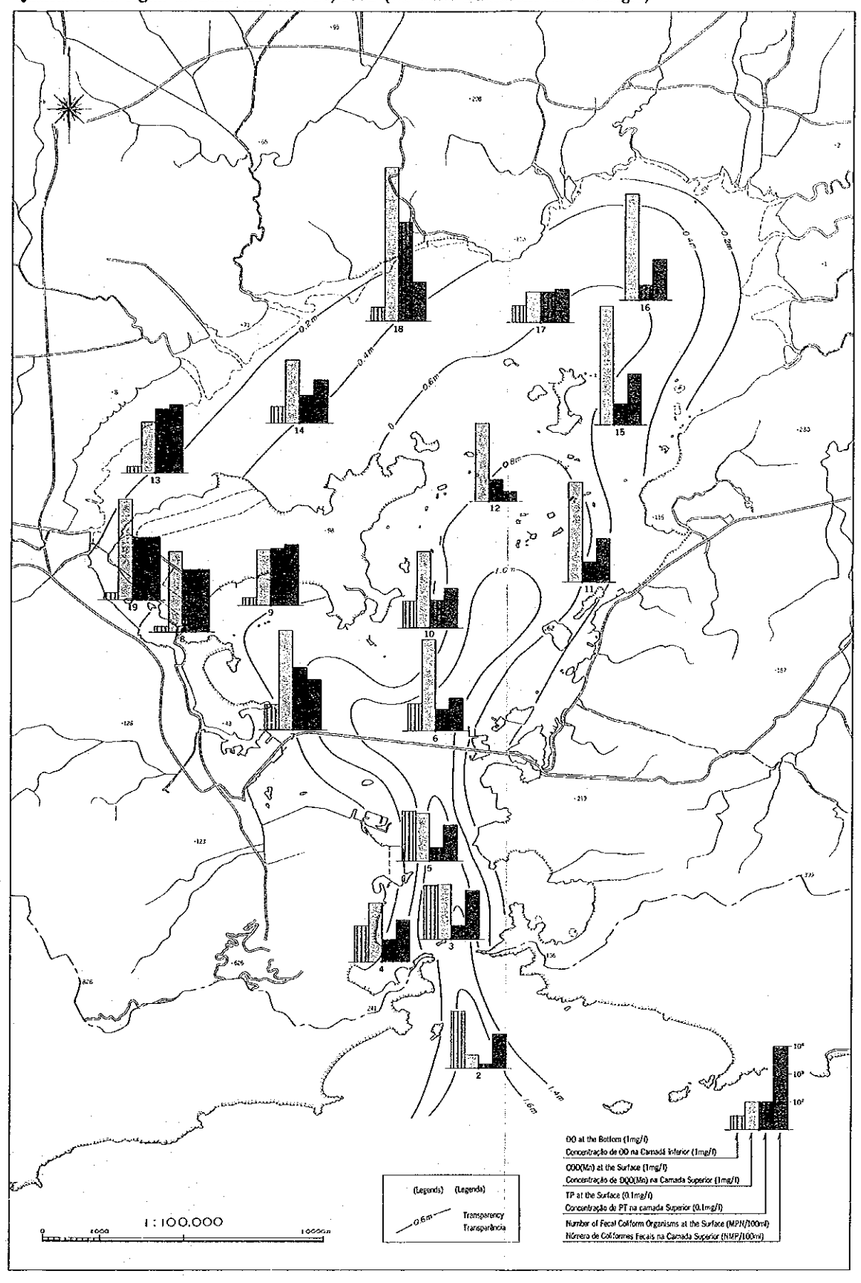
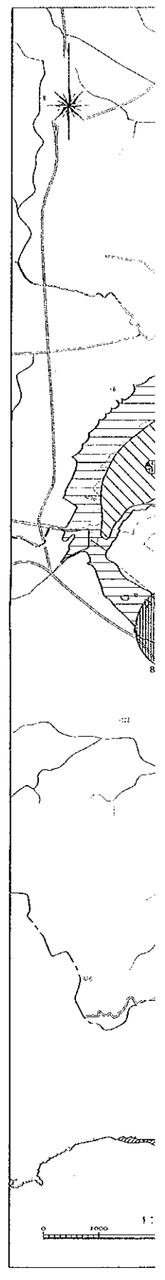


Bottom Materi
Materiais Bent



Sampling Station of Surface Sediments
(Sampling Station of Benthos)
Estação de Amostragem da Camada Superficial de Sedimentos
(Ponto de Coleta de Bentos)

Sampling Station of Columnar Sediments
Estação de Amostragem da Coluna de Sedimentos

Sampling Station of Fouling Organisms (June, 1992)
Estação de Amostragem de Organismos Incrustantes (Junho, 1992)

Sampling Station of Fouling Organisms (November, 1992)
Estação de Amostragem de Organismos Incrustantes (Novembro, 1992)

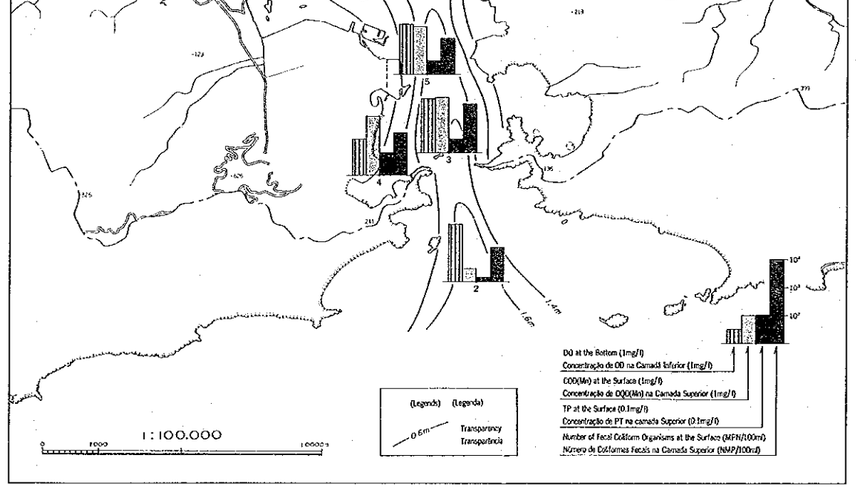
Survey Point of Mangrove and Salt Marsh
Ponto de Estudo no Manguezal e Pântano Salgado

1:200,000

Water Quality Classification of the Rivers
(Mean Value from 1992 to 1993)
Classificação da Qualidade da Água dos Rios
(Valor Médio de 1992 a 1993)

less than	3 mg/l (Class 1)
menor que	3 mg/l (Classe 1)
3~	5 mg/l (Class 2)
3~	5 mg/l (Classe 2)
5~	10 mg/l (Class 3)
5~	10 mg/l (Classe 3)
more than	10 mg/l (Class 4)
maior que	10 mg/l (Classe 4)

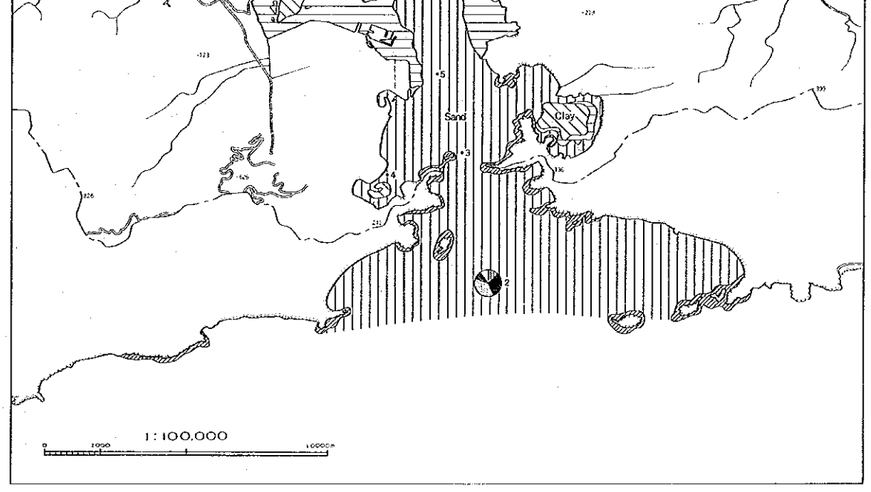
Water Quality in the Bay on Nov. 10, 1992 (Low water time in the spring tide period)
Qualidade da Água da Baia em Nov. 10, 1992 (Na Maré Baixa em Mare Sizigia)



(Legends) (Legenda)

- Airport Area / Área de Aeroporto
- Port Facilities Area / Área do Porto Marítimo
- Anchorage Area / Área de Ancoragem
- Central Fairway / Canal Central
- Ferryboat Route / Rota de Ferryboat
- Fishing Port / Porto de Pesca
- Yacht Harbor / Porto de Iate
- Sea Bathing Beach / Praia de Banho
- Marine Resort Area / Área de Lazer Marítimo
- Distribution Area of Fishing Force / Área de Distribuição de Pesca com Armadilhas
- Oil Facilities Area / Instalação de Refinaria e Depósito de Petróleo
- Gas Pipe Line / Gasoduto
- Sewage Pipe Line / Rede Coletora de Esgoto
- Sludge Disposal Site / Ponto de disposição
- Mangrove Forest / Floresta de Manguezal
- Area Reclaimed since 1962 / Área Aterrada desde 1962

Bottom Materials and Benthic Organisms of the Bay
Materiais Bentônicos e Bentos da Baia



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