

PD-ABI-674
10/1/92

Report of the
Samut Prakarn, Thailand
Corpus Christi, Texas
City Twinning Project
for Urban Environmental Infrastructure

Corpus Christi, Texas
August 14-28, 1993

A Program of:

The United States Agency for International Development (USAID) / Thailand

With Logistical and Technical Support from:



The World Environment Center
419 Park Avenue South, Suite 1800, New York, NY 10016
1600 Wilson Boulevard, Suite 500, Arlington, VA 22209
Silom Plaza, Second Level, 491/43-44 Silom Road, Bangkok, Thailand

TABLE OF CONTENTS

| | | |
|-------|--|----|
| I. | <u>Executive Summary</u> | 1 |
| II. | <u>USAID/Thailand's City Twinning Initiative and Corpus Christi's Role</u> | 2 |
| iii. | <u>Background: Current Environmental Services in Samut Prakarn</u> | 2 |
| | A. Overview of Samut Prakarn | 2 |
| | B. Solid Waste Management | 3 |
| | C. Wastewater Treatment | 3 |
| | D. Other Environmental Issues | 4 |
| III. | <u>Summary Notes from the Samut Prakarn Delegation's Visit to Corpus Christi</u> | 6 |
| | Overview of Corpus Christi | 6 |
| | Water Division | 6 |
| | Stevens Water Treatment Plant | 7 |
| | Financial Issues & Trends at the Local Utility | 7 |
| | Utilities Business Office Division | 9 |
| | City of Corpus Christi Wastewater Treatment Facilities | 10 |
| | Municipal Solid Waste | 12 |
| | Elliot Landfill | 13 |
| | Texas Ecologists | 14 |
| | Chemical Waste Management, Inc. | 15 |
| | The National Spill Control School, Texas A&M - Corpus Christi University | 16 |
| | City of Corpus Christi, Engineering Services | 17 |
| | Reynolds Metals | 19 |
| | City of Corpus Christi Fire Department | 19 |
| | Encycle/TEX, Inc. | 20 |
| | Texas Water Commission | 20 |
| | Hoechst Celanese Technical Center | 21 |
| | Building Inspection Department, City of Corpus Christi | 22 |
| IV. | <u>Evaluation and Follow-up</u> | 22 |
| V. | <u>Proposed Scope of Work for Corpus Christi Delegation to Samut Prakarn</u> | 23 |
| VI. | <u>Samut Prakarn Data to be Provided for the Delegation from Corpus Christi:</u> | 24 |
| VIII. | <u>Public Awareness</u> | 26 |
| IX. | <u>Annexes</u> | 28 |

Disclaimer

This project is supported by the U.S. Agency for International Development and the World Environment Center. The opinions expressed herein are the professional opinions of the authors and do not represent the official position of the Government of the United States of America or the World Environment Center.

I. Executive Summary

As a result of the rapid economic growth in Thailand, many cities are experiencing the challenges and problems associated with municipal solid waste (MSW) and wastewater management. In an effort to help city officials in Thailand choose appropriate treatment methods, the Thailand Mission of the United States Agency for International Development (USAID) proposed to bring together Thai cities with cities in the United States of comparable size, climate and geographic features that have found successful solutions to their waste problems. The World Environment Center (WEC) is coordinating this program in the United States.

From August 14-28, 1993, Mr. Prasert Wongaroon, Assistant Mayor, Mr. Chaiwat Thamrongrisook, City Manager, Mr. Prasert Na Songkhla, Director of Public Health and Environment, Mr. Prawee Punnon, Civil Engineer from the City of Samut Prakarn visited their "twin", Corpus Christi, Texas. The purpose of the mission was to allow the delegation from Samut Prakarn to get an objective view of Corpus Christi initiatives in solid waste management and wastewater treatment in an effort to find solutions applicable to their situation. The delegation found the visit extremely helpful in their effort to address the growing demands on their current waste infrastructure.

As a result of the initial visit to Corpus Christi, the Samut Prakarn delegates have a better sense of the options of solid waste management and wastewater treatment before them and the benefits and problems associated with each. In addition, the delegation has a renewed appreciation of public education and outreach programs as an essential element to the success of any solid waste or wastewater treatment system. Upon return, the City of Samut Prakarn will continue efforts to effectively meet their challenges and will look forward to hosting their counterparts from Corpus Christi to develop the issues further.

As a result of discussions in Corpus Christi, the delegation from Samut Prakarn will focus on two key areas in Samut Prakarn:

1. The development of a new landfill site on land recently purchased by the City of Samut Prakarn
2. A pilot wastewater treatment facility on land owned by the City of Samut Prakarn

II. USAID/Thailand's City Twinning Initiative and Corpus Christi's Role

The Regional Housing and Urban Development Office (RHUDO) of the United States Agency for International Development in Bangkok, Thailand conceived of the "twinning" model as a way to bring U.S. expertise to bear on development problems at a local level. In Thailand's urban areas, problems related to environmental infrastructure and services are among the most pressing. The concept of "twinning" allows delegates to learn about environmental issues, technologies and approaches in the "twin" city, as well. This approach takes into account technical, political, social and economic aspects of providing services and infrastructure at the municipal level.

USAID identified priority environmental issues in Samut Prakarn and identified the City of Corpus Christi, Texas as an appropriate "twin".

III. Background: Current Environmental Services in Samut Prakarn

A. **Overview of Samut Prakarn**

Samut Prakarn is a city of nearly 822,000 (the 12th largest city in Thailand), located approximately 20 kilometers south of Bangkok. The Samut Prakarn industrial area (which includes the municipality of Samut Prakarn and adjacent industrial parks) is the largest and fastest growing industrial district in Thailand. There has been very little planning associated with the industrial growth and the need for environmental infrastructure in the area far exceeds its availability. The serious level of environmental degradation in Samut Prakarn area is prompting city officials to look for new ideas to effectively address the situation.

In addition to its 822,000 official residents, city officials estimate that another 130,000 unregistered citizens, attracted by the large number of factory jobs available, live in the city. If the estimates of the city officials are correct, Samut Prakarn may be the most densely populated city in Thailand with a density of nearly 27,700 individuals per square kilometer. The Samut Prakarn area is reported to have more than 3,800 legal factories as well as an additional 400 illegal manufacturing establishments. A 1987 study estimated that there are approximately 2,000 factories in the Samut Prakarn area, suggesting that the number of factories has more than doubled in the last six years. Area firms engage in a wide range of economic activity including iron and steel manufacturing, tanning, automobile assembly, petrochemical production and textile manufacturing. A number of the iron, steel and textile firms employ in excess of 5,000 individuals each.

B. Solid Waste Management

Samut Prakarn officials indicate that one of the most serious problem facing the city is solid waste disposal. At the present time the city is disposing its wastes in a 25 rai (62.5 acre) landfill that is near capacity. It is seeking to develop a 100 rai (250 acre) site but lacks the necessary resources at the present time. The city collects an average of 80 tons of waste per day and officials estimate that an additional 15 tons is not collected. A 1987 study estimates that approximately 50 tons of hazardous waste from factories in the Samut Prakarn industrial area are not disposed of properly.

Specific issues include:

Municipal Solid Waste

- Ineffective recycling efforts
- Problems in personnel management in solid waste collection due to manpower shortage, inadequate wage, welfare and poor career image
- Littering and lack of public cooperation

Hazardous Waste Management

- Inadequate safety measures to handle hazardous waste
- Poor management of a rapidly increasing volume of industrial hazardous wastes. These wastes end up in non-hazardous waste sites and in waterways.
- Improper safety measures in the use, storage and destruction of various chemicals results in harm and injury to the collection team and others.
- Many chemical factories and hospitals, sources of many harmful wastes, do not take proper control measures for their waste.

C. Wastewater Treatment

Another serious environmental problem facing the city is the absence of suitable wastewater treatment facilities. At the present time the city does not treat household water. There is a small industrial treatment facility linked to about 130 tanneries and 50 other industrial facilities. However, because of their location at the mouth of the Chao Phraya River and immediately downriver of Bangkok, city officials do not expect to see any improvement in water quality in the immediate future, regardless of the progress made on the construction of their own sewerage treatment facility.

Specific issues include:

Pollution Control

- Most factories discharge their wastewater into surface waters (small rivers, Phong Phang Canal, Bang Ping Canal and Ta Ked Canal). Due to the quantity and strength of the industrial effluent, all rivers have become septic and give foul odors. These pollutants ultimately reach the receiving body of the Chao Phraya River.
- The irresponsible littering of hazardous chemical waste into the surface waters

- is another cause of water pollution.
- Due to lack of a central treatment system for domestic wastewater, problems with seepage to municipal drainage systems are great.
- Wastewater has contaminated groundwater sources.
- Contaminated water source is harmful to aquatic life.

Drainage

- The existing urban drainage system is a combined storm and wastewater system.
- Drainage pipes in use are inadequate and cause regular problems with flooding.
- Drains are blocked by garbage from public littering.
- Drain system are not modified as the volume of wastewater discharge increases due to increased water consumption from urban development and expansion
- Inadequate drainage creates pools of stagnant water which serve as breeding grounds for disease causing vector.

D. Other Environmental Issues

A variety of other environmental problems also concern city officials including air pollution and noise from automobile assembly plants. Officials note that many of the factories have air pollution abatement equipment but it is not operating effectively.

Air Pollution Control

- Traffic and industrial expansion are causing rapid urban air quality deterioration.
- Air pollutants include particulate matter, industrial gases emissions, automobile exhaust, and volatile organic substances from household use.
- The air pollutants are causing damage to natural resources, economy and human health.

Health and Environment

- Contaminated drinking water is causing communicable diseases.
- The improper construction of latrines and maintenance of grey water are causing water pollution.
- Insects and rodents are vectors for diseases.
- Occupational Health problems are mostly caused by poor working condition and practice eg. negligence in wearing protective equipment.

Transportation and Traffic

The use of cars and motorcycles is an important mode of transportation for sustaining daily socio-economic activities of urban populace are causing following environmental problems:

- traffic congestion
- air and noise pollution

Urban Green Areas Management

- Inadequate green areas and public parks for relaxation
- Increasing loss of green areas due to rising population density
- Urban water courses are all polluted and public waterways are encroached.

Congested Area (Slum) Improvement

- Rapid increase in urban population is creating congestion problems and unlawful encroachment of public lands.
- Inappropriate location of settlement areas create problems to the city as well as the slum communities themselves.
- The lack of habitat right and security holds back the eagerness to improve their living places and further develop their communities.
- These low income communities are at high risk for fire and many other hazards.
- Congested communities lack supporting infrastructure, walkway, drainage and other basic services.

Compiled by Mr. Prasert Na Songkhla
Director, Environment and Health Division

III: Summary Notes from the Samut Prakarn Delegation's Visit to Corpus Christi

Overview of Corpus Christi

The City of Corpus Christi, located on the Gulf of Mexico, is the eighth largest city in Texas. This location has been a positive factor in the city's economic development.

The city's economic base is fairly diversified, and many of its important industries experienced significant growth during 1991-1992 period. Major industries which contribute to the city's economy include: agriculture, petrochemical, tourism, education, real estate, shipping, retail, military, and health care.

City of Corpus Christi, Water Division

| | |
|---------------------|--|
| Victor Medina, P.E. | Water Superintendent |
| Valorie Gray | Wastewater Construction Superintendent |
| Keith Rodriguez | Engineer Assistant II |

The Water Division manages the Nueces River Drainage Basin (16,000 sq. miles) and collects the surface runoff at two reservoirs, Lake Corpus Christi located at Mathis and Choke Canyon Reservoir located at Three Rivers. Water is sold to the Cities of Mathis, Beeville, and Alice from Lake Corpus Christi.

The mission of Water Division is to preserve and protect water quality for citizens of Corpus Christi and the Coastal Bend area. The Water Division provides the collection, treatment and distribution of safe drinking water in accordance with federal, state and local regulations.

The most pressing need for the city is to identify and manage a long-term supply of water for the area. The strategy includes maximizing existing supplies, acquiring additional supplies, and making improvements at a pace affordable to the ratepayer. Revenues are derived from sales of water, natural gas and water treatment by the city to business and residential customers and to surrounding communities. Stormwater treatment will continue to be a major concern for the future.

Extending and replacing water mains and other rehabilitation work are also key activities of the Water Division.

The Computer Aided Drafting/Geographic Information System (GIS) is currently being developed, and when complete, will be an invaluable tool in infrastructure management and in the rapid retrieval of information.

Stevens Water Treatment Plant

Hubert Hall
Eduardo Garana

Production Superintendent
Assistant Water Superintendent

The delegation participated in a comprehensive guided tour of the Stevens Water Treatment Facility. The delegation observed the most modern laboratory and reviewed a process flow chart which included a typical chemical feed rate, a treated water mineral analysis, and a chemical analysis. For details refer to Appendix 1.

Financial Issues & Trends at the Local Utility

Steve Klepper

Public Works Financial Officer

Key Water Issues

The most important issues facing the utility include planning for future water supply needs, budgeting for increasing costs of environmental regulations and responding to non-point source pollution rules.

The Utility Debt Service Fund

The unified City Utility System includes three operating components: water, gas, and wastewater. In November 1990, the City of Corpus Christi issued Water Revenue Bonds and General Obligation Bonds to fund capital improvements to the wastewater system. This action established a unified city utility system in order to:

1. reduce projected rate increases by levelling and extending existing outstanding water and wastewater debt service requirements and,
2. enable future capital additions and capital improvements to the System to be financed by in lieu and pledged revenues of the Utility System revenue bonds

The City makes debt service payments from user fees in the Water Operations Fund and the Wastewater Operations Fund. These payments also cover bond interest and redemption reserves.

One of the biggest challenges facing the Utility is to keep annual rate increases within a 6% cap while maintaining a system that complies with regulatory requirements and keeping up with necessary capital improvement projects necessary in an aging infrastructure. National surveys indicate that municipal costs to keep in compliance with the Clean Water Act increased 167% over the last three years. Surveys also indicate that wastewater operating and maintenance costs for local utilities are annually increasing by 8% and that sewer service charges are doubling every 6 years. Factors behind this increase include: decreased federal and state funding for new wastewater facilities, an increased burden on local agencies to fund capital facilities, and increased operation and maintenance costs due to stricter treatment requirements and newly mandated environmental programs.

Effluent Regulations

In December 1989, the Coalition About Restoration of the Estuaries (CARE), a local environmental group, filed a complaint with the Texas Water Commission against the City of Corpus Christi. The groups charged that the City was not providing water to the bays and estuaries in accordance with their legal obligations.

Dialogue has continued with these groups regarding fresh water releases, and the search for a satisfactory permanent operating plan has led to extensive legal and consulting costs. The City has a number of studies planned for the next five years to determine the freshwater needs of the estuary in an effort to construct a plan which meets the rising water demands in the community while protecting the natural environment.

Stormwater and Non-Point Source Pollution Control

Anticipating new stormwater and non-point source pollution regulations with the U.S. Environmental Protection Agency's Clean Water Act, the City of Corpus Christi transferred stormwater activity from the Street Department to the Water Department in FY 1989. The financial burden to comply with the new regulations of urban run-off will all be borne at the local level. To meet this challenge, the City is considering establishing a stormwater utility. This new utility would be able to raise revenues through a user fee based on land ownership and would function as any other utility with the ability of issuing bonds to finance capital improvement projects.

Water Supply Management Plan

Depending on the rate of growth in the area, current reservoirs will meet water needs through 2010 or 2030. These estimates, however, did not anticipate the increased demands from CARE and the Texas Water Commission for greater fresh water releases which have already shortened the supply horizon.

The City has proposed two options for meeting water demand. One option involves an inter-basin transfer of water. The other maximizes existing water sources within the Nueces River Basin. Both of these options are costly and the City must also consider alternative funding schemes.

Fee Structure - Winter Averaging

Beginning in July 1993, wastewater charges are based on the amount of water used during the winter months. This approach assumes that most of the water consumed in the winter months enters the wastewater system. Previously, the wastewater charges were based on the amount of water used each month including volume use to watering the garden which does not go through waste treatment system. Under the new system, customers pay a wastewater rate based on their winter water consumption for the entire year.

General Financial Management Policies

- Operating and Maintenance expenditures cannot be funded through debt
- The City will maintain adequate reserves to cover bond covenants and maintain a debt service coverage of at least 1.25 (which means the system will produce

annual net revenues at least equal to 125% of the average annual principal and interest requirements of the outstanding revenue bonds.

In general, officials in Corpus Christi stressed the importance of setting appropriate wastewater rates from the beginning. Once customers are used to one rate, it is extremely difficult to restructure charges.

Utilities Business Office Division

Victor M. Salas (Manager)

The Division has four units with following activities:

- 1) Customer Service Activity (Telephone & Walk-in Sections)
 - Service Initiation Orders
 - Service Termination Orders
 - Name/Address Changes
 - Service Transfer
 - Payment Extension
 - Questions concerning Accounting/Billing
 - Customer Information
- 2) Field Service Activity
 - Turning on Water and Gas Services
 - Turning off Water and Gas Services
(Including cessation of service on delinquent accounts)
 - Account Investigation
(High bill complaints, leak investigations, field testing of meters, and re-reading of accounts)
- 3) Meter Reading Activity
 - Monthly Reading of Gas and Water
 - Monthly Account Billing
- 4) Utilities Business Office - Administration
 - Coordination of four activities.

Key points:

- The operation is fully computerized.
 - The Utility uses computerized, hand-held units with a full range of memory options for meter reading operations.
-

12

City of Corpus Christi Wastewater Treatment Facilities

| | |
|-----------------|-------------------------------------|
| Wayne Cockroft | Wastewater Superintendent |
| Bhaskar Patel | Wastewater Treatment Superintendent |
| Foster Crowell | Assistant Wastewater Superintendent |
| Danny N. Ybarra | Facilities Superintendent |

The delegates visited three of the six wastewater treatment plants in Corpus Christi. They also observed the collection system maintenance equipment including the vacuum cleaning truck and the inspection vehicle equipped with a color TV camera unit. They also visited one of the major lift stations.

Allison Wastewater Treatment Plant

The Allison plant is designed to treat 5.0 MGD of domestic wastewater with a peak flow of 15.0 MGD. The plant serves the northwest part of the city. It also receives wastewater flow from a beef packing plant and a chemical research facility. The waste strength from the beef packing plant is usually high (over 2,000 mg/l) which constantly causes treatment problems, as the plant is not designed to handle this contaminant loading. Solids represent the biggest problem, and it is a constant battle for the staff to keep up with the operations but they have been able to consistently comply with the discharge permit. The effluent parameters are 20 mg/l BOD₅ and 20 mg/l TSS while the effluent is far better in quality (average about 3 mg/l BOD₅ and 5 mg/l TSS).

The Allison wastewater treatment plant utilizes an activated sludge technology which is operated in a Complete Mix process. Presently the flow averages about 3.0 MGD. Two 24" gravity mains carry the sewage to the plant lift station and through two mechanical bar screens.

Three pumps with variable speed drives pump the raw sewage from the lift station to the headwork. The headwork consists of a manual bar screen, an aerated grit chamber and a grit collector with screw conveyor. The flow is split equally into two trains.

The sewage flows by gravity to the aeration tanks where it is mixed with the return activated sludge from the clarifiers. The aerated sludge is settled in the two 70 foot diameter clarifiers. Here the flocculated sludge settles and the clear liquid flows over the weirs into the troughs which are connected to the two chlorine contact chambers. These chambers are designed for a detention of 20 minutes at a peak flow of 15.0 MGD. The chlorine is injected in to the first tank of each chamber for disinfection. Sulfur dioxide is added prior to the flow measuring device for dechlorination. The effluent is discharged into the Nueces River.

Sludge is wasted, at regular intervals from the secondary clarifiers to the Pre-thickener. The supernatant is returned to the lift station while sludge is pumped to

13

the aerobic digester where it is aerated and stabilized. The digested sludge is then pumped into a Post-thickener from where it is pumped to the belt filter presses. The dewatered sludge is then disposed at the sanitary landfill.

Oso Wastewater Treatment Plant

The Oso Treatment plant is designed to treat 16.2 MGD of domestic wastewater and serves approximately 50% of the Corpus Christi. Currently the treatment plant is treating about 80% of the capacity and consistently complying with the discharge permit. It is designed to operate in a Contact Stabilization mode with 2:1 ratio of mixing and re-aeration. This is the largest of the City's plants. A 42" diameter gravity line feeds into one of the two in plant lift stations. Also, twin 36" diameter and a 24" line feeds into the second plant lift station.

The force mains from the two on-site lift stations and one off site lift station pump sewage to the plant headwork. The headwork consists of two mechanical bar screens and an aerated grit chamber with grit screw. The flow is split equally at the split box into parallel plants each designed to treat about 8.0 MGD. Both sides are designed similarly with five aeration tanks, four rectangular clarifiers and two Chlorine Contact Chambers. Flows from both sides are blended prior to dechlorination and metering. The final discharge is to the Oso Bay. This plant has a 20 mg/l BOD₅ and 20 mg/l TSS permit.

The sludge is wasted from the re-aeration into the Pre-thickener while the return from the clarifiers is continuous. The settled sludge is pumped to the aerobic digester while the supernatant is returned to the lift stations. Four Digester tanks are provided and operated in series. The sludge is pumped from the digesters to the two Post-thickeners at regular intervals. The thickened sludge, about 2% solids is pumped to the sludge handling building where two 2.0 meter belt filter presses dewater the sludge. The sludge cake which contains about 18% to 20% solids is then disposed of in the sanitary landfill.

Broadway Treatment Plant

The Broadway Treatment Facility is a two-stage trickling filter plant which backwash filters for polishing to the effluent. It is designed to treat 10.0 MGD of domestic wastewater with 20.0 MGD peak flow.

Thirty six inch and 24 inch gravity lines carry wastewater into the plant bar screens. Two mechanical bar screens are installed prior to the plant lift station. The lift station has three pumps which pump the influent to the grit chamber. From the grit chamber, the raw sewage flows to the two primary clarifiers. The settled sludge is removed to aerobic digesters while the clarified sewage or the primary effluent overflows the weirs into the gravity line which feeds to the center column of the high rate trickling filters. The wastewater flows through the five feet of rock media to the underdrain. A slimy film which forms on the surface of the media encourages the

14

growth of micro-organisms which thrive on this biological growth in presence of oxygen causing biodegradation of the waste. The slime layer slough off into the waste flow once the layers become heavy. The wastewater flows to the intermediate clarifiers via the underdrains. The sludge from the clarifiers is pumped to the return flow reconditioning (RFR) unit while the effluent drains to the pump station. The effluent is pumped to the four standard rate filters. The effluent from the standard rate filters is conveyed to the final clarifiers where organic waste settles out of the stream. The sludge from the final clarifiers is removed to the RFR unit while the effluent is pumped to the automatic backwash filters. The filtrate is chlorinated, metered and dechlorinated before it is discharging to the ship channel.

For details on the three wastewater treatment plants refer to Appendix 2.

Municipal Solid Waste

Robert T. Bruner
Estela Garcia

Director, Solid Waste Service Department
Administrative Assistant III, Recycling Coordinator

Solid Waste Service Department

The mission of the Solid Waste Services Department is to serve the citizens of the City of Corpus Christi through the collection and disposal of municipal solid waste, brush and recyclable materials in a way that is timely, safe and in compliance with standards and regulations, and ensures public health as well as beautification of the City.

The Solid Waste Services Department operates and maintains Elliott Landfill in compliance with local, state and federal regulations. The Department also provides residential refuse collection twice weekly, recycling collection twice a month, and collection of light brush and heavy debris.

The Department continues to focus on developing a Solid Waste Services long-range plan in an effort to provide high service levels for the community. Long-range plans for disposal are developed in accordance with state and federal requirements.

Other initiatives by the Department include the appointment of a Solid Waste Compliance Officer to curb illegal dumping and keep the city clean. City-wide recycling has resulted in an initial participation rate of 60%. A "Litter Critter" program provides a means of neighborhood clean up at no cost to the citizens. In addition the city is enhancing the street cleaning program with additional crews and trucks which should improve the yardwaste collection and help keep streets cleaner.

The Department is currently working with neighboring cities and towns to develop a Regional Solid Waste Service plan. The plan is designed to help the region meet

15

the challenge of future regulations and population demands.

Elliot Landfill

Mucio Garza

Landfills Engineer

Landfills are the most widely used waste management method in the United States, as approximately 80% of the nation's municipal solid waste is disposed of in landfills (EPA, 1988). Many communities, however, are having difficulties siting new landfills, and as old facilities reach capacity, a "capacity crisis" may result. The capacity crisis has resulted from the increasing quantities of waste generated coupled with decreasing disposal capacity. The difficulty in siting new landfills has resulted largely from an increased concern among citizens and government of the adverse environmental impacts associated with improperly located, designed, or operated landfills. Many communities are in the unfortunate situation of having to commit considerable resources to the cleanup of past disposal practices.

Modern municipal solid waste landfills are coming under increased regulatory requirements. Specific technologies are associated with a state-of-the art landfill:

- Liner system (clay and/or synthetic);
- Leachate collection systems;
- Leachate treatment;
- Landfill gas control and recovery;
- Improved closure techniques;
- Provisions for post closure care and maintenance;
- Monitoring systems; and
- Control of materials entering the site

Texas Ecologists

Larry Reiter

Site Engineer

Texas Ecologists facility began its operations in 1973. The process is to place hazardous waste in disposed cells. The generator must identify waste components before shipment. Samples are taken and analyzed to verify waste characteristics and receipt.

| Accepted For Disposal | Not accepted for Disposal |
|--|--|
| <ul style="list-style-type: none">• RCRA hazardous waste as defined by TCLP which are not landfill restricted• Texas Class I non-hazardous material• Drummed solid wastes• Building solid wastes• Materials generated from cleanups and facility closure and remediation projects• Lab packs• Empty agricultural chemical containers | <ul style="list-style-type: none">• Liquid wastes• PCBs, Dioxins or radioactive wastes• High acid content (Ph less than 2.0)• High caustic content (Ph greater than 12.5)• Cyanide (CN) or sulfide (S) compounds with concentrations greater than 10%• Gas or gas containers• Highly biodegradable organic matter• Infectious/medical wastes. |

17

Chemical Waste Management, Inc.

Zelner Houchin

General Manager

Timothy J. Martin

Environmental Manager

The steps to proper hazardous waste management begin long before the waste reaches either Port Arthur or Corpus Christi. Any generator wishing to have Chemical Waste Management Inc. (CWM) disposed of his waste must first provide a detailed profile and a sample of the waste for CWM's laboratory to analyze. Through an analysis, CWM confirms that facility of CWM is permitted to accept the waste for disposal if the waste is acceptable. The waste generator then enters into a contract with Chemical Waste Management to accept the waste for disposal, with time of arrival closely coordinated by facility personnel.

When each tank truck carrying an approved waste arrives at either Port Arthur or Corpus Christi, another sample is taken. A fingerprint analysis of this latest sample is compared to the previous test studies to confirm the identity of the waste.

When accepted for disposal, the tanker is off loaded into a receiving tank where the waste is processed by pH adjustment, blending and filtration. After these process steps are completed the waste is pumped to a holding tank from which it is injected. The empty tanker is rinsed clean before leaving the facility and the rinse water is also processed and injected.

The transport of liquid waste from the generator to the disposal site can be done by CWM's transport fleet of highly-trained professional drivers or by a private carrier of the generator's choosing. All vehicles transporting wastes to any Chem Waste facility must meet the rigid safety standards of the United States Department of Transportation as well as CWM's own stringent requirements.

The Conrad Bulcher Institute for Surveying and Science, College of Science and Technology and The National Spill Control School, Texas A&M - Corpus Christi University

Texas A&M University - Corpus Christi

| | |
|-----------------|---|
| Ruth Bakke | Dean, College of Science and Technology |
| David A. Jensen | Associate Director, National Spill Control School |
| Gary Jeffress | Director of Research, Blucher Institute for Surveying and Science |
| Steve Barnes | Director, National Spill Control School |
| Jennifer Prouty | Director, Environmental Science Program |
| David Hicks | Research Assistant, Center for Coastal Studies |

Dr. Gary Jeffress, Director of Research and Education, Environmental Research Consortium and Associate Director, Center for Coastal Studies, College of Science and Technology started the presentation and spoke on the TYCOON Data Collection System and Platforms. TYCOON is an automated/computerized system that obtains water level measurements using a schematic of wells which provides 191 observations or 1 water level measurement. There are 44 platforms all along the coast and bay of Corpus Christi and 6 gauges. The TYCOON Data Collection Platforms contain packet radio antennas that receive information with satellite antennas.

Information can be transmitted to Texas General Land Office for a quick response on oil spills in Texas. All data and information collected sits in Computer (Ingress software package) and is integrated with the GIS system. It is set up to zoom in to these stations and bring out data. Communication is possible with these gauges and this is how data is obtained. The data collected is kept on file and used for scientific analysis on changes in water levels, winds, barometric pressures, etc. The data is useful for knowing what the wind speed is because the public call the office for that information. This is an important factor for some people such as fisherman, port, commercial users and recreational activities like surfing. Altogether, 6,500 phone calls have been received in one month's time.

GIS also keeps track of environmental conditions and facts and stores all environment data for future use. This information can also be integrated with oil spill information to provide a breakdown showing where oil spills can occur and therefore allow for better preparation by emergency crews. The GIS products include a Hewlett Packard computer with 735 stations and 6 terminals for teaching. Classes are taught for credit and the school also offers short courses for business individuals and companies.

Dr. Steve Barnes, Director of National Spill Control School and Professor of Chemistry, College of Science and Technology, Texas A&M - Corpus Christi University

The University offers Masters and Bachelors programs in Environmental Science. The Center of Science and Technology at Texas A&M Corpus Christi also includes environmental research and is composed of the National Spill Control School, Coastal Studies, Conrad Blucher Institute and the Center for Water Supply Studies. Texas A&M - Corpus Christi also works closely with the U.S. Fish and Wildlife Service and Texas Wildlife Service.

The program started in the early 1970's when a large oil spill occurred in Santa Barbara. Local oil producing companies decided that a similar accident could also happen here and organized the Oil Spill Control Association. The association found out that there were no adequate programs around the U.S. The association secured a grant from the ER&D, (now known as U.S. Department of Energy). Since that time, program has been self supporting. In late 70's, there were no oil spills and a change in government at the federal level resulted in reduced interest in keeping such a program for oil spill cleanup.

As a result, the Director of the National Spill Control School then decided to get involved in hazardous management and hazardous materials management courses in its curriculum. The school also conducts classes outside the State of Texas. Some of the other places that classes have been conducted include South Pacific, Korea, and Singapore.

Dr. Barnes stated that the school has a cooperative working relation with Carl Christianson at the Oil Spill Office with the City of Corpus Christi to provide practical on-the-job experience.

Communication with media and public is a very important and crucial element. A one-day class is offered to students where they get experience being interviewed and learn public speaking tools.

City of Corpus Christi, Engineering Services

Carl E. Crull

P.E. Director of Engineering Services

The 48 employees for the Department of Engineering Services provide complete engineering support for the City including streets, sanitary sewers, the airport, and public buildings. The department does not do maintenance work, but focuses on new buildings and repairs. The staff includes an architect, a survey team of three and a group of five responsible for acquiring land for City projects.

The Department also relies on consulting contractors for approximately one-half of their work. The City puts out requests for proposals and qualifications for open bidding on projects beyond the scope of the department. A staff committee then selects a few firms to give more detailed presentations including specifics impact statements and solid bids to cover their costs. The committee makes a recommendation to the City Manager who must secure final approval from the City Council.

Mr. Crull then gave an overview of the City's Geographic Information System (GIS) and its uses in the Engineering Services Department to indicate topographic features and other factors essential to the Department's operation including size of lines, maintenance and repair histories, financial information etc. The GIS system can also be used to plot census data, and other statistical information such as crimes committed in specific areas and number of children per household to decide school zones etc. The City is in the process of using this survey point system for the wastewater, police and education departments.

City of Corpus Christi, Planning and Development Department

| | |
|-------------------|----------------|
| Robert E. Payne | Senior Planner |
| Miguel S. Baldang | City Planner |

The Department of Planning is responsible for the overall development in the City of Corpus Christi. The department focuses on the environmental impact of all new developments in the city, recommending and administering organization-wide policies, programs, procedures, and ordinances regarding all physical developments in the city. The department is divided into sections: Comprehensive Planning, Zoning and Planning Administration, Annexation Studies, Graphics and Map Maintenance, Demographics, Physical Planning and Special Studies.

Sealed drawings of land surveys showing location and boundaries of individual tracts to be developed are submitted to the Planning Department and forwarded to other city departments and local utility companies for review to determine if the necessary easements and rights-of-way have been provided and if water, sewer, street improvement will be necessary.

Zoning aids rational land utilization and the economical provision of public facilities and services. Zoning ensures proper land use relationship, provides sufficient land area for each development type, and allows a change to heavier uses only in areas with adequate facilities and services such as streets, schools, prevention areas and utility systems. Zoning also directs new growth to appropriate areas, and protects existing property and users from incompatible adjacent development.

Reynolds Metals

Tony Dunn

The Reynolds Metals Company is situated on the North Shore of Corpus Christi Bay in Portland.

The refinery group is a modified "Bayer Process" Alumina plant. The "Bayer Process" is a hydro-metallurgical process which utilizes larger amount of caustic soda solution combined with high temperature and pressure to first dissolve Aluminum Hydrate from a bauxite slurry, clarify the resultant liquor of impurities, then precipitates the Hydrate in crystalline form. The hydrate is then calcined to produce Aluminum Oxide for use in primary Aluminum production.

The plant's process waste is produced in the form of Red Mud tailing which are pumped through a pipeline to a waste management site.

City of Corpus Christi Fire Department

Patrick B. McMacken Administrative Assistant

The mission of the Fire Department is to protect lives, property and the assets of the citizens of the City of Corpus Christi by the prevention and suppression of hostile fire, by responding to medical emergencies, and by creating and enforcing fire safety standards.

The Corpus Christi Fire Department responds to all emergency situations, such as fires, natural disasters, hazardous material releases, and life-threatening situations within the City. Its overall goal is to minimize property loss and provide basic life support to injured or sick victims. The Department administers programs and activities which provide fire safety practices in homes and public buildings.

The Department spends a significant amount of time and effort to developing pre-emergency plans, training staff, and maintaining equipment in a ready mode in order to respond quickly and effectively to all emergencies.

Coordination and planning with other emergency/disaster response agencies within the City and County is high priority.

The department also supervises the Emergency Medical Services (EMS). The EMS Division provides on-the-scene emergency medical treatment to injured or ill individuals, when necessary, EMS, will transport them to the closest appropriate hospital.

Encycle/TEX, Inc.

| | |
|------------------|--|
| John K. Likarish | President |
| James W. O'Neil | Executive Vice President |
| S. Rick Gilbert | Technical & Business Development Manager |
| Elizabeth Payne | Environmental Manager |

Encycle/TEX Inc. (Encycle) specializes in recovering and recycling nonferrous metals from hazardous and nonhazardous inorganic solids, sludge and solutions. The facility on 106 acre hydro-metallurgical complex, chemically recovers the metals in the waste materials shipped to the plant, and returning those metals to commerce.

The metal components in wastes accepted by Encycle are processed and shipped to smelters to be used as raw materials. Recycling is the EPA's preferred waste management technology and greatly diminishes a long-term liability as a waste generator.

Encycle receives hazardous and nonhazardous waste shipments by almost every form of truck transportation including vans, roll-offs, flat decks, tankers, vacuum trucks and dump trucks.

A fully equipped laboratory at Encycle provides a complete waste stream analysis and confirm process effectiveness of customer's waste materials and systems and is operated under strict protocols and procedures by a highly skilled professional staff.

Texas Water Commission (TWC) (name changed to Natural Resource Conservation Commission as of September 1, 1993)

Mickey Garza Field Investigator

TWC is a State Environmental Control Agency monitoring legal standards for air, water and waste with its headquarters in Austin, Texas. There are 14 Districts and Corpus Christi is District No 12.

Laws enacted by the Texas Legislation appear in the form of statutes or codes. These are usually general statements of regulatory policy that the legislative has decided should be observed by the public. In these statutes or codes, the Legislature often direct that state agencies develop the specific or details of these regulatory policies. These specific requirements are adopted with public input by state agencies and are called rules. Both statutes and rules have the force of law.

TWC's vision

An environmentally safe and pollution-free future with an adequate supply of clean water.

Main responsibilities:

- Be responsive to the people of Texas
- Protect public health and safety
- Protect and improve the quality of surface and ground water.
- Prevent and reduce various forms of pollution.
- Protect food sources from contamination.
- Ensure that hazardous and non-hazardous solid wastes are properly managed.
- Improve water and wastewater services throughout Texas
- Optimize the beneficial uses of the State's water resources, including the development of additional supplies where appropriate.
- Balance economic growth with environmental protection goals

Hoechst Celanese Technical Center

| | |
|----------------------|---|
| Dr. Peter K. Eckardt | Manager of Piloting Services |
| Kenneth A. Roberts | Regulatory Affairs, Group Leader |
| Les Wabe | Manager Environmental Technology/Customer Technical Services |
| George P. Seeman | Engineering Associate |
| Garry Philips | Environmental Engineer |

The mission of the Hoechst Celanese Technical Center is to create new business based on advanced chemical technology while supporting existing commercial processes. Hoechst recognized years ago that reconciling productivity and environmental pollution control requires technological innovation. As a result, many operations at and many projects of the Center focus on environmentally safe processes.

Hoescht is also determined to be a "good neighbor." As a result, the Center strives to minimize the environmental impacts of their operations by treating all emissions through scrubbers and/or burners. Aqueous effluent is biologically treated in a BIOHOCH reactor prior to passing to the local water treatment plant for further processing.

Hoescht installed this BIOHOCH pre-treatment facility at a cost of \$4.5 million in 1988. The reactor is an advanced biological process which is the result of 20 years of development and represents a collective effort between Hoechst and Uhde GmbH. The reactor consists of a cylindrical activated sludge basin divided by a perforated plate, and a cone shaped final clarifier which forms a rind around the activated

sludge basin. The plate allows gas to be released from the sludge/water mixture, improving the settling properties of the activated sludge in the final clarifier. The activated sludge is aerated by means of radial-flow jets, which are arranged at the tank bottom. The air requirement and thus the amount of waste gas produced is substantially lower than in conventional plants as a result of highly-efficient oxygen utilization by this process.

Building Inspection Department, City of Corpus Christi

| | |
|--------------------|--------------------------------------|
| Romeo Bazan | Chief Permit Officer |
| Erik Johnson | Chief Building Inspection |
| J. Lelland Kirbow | Chief Plumbing Mechanical Inspection |
| Adalberto Palacios | Electrical Inspector I |

The Department processes and issues permits for Building, Electrical, Mechanical, Plumbing disciplines and Certificates of Occupancy in the commercial and residential construction fields.

The issuance of permit for new residential normally takes one day where as the more complicated commercial development would take not more than 5 weeks for approval.

IV. Evaluation and Follow-up

The delegation from Samut Prakarn learned a great deal from their meetings and visits in City of Corpus Christi and the surrounding industries. Officials from both cities felt that the "twin city" partnership offers an unique opportunity to discuss problems related to urban environmental infrastructure and services objectively and constructively. In Corpus Christi, the officials were very candid in discussion of the political, economic, social and technical factors affecting the decision for the solid waste and wastewater treatment facilities and programs now in operation.

V. Proposed Scope of Work for Corpus Christi Delegation to Samut Prakarn

As the main concerns are solid waste and wastewater treatment, the general consensus among the delegates from Thailand is that the reverse delegation from Corpus Christi to Samut Prakarn should focus on the two major issues.

The Objectives of the Corpus Christi Visit to Samut Prakarn should be:

- To assist in the development of a new landfill site approximately 10 acre, where the city of Samut Prakarn has recently purchased.
- To develop a pilot wastewater treatment facility on the land where the city has the ownership (site to be advised).

The tentative dates of the project will be: November 30 - December 10, 1993

The Corpus Christi Delegation will consist of:

Bhaskar Patel, Wastewater Treatment Superintendent

- Master of Engineering (Electrical) Texas A&M University - Kingsville
- Class "A" Plant operator License for wastewater issued by Texas Water Commission
- Over 20 years experience in design and operation of water & wastewater plants
- Registered Professional Engineer, Texas

Andres (Andy) Leal, Jr., Assistant Director, Solid Waste Service Department

- Bachelor of Science (Civil) Texas A&M University
- Class "A" Solid waste operations license
- Over 10 years experience
- Registered Professional Engineer, Texas

VI. Samut Prakarn Data to be Provided for the Delegation from Corpus Christi:

Solid Waste

- Topographic map(s) of landfill area including:
 - planned expansions
 - surrounding areas
- Soil data including:
 - type of soil in landfill area where there are boring logs
 - data to the planned bottom elevations
 - groundwater elevation
- Rainfall information - averages by month[?]
- Flooding information including
 - Historical flooding incidents
 - Source of flooding
 - Drainage infrastructure at the landfill and receiving body
- Municipal Solid Waste Composition study by volume and weight
 - If possible breakdown by categories such as the following:
 - Household waste
 - Construction materials
 - Industrial
 - Other
- Population the landfill will serve, and expected landfill life
- Description of how waste is transported to landfill, and estimated number of customers (dumpers) per day
- Description of equipment now used to operate landfill
- Other disposal methods and/or facilities that are under consideration to dispose of undesirable waste at the municipal landfill

Wastewater Treatment Plant

- Detailed site plan of location and surrounding area with photographs
- Strength of Sewage from different sources - before and after stream
- Per household flow, average and maximum.
- Water composition - any heavy metals, pesticides, hydrocarbons, etc.

The Samut Prakarn delegation is to provide the above information not later than end September 1993.

Communication

To facilitate communication, information should be sent by fax directly to:

| | | |
|----------------|------|--|
| Corpus Christi | FAX: | 011-512- 857-1889 Bhaskar Patel |
| Samut Prakarn | FAX: | 011-662- 395 2790 Chaiwat Thamrongrisook |

VII. Future Initiatives

Bill Hennings, Group Manager, Public Works and Utilities (promoted to Assistant City Manager in September 1993) chaired the closing meeting on Wednesday, August 26. At this meeting, the delegation from Samut Prakarn proposed that before the City of Samut Prakarn begins operation at the new landfill site, the City would like to send one/two solid waste management staff for Hands-on training on solid waste management practices in Corpus Christi. This would be an initiative of the City of Samut Prakarn and they would seek separate funding for the expenses involved. The proposal was well appreciated and would be considered when the time comes.

VIII. Public Awareness

Mayor Mary Rhodes of Corpus Christi hosted a luncheon for the delegation from Samut Prakarn on Tuesday August 17, 1993 at the City Hall. The official recognition of the delegation also took place at the weekly City Council Meeting in the same afternoon. The Assistant Mayor of Samut Prakarn Mr. Prasert Wongaroon presented to the Mayor of Corpus Christi a gift from Thailand in appreciation for the City Council's welcome and for the support extended to the City Twinning Program. The procedures were video recorded and later released on television during the news broadcast. The activities of the delegation from Samut Prakarn, Thailand were also reported in the *Corpus Christi Caller Times* on Thursday August 19 and Tuesday August 24, 1993.

LOCAL NEWS

Corpus Christi Caller Times

BEAT NOTES

COMMUNITY

Thai visitors

A group of city leaders from Samut Prakarn, Thailand, will be here through Aug. 27 touring city facilities. The group includes the assistant mayor, the city manager, director of public health and environment and two civil engineers. They will be visiting the wastewater plants, the Elliott Landfill, Chemical Waste Management, Reynold's Metal Co. and other businesses in the community. The delegation met the City Council on Tuesday. Their visit is part of a "Twinning City" project sponsored by the World Environment Center.

★ Thursday, August 19, 1993

29

LOCAL NEWS

B2/Tuesday, August 24, 1993

Corpus Christi Call-Times

BEAT NOTES



JAY JANNER/STAFF PHOTOGRAPHER

Thailand tour group

Steven S. Barnes, director of the National Spill Control School, (left) helps David Jensen, the school's associate director, put on a hazardous materials suit at Corpus Christi State University Monday. The two demonstrate the gear to representatives of Samut Prakarn, Thailand.

The visiting group includes Chaiwat Thamrongrisook, city manager (third from left); Chakthep Senivongs, project manager for the World Environmental Center Thailand office (bending); and Prasert Wongaroon, assistant mayor.

Samut Prakarn - Corpus Christi City Twinning Project, August 1993

27

BEST AVAILABLE COPY

30

IX. Annexes

ANNEX 1

City of Corpus Christi Water Treatment Facility Handouts

CITY OF CORPUS CHRISTI WATER DIVISION

TYPICAL CHEMICAL FEED RATE

LAKE CAPACITY

| | |
|------------------------------|--------------------------------|
| CHLORINE | 82 POUNDS PER MILLION GALLONS |
| ALUMINIUM SULFATE | 365 POUNDS PER MILLION GALLONS |
| FERRIC SULFATE | 33 POUNDS PER MILLION GALLONS |
| LIME | 200 POUNDS PER MILLION GALLONS |
| POLYMER | 7 POUNDS PER MILLION GALLONS |
| AMMONIA | 22 POUNDS PER MILLION GALLONS |
| FLUORIDE | 28 POUNDS PER MILLION GALLONS |
| POTASSIUM PERMANGANATE | 7 POUNDS PER MILLION GALLONS |
| POWDERED ACTIVATED CARBON | 2 POUNDS PER MILLION GALLONS |
| SODIUM CHLORITE | 20 POUNDS PER MILLION GALLONS |
| LIME DISPERSANT | 1 POUND PER MILLION GALLONS |
| FILTER AID (ANIONIC POLYMER) | 0.5 POUNDS PER MILLION GALLONS |

CITY OF CORPUS CHRISTI
WATER DIVISION
PRODUCTION ACTIVITIES
LABORATORY

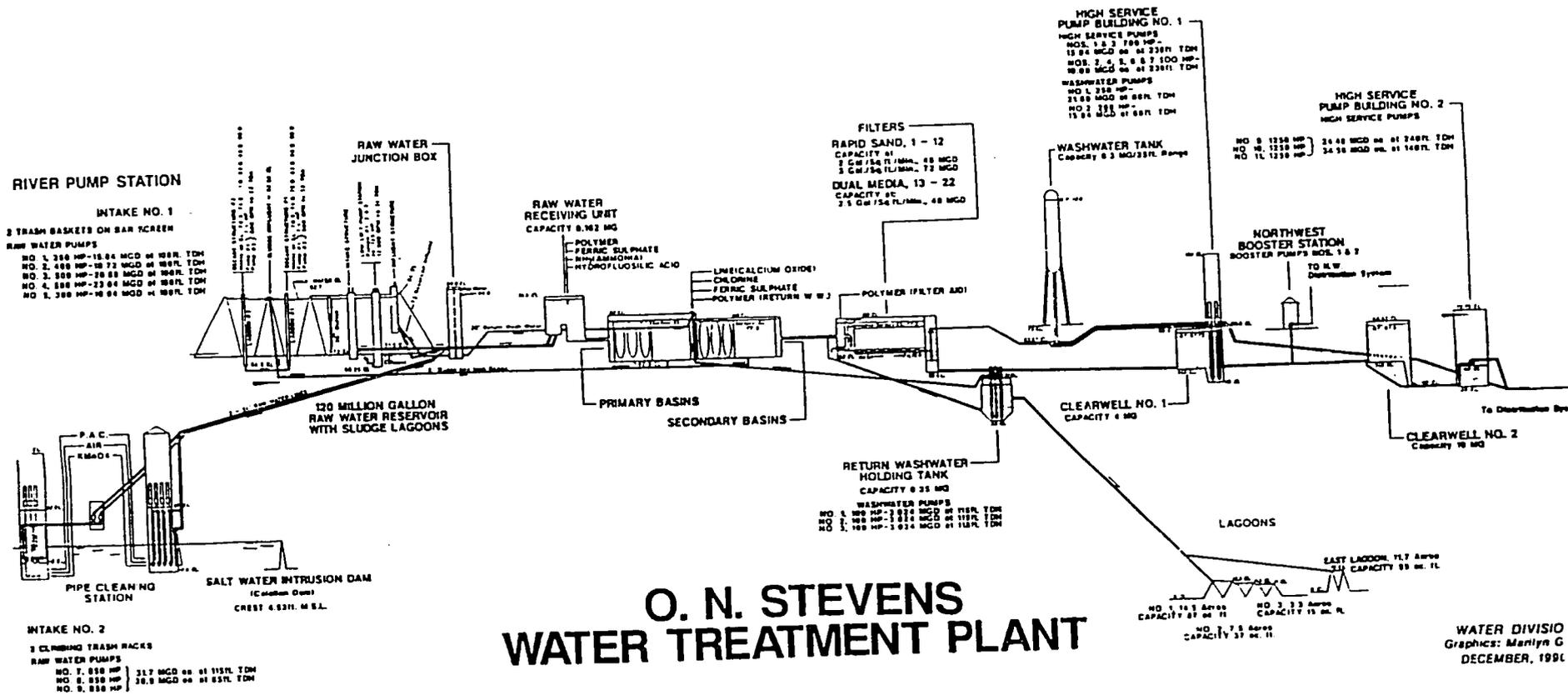
Corpus Christi, Texas 78410

TREATED WATER MINERAL AND CHEMICAL ANALYSIS

JULY 6, 1993

STEVENS
PLANT

| | |
|-------------------------|------|
| TOTAL SOLIDS..... | ==- |
| | 325 |
| PHENOL ALKALINITY..... | 2 |
| TOTAL ALKALINITY..... | 109 |
| CALCIUM..... | 52 |
| CHLORIDES..... | 91 |
| FLUORIDE..... | 0.86 |
| HARDNESS..... | 175 |
| ALUMINUM..... | 0.20 |
| MAGNESIUM..... | 11 |
| pH..... | 8.4 |
| SILICA..... | 15 |
| SODIUM..... | 94 |
| SULFATE..... | 65 |
| TURBIDITY (NTU)..... | 0.03 |



O. N. STEVENS WATER TREATMENT PLANT

WATER DIVISION
 Graphics: Marilyn G
 DECEMBER, 1991

BEST AVAILABLE COPY

ANNEX 2

City of Corpus Christi: Wastewater Treatment Facilities

BROADWAY TREATMENT PLANT

TWC Permit # 10401-05

NPDES Permit # TX0047066

Process: Two stage Trickling Filter with backwash filter

Design Flows:

| | |
|---------------------------|----------------|
| a. Average Daily Flow | 10.0 MGD |
| 2 Hr. Peak flow | 20.0 MGD |
| b. BODs Influent (Design) | 214 mg/l |
| TSS Influent | 306 mg/l |
| BODs loading | 17,848 lbs/day |
| TSS loading | 25,520 lbs/day |

Treatment Units:

1. Bar Screen
Size - 3' wide, 2" x 3/8" bars with 1" openings
Quantity - 2 in number.
2. Lift Station
Type - wet well/dry well
Pumps - Variable speed - four pumps
Minimum capacity 2.88 MGD/pump—
Maximum capacity 21.6 MGD with four pumps
3. Grit Removal - two units
Dimensions - 14' diameter - 14'x14'x3'-6" each
= 10,262 gal (2 units)

Detention time:
Flow 10 MGD - 1.5 min.
Flow 6 MGD - 2.5 min.
4. Primary Clarifiers
No. of units - two units
Dimensions - 100' diameter with 12' SWD
2: 12 bottom slope
Volume - 1,410,000 gallons (ex. bottom cone)
Detention time:
10.0 MGD - 3 hrs. 23 min.
6.0 MGD - 5 hrs 38 min.
5. High Rate Filters
No. of units - two units
Dimensions - 108' diameter with 6.5' rock depth.
Volume - 1.41 ac. ft./unit If level is 2'
Detention time:
10.0 MGD 39 min.
6.0 MGD 1 hr. 6 min.

6. Intermediate Clarifiers
 No. of units - two units
 Dimensions - 60' diameter with 10' SWD
 Volume - 422,000 gallons
 Detention time:
 10 MGD - 1.0 hr.
 6 MGD - 1.0 hr. 41 min.
7. Standard Rate Trickling Filter
 No. of units - four units
 Dimensions - 160' diameter x 5' rock depth
 Volume - 1.84 x 5 ac. ft.
 Detention time:
 10.0 MGD - 2 hrs. 53 min.
 6.0 MGD - 4 hrs. 49 min.
8. Final Clarifiers:
 No. of clarifiers - two
 Dimensions:
 1st unit - 60' diameter x 7.5' SWD
 2nd unit - 85' diameter x 7.5' SWD
 Volume - 476,690 gal
 Detention time:
 10.0 MGD - 1 hr. 8 min.
 6.0 MGD - 1 hr. 55 min.
-
9. Automatic Backwash Filters
 No. of Units - two units
 Dimension:
 16' X 114' = 1824 sq. ft.
 5.15 ft depth
- Volume of 2 filters - 140,700 gallons
 Detention time:
 10.0 MGD - 20 min.
 6.0 MGD - 34 min.

Detention Time:

10.0 MGD - 1.5 min + 3 hr. 23 min. + 39 min. + 1.0 hr
 + 2 hr. 53 min. + 1 hr. 8 min. + 20 min. = 9 hrs. 25 min.

6.0 MGD - 2.5 min. + 5 hr. 38 min. + 1 hr. 6 min.
 + 1.0 hr. 41 min. + 4 hrs. 49 min. + 1 hr. 55 min.
 + 34 min. = 15 hrs 46 min.

OSO TREATMENT PLANT

TWC Permit # 10401-04

NPDES Permit # TX0047008

Design Flows:

| | |
|---------------------------|----------------|
| a. Average Daily Flow | 16.2 MGD |
| 2 Hr. Peak flow | 98.0 MGD |
| b. BODs Influent (Design) | 225 mg/l |
| TSS Influent | 225 mg/l |
| BODs loading | 30,400 lbs/day |
| TSS loading | 30,400 lbs/day |

Treatment Units:

Plant Lift Stations
Two in number.

Lift Station 1
Design 21.5 MGD

Lift Station 2
Design 27.5 MGD

Mechanical Bar Screen:
Type - Catenary chain type
No. of units: Two units

Grit Removal:
Dimension - 60.8' x 30.0'
Water Depth - Average 16.2 ft.
Volume: 26.780 cu. ft. = 200,300 gal.
Detention Time:
Design Flow 16.2 MGD 18 min.
Actual Flow 14.0 MGD 21 min.

Mixing and Reaeration Basins:

Dimensions and Volume:

Mixing tanks

a) West Plant
Mixing tank 1 - 66,971 cu. ft.
Mixing tank 2 - 80,190 cu. ft.
Channels 19,675 cu. ft.
Total 166,836 cu. ft.
= 1,247,933 gallons

b) East Plant
Mixing tank 3 - 61,752 cu. ft.
Mixing tank 4 - 74,400 cu. ft.
Channels 19,129 cu. ft.
Total 155,281 cu. ft.
= 1,161,502 gallons

Total volume of mixing - 2,409,435 gallons

Reaeration Tanks:

a) West Plant

8 ft. Transfer Channels = 47,477 cu. ft.
4 ft. Transfer Channels = 1,947 cu. ft.
Re-Air Tank #1 = 81,180 cu. ft.
Re-Air Tank #2 = 81,180 cu. ft.
Re-Air Tank #3 = 80,685 cu. ft.
292,469 cu. ft.
= 2,187,668 gallons

b) East Plant

8 ft. Transfer Channels = 47,477 cu. ft.
4 ft. Transfer Channels = 1,947 cu. ft.
Re-Air Tank #4 = 75,360 cu. ft.
Re-Air Tank #5 = 75,360 cu. ft.
Re-Air Tank #6 = 74,880 cu. ft.
275,024 cu. ft.
= 2,057,180 gallons

Total volume of reaeration = 4,244,848 gallons

Detention time:

Mixing tank - 16.2 MGD - 1 hr. 47 min. (100% return)
 14.0 MGD - 2 hrs 4 min.

Reaeration tanks - 16.2 MGD - 6 hrs. 17 min.
 14.0 MGD - 7 hrs. 17 min.

Clarifiers

No. of Clarifier: West Plant - 4 units
 East Plant - 4 units

Dimensions:

Length - 200 ft. Width - 46 ft.

Effective Water Dept. - 12 ft.

Volume of each tank: 825,792 gallons

Clarifiers operate in parallel.

Detention time $\frac{8 \times 825,792 \text{ gallons} \times 24}{16.2 \text{ MGD}} = 9 \text{ hrs. } 47 \text{ min.}$

At 14.0 MGD $\frac{8 \times 825,792}{14.0 \text{ MGD}} = 11 \text{ hrs. } 20 \text{ min.}$

Chlorine Contact Chamber

Number of basins:

Westside Plant:

1 - rectangular channel
2 - circular tanks

East Plant:

1 - rectangular channel
2 - circular tanks

Dimensions and Volume:

West Plant:

a) Channel 406' x 4' x 14.3' W.L.
Volume - 23, 223 cu. ft.
= 173,708 gallons

b) Circular tanks
Diameter 70 ft. with 10.1 ft. W.L.
Volume each tank - 38,869 cu. ft.

Total Volume West Plant = 755,188 gallons

East Plant:

a) Channel 406' x 4' x 14.3' W.L.
Volume - 23, 223 cu. ft.
= 173,708 gallons

b) Circular tanks
Diameter 70 ft. with 8.7 ft. W.L.
Volume each tank - 33,481.5 cu. ft.
= 250,442 gallons

Total Volume East Plant = 674,592 gallons

Detention Time:

16.2 MGD West Plant $\frac{755,188}{16.2 \text{ MGD}} \times 2 \times 24 = 2 \text{ hrs. } \overline{14} \text{ min.}$

16.2 MGD East Plant $\frac{674,592}{16.2 \text{ MGD}} \times 2 \times 24 = 2 \text{ hrs.}$

TOTAL = 4 HRS 14 MIN.

Detention Time: (Chlorine Contact Chamber)

Actual flow 14.0 MGD
West Plant $\frac{755,188}{14.0 \text{ MGD}} \times 2 \times 24 = 2 \text{ hrs. } 35 \text{ min.}$

East Plant $\frac{674,592}{14.0 \text{ MGD}} \times 2 \times 24 = 2 \text{ hrs. } 19 \text{ min.}$

TOTAL DETENTION TIME = 4 HRS 54 MIN.

Plant Detention Chamber

Design Flow: 16.2 MGD

18 min. + 1 hr. 47. min. + 6 hrs 17 min. + 9 hrs. 47 min.
+ 4 hrs. 14 min. = 22 hrs. 23 min.

Actual Flow: 14.0 MGD

21 min. + 2 hr. 4 min. + 7 hr. 17 min. + 11 hrs. 20 min.
+ 4 hr. 54 min. = 25 hrs. 56 min.

- b. West Plant
 Dimensions Three Basins 76' X 32" X 15' W.D.
 Volume Three Basins 36480 ft' X 3 = 109,440 ft'
 = 818,610 gallons
- c. Total Aeration Volume = 818,610 + 786,150 gallons
 = 1,604,760 gallons
- d. Detention time
 for 5.0 MGD = 7 hours 42 minutes
 for 3.0 MGD = 12 hours' 50 minutes

Clarifiers:

Number of Units - 2
 Type - Circular 92' diameter
 Surface Area 6644 ft.' with water depth - 11 ft.
 Volume 11 X 6644 X 2 = 146,168 ft.'
 = 1,093,337 gallons

Weir length 471 feet each

Detention Time
 Flow 5.0 MGD = 5 hours 15 minutes
 Flow 3.0 MGD = 8 hours 45 minutes

Chlorine Contact Chamber

Dimension
 Basin 16' wide X 82' long
 Tanks 16' wide X 16' long
 Compartment 7.75' wide X 16' long X 13.5' water depth

Volume

Each tank - 2832' cubic feet = 21,183 gallons (liquid)
 5 tanks on each side, two sides or compartments

Total Volume = 21,183 X 2 X 5 = 211,830 gallons

Detention time
 at 5.0 MGD flow = 61 minutes or 1 hour 1 minutes
 at 3.0 MGD flow = 101 minutes or 1 hour 41 minutes

Total Detention time
 At Average Daily flow of:

5.0 MGD - 22 min. + 7 hr 42 min. + 5 hr 15 min. + 61 min
 = 14 hours 20 minutes

3.0 MGD - 36.7 min + 12 hr. 50 min + 8 hrs 45 min + 1 hr 41 min
 = 23 hrs. 53 min.

WESTSIDE TREATMENT PLANT

TWC Permit # 10401-03

NPDES Permit # TX0047074

Design Flows:

| | | |
|----|------------------------|----------------|
| a. | Average Daily Flow | 6.0 MGD |
| | 2 Hr. Peak flow | 18.0 MGD |
| b. | BOD5 Influent (Design) | 275 mg/l |
| | TSS | 345 mg/l |
| | BOD5 loading | 13,745 lbs/day |
| | TSS loading | 17,243 lbs/day |

Treatment Units:

1. Mechanical Bar Screen
One in number
Channel size 4'0 W X 8'-0" Deep
2. Lift Station
10 pumps, 10 HP, 9 - 35 HP
3. Grit Removal
a. Type - Aerated rolling type
b. Dimension:
Surface Area - 28 ft X 28 ft
Side water depth - 13' - 8"
Center water depth - 19' - 8"
c. Volume - 91,835 gallons

Detention Time:

| | |
|---------|---------|
| 6.0 MGD | 22 min. |
| 3.0 MGD | 44 min. |

Primary Clarifiers:

- a) Number of Units - 3
- b) Dimensions:
Diameter - 65'
Side water depth - 10'
Surface area - 3318 S.F.
- c) Volume - 33,183 C.F. (not including the bottom cone)
- d) Detention time
6 MGD - 3 hrs.
3 MGD - 6 hrs.

Mixing Basins and Reaeration Basins

a) Dimension:

Mixing - 32' X 118' X 17' S.W.D.
Reaeration - 2 X 32' X 118' X 17' S.W.D.
Reaeration Channels - 8' X 165' X 17' S.W.D.

b) Volume:

Mixing - 64,192 C.F. = 480,156 Gal.
Reaeration 161,704 C.F. = 1,209,546 Gal.
Total 225,896 C.F. = 1,689,702 Gal.

With 100% Recirculation

Detention time:

| | |
|--------------------|--------------|
| Mixing (12 MGD) | - 57.6 min. |
| Reaeration (6 MGD) | - 290.3 min. |
| Mixing (6 MGD) | - 115.2 min. |

FINAL CLARIFIERS

a) Number of units 2

b) Dimension:

Diameter - 106'
Side water depth - 11' - 10"
Surface area - 8,824 S.F.

c) Volume

Total - 104,417 C.F. (781,039 Gal.)

d) Flows to each unit

Total Average flows to each clarifier - 6 MGD
R.A.S. flow to reaeration - 3 MGD

Detention Time:

At average daily flow of 6.0 MGD - 187.5 min.
At average daily flow of 3.0 MGD - 375 min.

Chlorine Contact Chamber

a) Number of Unit 2

b) Dimensions

Diameter - 65'
Side Water Depth 10'

Surface Area - 3318 S.F.

c) Volume - 33,183 C.F.

Detention Time:

At average daily flow 6.0 MGD - 119 min.

At average daily flow 3.0 MGD - 238 min.

EFFLUENT STRUCTURE

Past Aeration - 1718 C.F.

Detention Time:

6 MGD - 3 min.

3 MGD - 6 min.

Total Detention Time

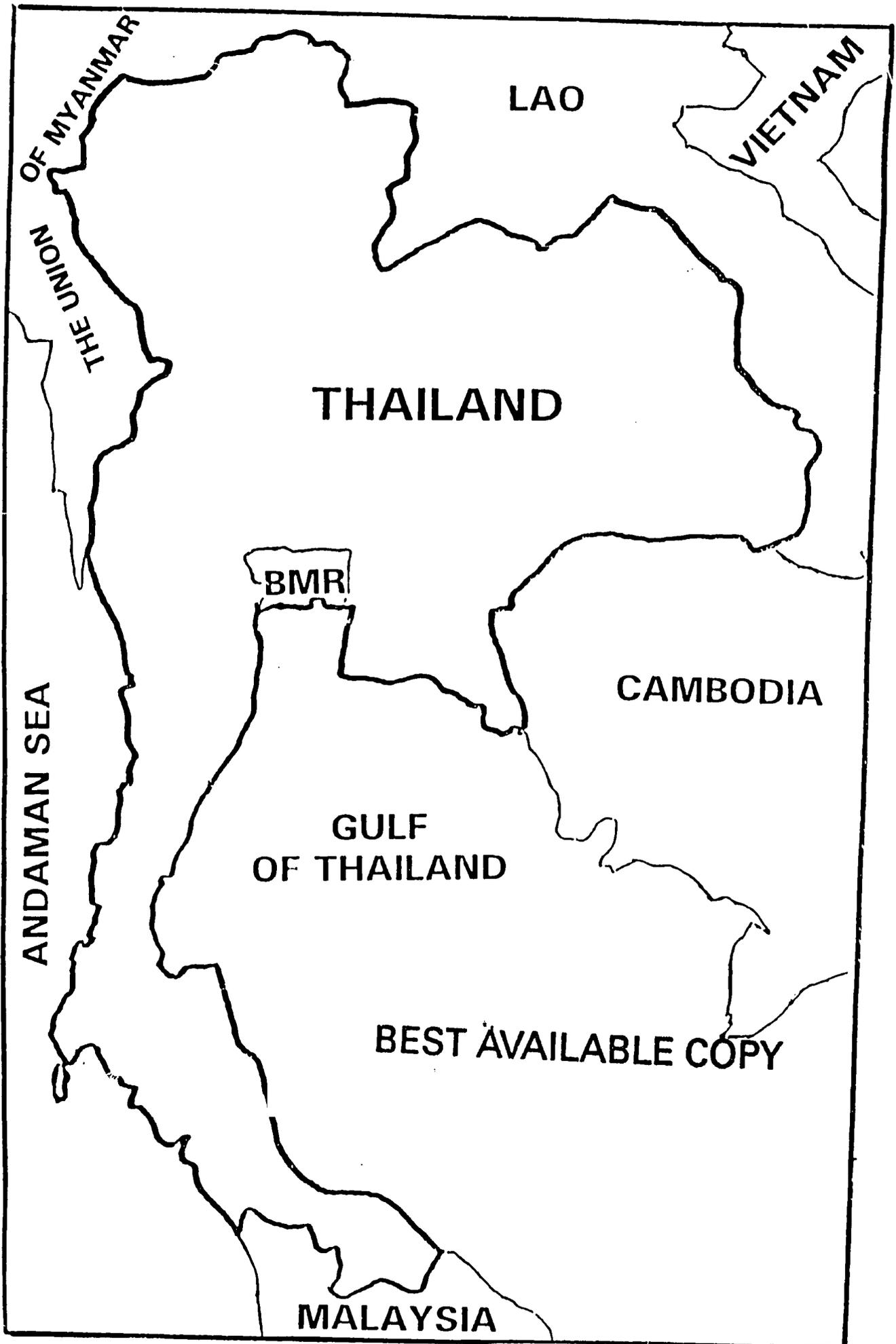
At 6.0 MGD = Av. daily flow 22 min + 3 hrs + 57.6 min + 3 hrs
7.5 min + 1 hr 59 min + 3 min
= 9 hrs 29.1 min.

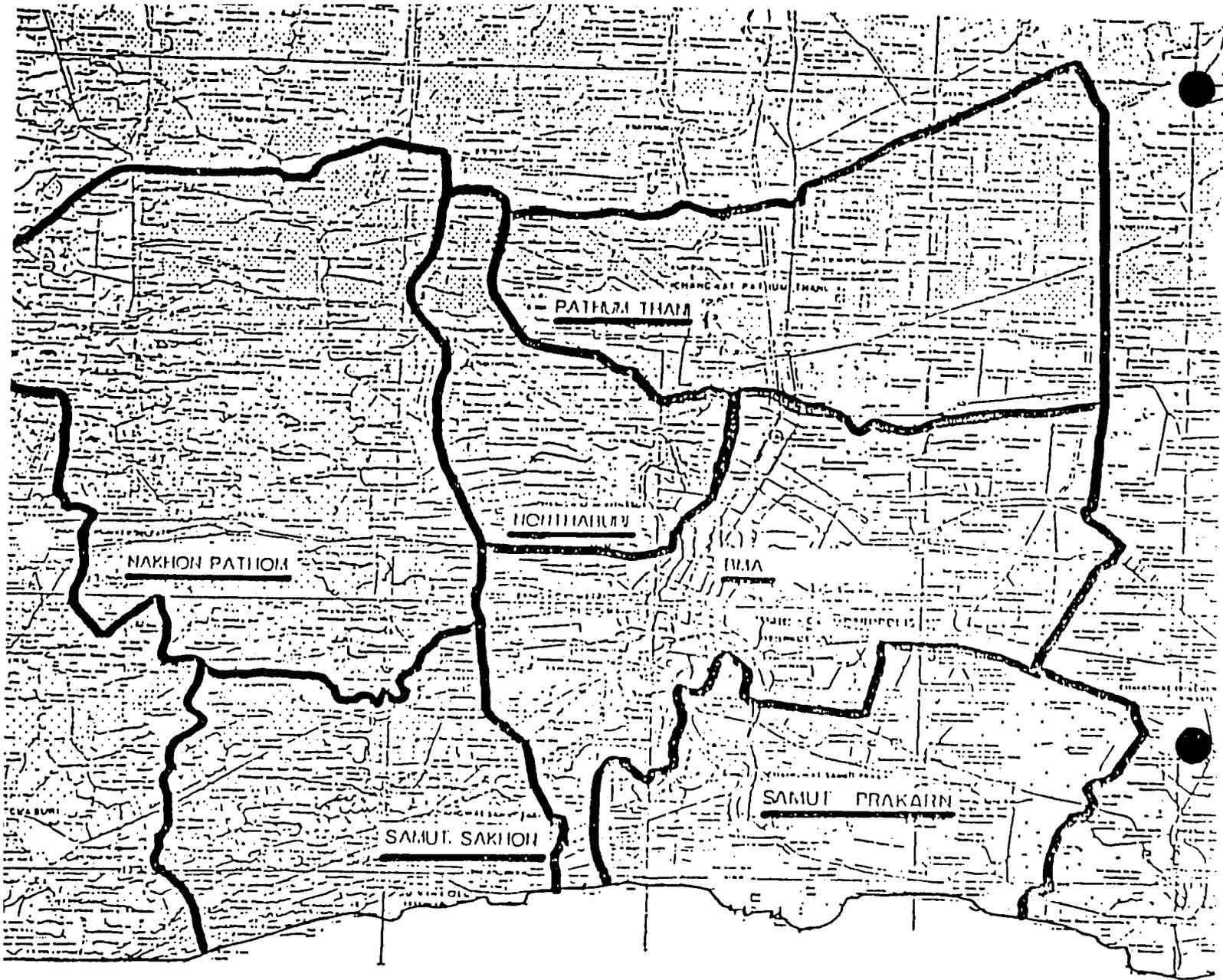
At 3.0 MGD = Av. daily flow 44 min + 6 hrs + 1 hr 55.2 min +
6 hrs 15 min + 3 hrs 58 min + 6 min
= 18 hrs 58.2 min.

plant03.bp

ANNEX 3

Samut Prakarn Presentation Slides





BEST AVAILABLE COPY

BANGKOK METROPOLITAN REGION

NAKHON PATHOM PRATHUM THANI

BANGKOK METROPOLITAN AUTHORITY

SAMUT SAKHON NONTHABURI SAMUT PRAKARN

Samut Prakarn Province

Location: * Central Plain of Thailand
 * 20 Km south of Bangkok
 * 12th Largest City of
 Thailand

Area Coverage : 890 sq.km

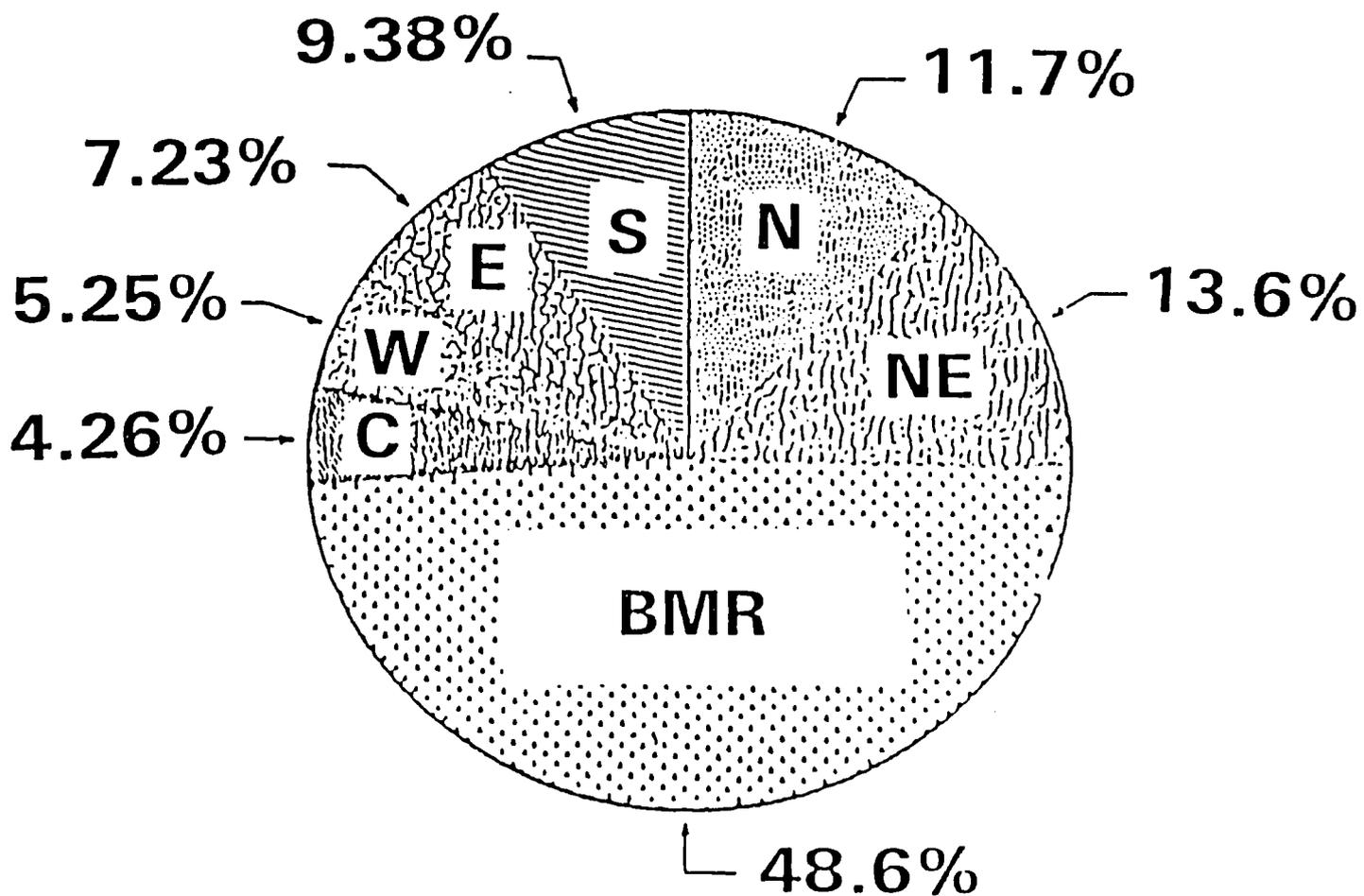
Urban Area: 15.8%

Pop. in 1990: 822,318 persons

Pop. Density: 27,700 persons/sq.km

Samut Prakarn as the country top rank:

- Most densely populated city in Thailand
- Largest & fastest growing industrial district



CONTRIBUTION TO GNP BY REGION

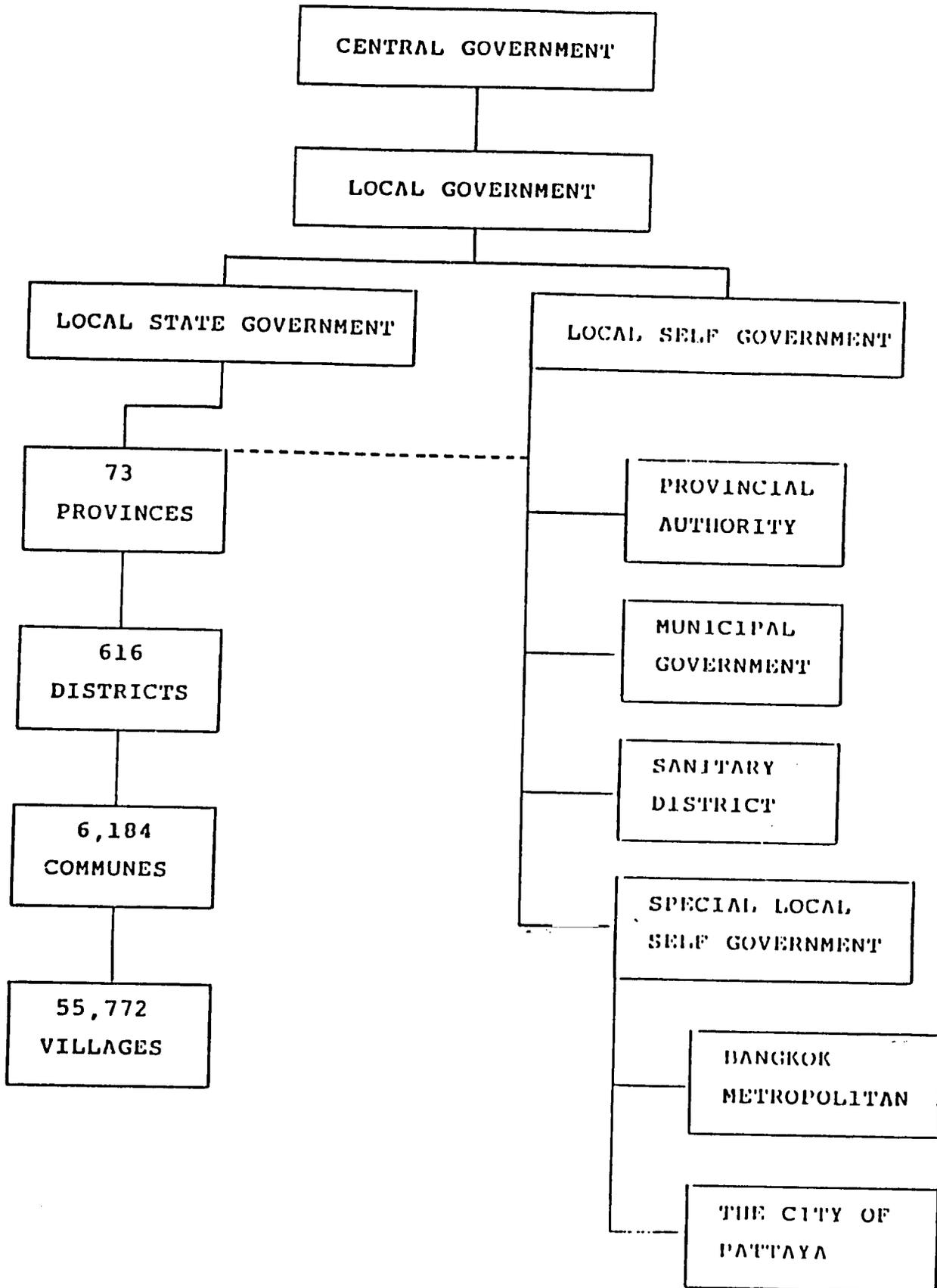
SP Municipality Problems

1. The most serious is : Solid Waste Disposal
 - * Generation Rate : 95 tons/day
 - * 80 tons is collected, 15 tons uncollected
 - * Existing 25 rai (9.88 Ha) is nearly filled
 - * Seeking to develop a 100 rai site
2. Lack of suitable wastewater treatment facilities
 - * City does not treat household wastes
3. Industrial Air Pollution
(non - functioning of Air Pollution abatement equipment and city has no control)
4. Traffic/Noise from vehicles
5. Hazardous Waste
6. Flooding

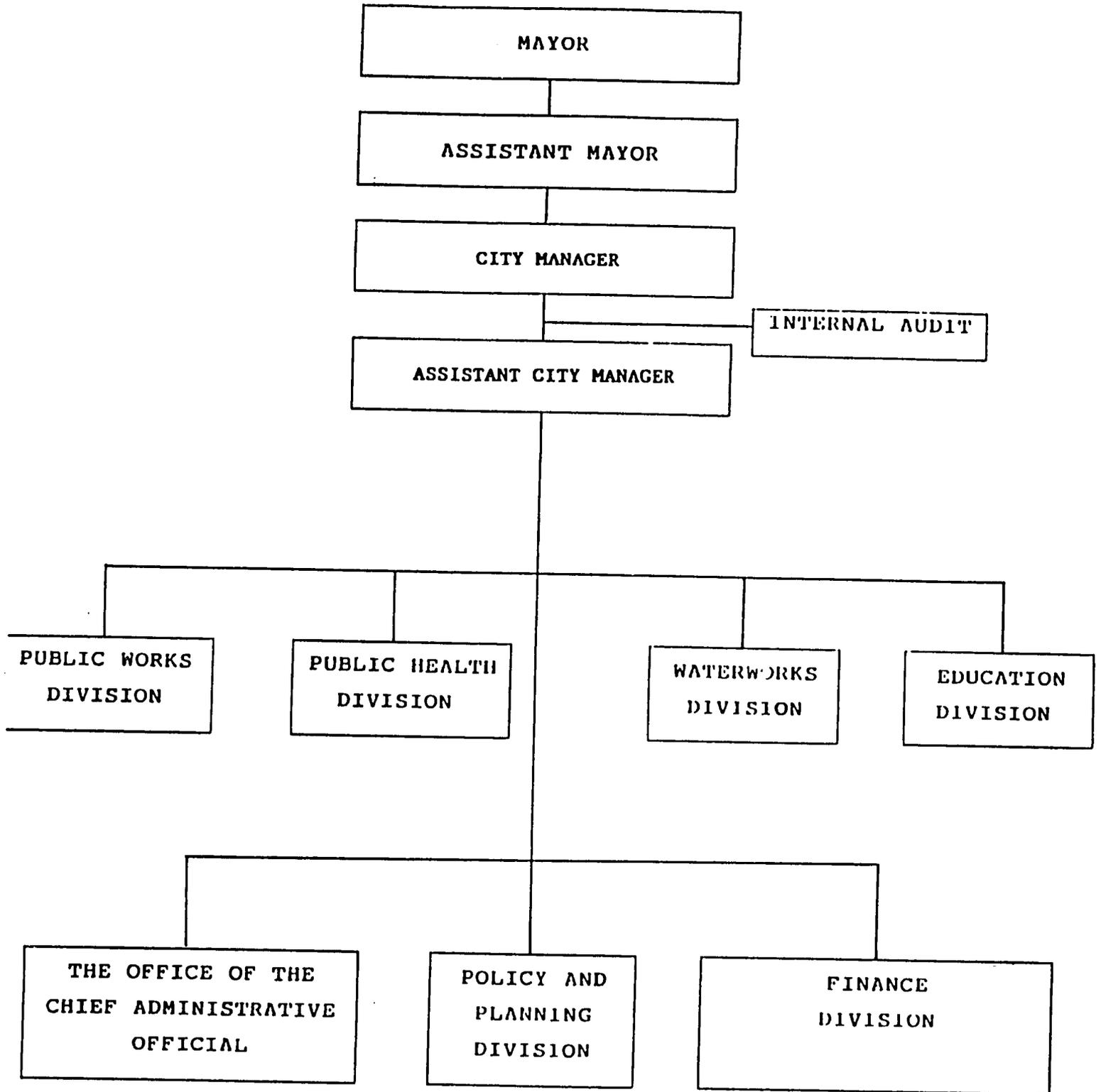
Expected Output

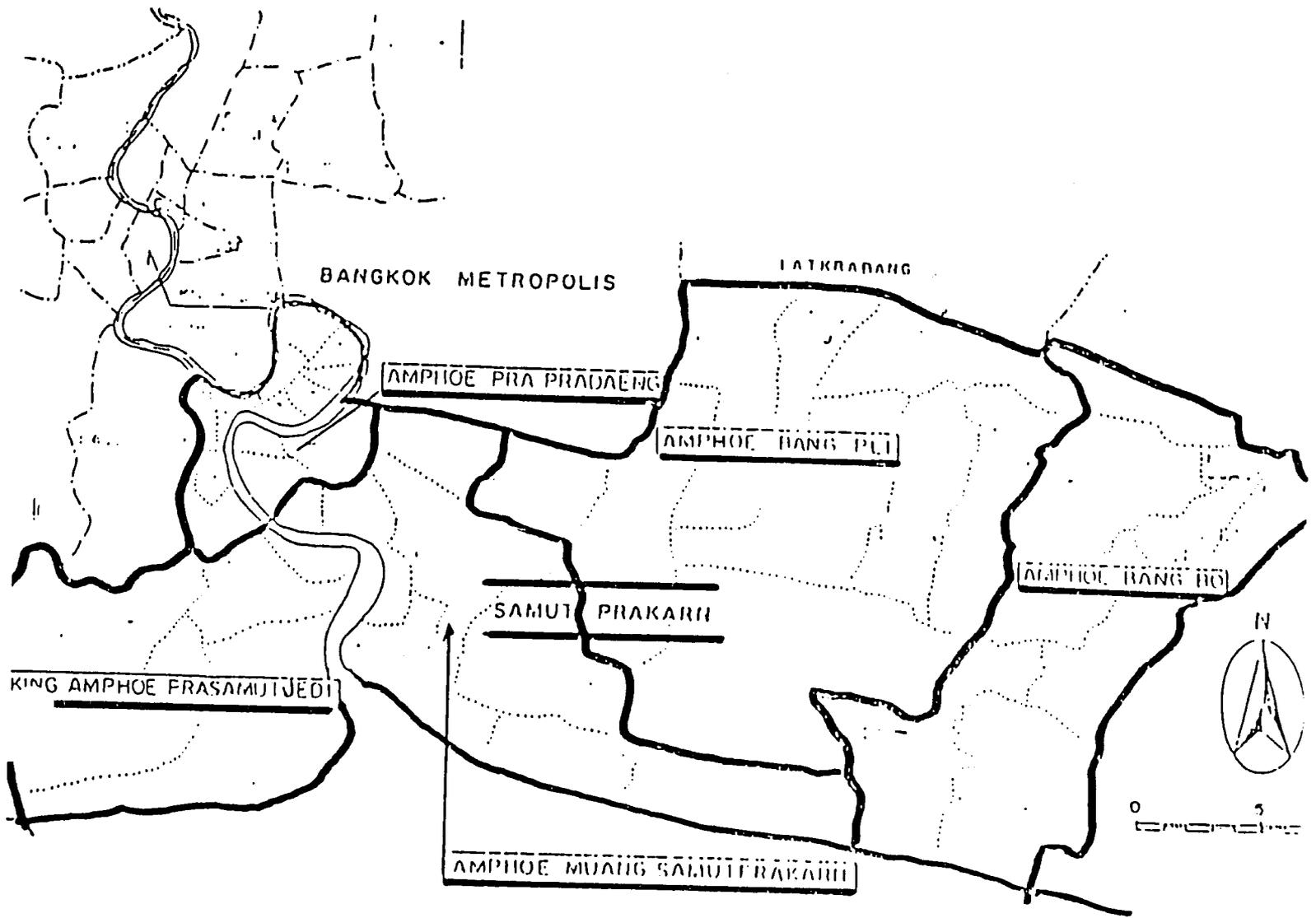
1. **Methods of improving all phases of solid waste management ie:**
 - * **Sanitary landfill management**
 - * **Recycling**
 - * **Garbage collection route management**
 - * **Solid waste collection fees structure**
 - * **Toxic waste separation methods**
 - * **Mechanical solid waste sorting means**
2. **Wastewater management cost optimization methods**
3. **Tariff structure and management**
4. **Privatization for solid waste management**
5. **Public awareness campaign to gain local support for city's initiatives**
6. **Local environmental regulation compliance**
7. **Low lying area drainage methodology**

STRUCTURE OF CENTRAL AND LOCAL GOVERNMENT



GENERAL ORGANIZATION STRUCTURE OF THE MUNICIPALITY

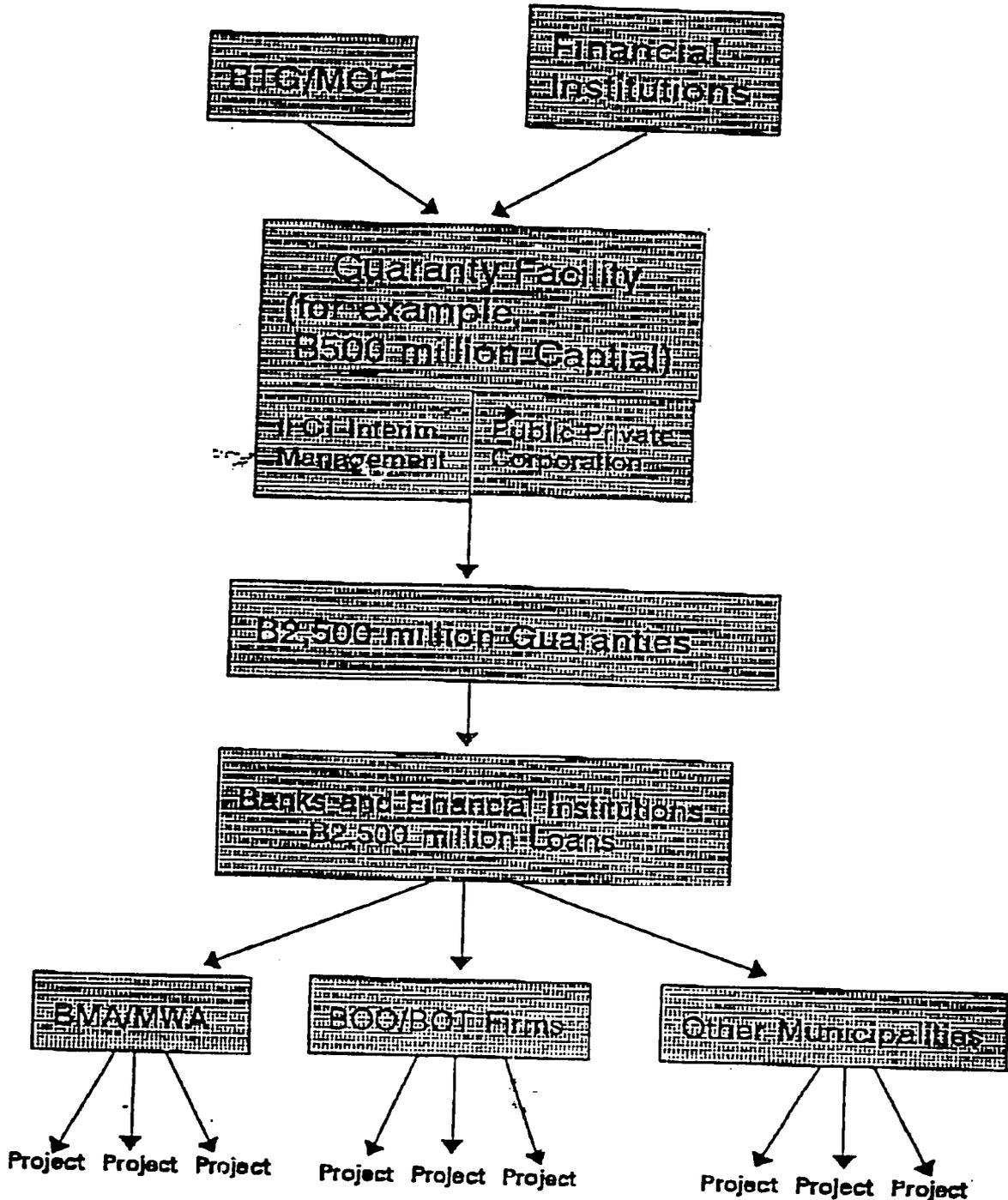




BEST AVAILABLE COPY

LOCATION PLAN OF
SAMUT PRAKARN PROVINCE

STRUCTURE OF URBAN INFRASTRUCTURE CREDIT GUARANTY FACILITY



BEST AVAILABLE COPY

57

ANNEX 4

Itinerary

Thailand Twinning City Project Program Schedule

- August 14, 1993** 7:43 P.M. Arrival from Thailand on American Airline Flight No. 755 - Bhaskar and Ron to pick up from Airport. Staying at Marriott Hotel
- August 15, 1993** Free time.
- August 16, 1993** Victor to pick up from hotel. Water Presentations/GIS in the morning.
- Lunch at Gallagers with City Staff (Juan Garza, Bill Hennings, Bob Bruner, Victor Medina, Ed Garana, Foster Crowell, Wayne Cockroft, Hubert Hall, Victor Salas, Norma Ramirez, Mercedes Salinas, Steve Klepper, James Dodson, and Bhaskar Patel.
- Stevens Plant Tour in the afternoon.
(Victor to arrange.)
- August 17, 1993** Meeting with Steve Klepper at 8:30 a.m. to 10:00 a.m. Finance Department/Capital Financing; Utilities Business Office with Victor Salas at 10 a.m. to 12:00.
- (Steve to drive from hotel to City Hall.)
- Lunch with City Council at 6th floor Conference Room catered by Bar-B-Que Man.
- Recognition at City Council meeting.
Free time after meeting.
- August 18, 1993** Wastewater tour. Lunch to be provided.
(Bhaskar to drive.)
- August 19, 1993** Meeting with Solid Waste Staff; recycling overview and landfill presentation/tour.
(Estela/Ralph to drive.)

- August 20, 1993** Visit to Texas Ecologists Inc. in the morning; Hazardous Waste Landfill Site, 8:30 to 11:00 - Bob Marchard; 387-3518.
- Lunch on their own.
- Chemical Waste Management in the afternoon, Injection wells for hazardous waste. (Bhaskar to drive.)
- August 21 and 22** Free Time. Bhaskar to get contractors in touch with delegation.
- August 23, 1993** Visit Corpus Christi State University, Spill prevention school, Coastal Studies, Fisheries and Wildlife. 9:00 a.m. to 11:00; Dr. Ruth Bakke; 994-2349 and Dave Jansen; 994-2688. (James to drive.)
- Engineering Department/Contracts at 1:30 p.m. and Planning Department/mapping at 3 p.m.
- August 24, 1993** Visit and tour Reynolds Metals; Industrial Wastewater Treatment, safety issues, air pollution control. 9:30 a.m. to 1:00. Tony Dunn; 777-2294.
- Tour of Police, Fire and Emergency Mgt. (Mercedes to drive.)
- August 25, 1993** Visit Encycle Inc; hazardous waste treatment, minimization and recycling. Includes lunch. 9:30 to 11:30 - Jim O'Neil; 289-0300.
- Visit the Texas Water Commission regional office in the afternoon, Regulators - Water, Solid Waste and hazardous waste issues. 2:00 p. m.. Mickey Garza; 851-8484 (Ron to drive.)
- August 26, 1993** Visit Hoechst Celanese Technical Center in the morning; a chemical manufacturing research center-tour of laboratories, the wastewater pretreatment plant, etc. Includes lunch. (Bhaskar to drive.)
- August 27, 1993** Visit the Port Authority in the morning. Greg Breubeck, Director of Engineering.
- Afternoon shopping. (Mercedes to drive.)
- August 28, 1993** 8:54 a.m. departure on American Airlines Flight No. 382. (Bhaskar to drive to Airport.)

ANNEX 5

Business Cards of Persons Contacted



ไชยวัฒน์ ชำรงศรีสุข
 ปลัดเทศบาลเมืองสมุทรปราการ
 CHAIWAT THAMRONGSRISOOK

ที่ทำงาน โทร. ๐๙๙๒๘๙๐
 ๐๙๙๐๐๒๘
 ๐๙๙๐๐๒๘ CITY MANAGER ฝ่ายปลูก
 โทร. ๐๙๙๐๐๒๘ SAMUT PRAKARN

PRASERT WONGARON

Assistant Mayor of Samutprakan Municipal

SAMUTPRAKAN MUNICIPAL
 1 SUTHEPVIHOM ROAD, AMPHUR MUANG
 SAMUTPRAKAN 10270, THAILAND. TEL: 662-3954138

PRASERT NA SONGKHLA
 Director of Public Health and Environment

Smutprakarn Municipality
 Thailand 10270 Home
 Tel. 662-3880501 Tel. 662-3952998

ประวี พันธ์เข้าแก้ว
 วิศวกรโยธา

กองช่าง เทศบาลเมืองสมุทรปราการ
 อ. เมือง จ. สมุทรปราการ โทร. ๐๒-๓๑๕๔๔๐๒

PRAWEE PUNNON
 CIVIL ENGINEERING
 TEL. 3954492 SAMUTPRAKARN MUNICIPALITY THAILAND

BEST AVAILABLE COPY

WEC World Environment Center
 Thailand Office

จักรเทพ เสนีวงศ์ ณ อยุธยา
 CHAKTHER SENIVONGS
 PROJECT MANAGER

WORLD ENVIRONMENT CENTER
 SILOM PLAZA, SECOND LEVEL,
 401/43-44 SILOM ROAD,
 BANGNAK, BANGKOK 10000
 THAILAND

TEL : (002) 236-8727
 FAX : (002) 237-6000

62



**City of
Corpus
Christi**

Lloyd C. Lindeburg
Gas Superintendent

Gas Department
4225 South Port Avenue
Corpus Christi, Texas 78415-5311
(512) 854-4396




**City of
Corpus
Christi**

James Dodson
Regional Water Director

1201 Leopard P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 880-1868



BEST AVAILABLE COPY



**City of
Corpus
Christi**

Robert E. Payne, AICP
Senior Planner

Planning and Development
P.O. Box 9277
(City Hall - 1201 Leopard)
Corpus Christi, Texas 78469-9277
(512) 880-3560




**City of
Corpus
Christi**

Miguel S. Saldana, AICP
City Planner

Planning Department
P.O. Box 9277
(City Hall - 1201 Leopard)
Corpus Christi, Texas 78469-9277
(512) 880-3860





**City of
Corpus
Christi**

Juan Lerma
Field Representative

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1815 FAX (512) 857-1889



**City of
Corpus
Christi**

Olga Rodriguez
Plant Supervisor II

Department of Public Utilities
Wastewater Services Division
1300 Saratoga - P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 855-7821



**City of
Corpus
Christi**

Julian Buentello
Plant Supervisor I

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1818
Fax (512) 857-1889



**City of
Corpus
Christi**

Wesley Mackenzie
Plant Supervisor III

Department of Public Utilities
Wastewater Services Division
501 N. ... P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 991-5576





**City of
Corpus
Christi**

Romeo Bazan
Chief Permit Officer

Building Inspection Department
P.O. Box 9277
(City Hall - 1201 Leopard)
Corpus Christi, Texas 78469-9277
(512) 880-3240




**City of
Corpus
Christi**

Erik Johnson
Chief Building Inspector

Inspection Division
P.O. Box 9277
(City Hall - 1201 Leopard)
Corpus Christi, Texas 78469-9277
(512) 880-3256



BEST AVAILABLE COPY



**City of
Corpus
Christi**

J. Leland Kirbow
*Chief Plumbing
Mechanical Inspector*

P.O. Box 9277
(City Hall-1201 Leopard)
Corpus Christi, Texas 78469-9277
(512) 880-3275




**City of
Corpus
Christi**

Adalberto Palacios
Electrical Inspector I

Building Inspection Dept.
P.O. Box 9277
City Hall - 1201 Leopard
Corpus Christi, Texas 78469-9277
(512) 880-3273





City of
Corpus
Christi

Captain Leonard B. Scott
Central Information

Police Department
P.O. Box 9016
321 John Sartan Street
Corpus Christi, Texas 78401
(512) 886-2746



City of
Corpus
Christi

Patrick B. McMacken
Administrative Assistant

Emergency Management
P.O. Box 9277
1201 Leopold Street
Corpus Christi, Texas 78401
(512) 880-1700



City of
Corpus
Christi

Police Department

Michael S. White
Sergeant

Communications

P. O. Box 9016
Corpus Christi, Texas 78409

Office 886-2801 Area Code Box 886-2600
Emergency 911 512 Fax 888-5142

66



City of
Corpus
Christi

Carl E. Crull, P.E.
Director of Engineering Services
City Engineer
(City Hall-1201 Leopard)
P.O. box 9277
Corpus Christi, Texas 78469-9277
(512) 880-3504



City of
Corpus
Christi

Victor M. Salas
Manager

Utilities Business Office
P.O. Box 9097
(City Hall-1201 Leopard)
Corpus Christi, Texas 78469-9097
(512) 880-3411



BEST AVAILABLE COPY

MUCIO GARZA
ENGINEER

CITY OF CORPUS CHRISTI
512-857-6455 WK



City of
Corpus
Christi

Robert T. Bruner
Director

Solid Waste Service Department
2525 Hygeia-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1966 857-1965



City of
Corpus
Christi

Andres (Andy) Feul, Jr., P.E.
Assistant Director

Solid Waste Services
P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1966
857-1970



City of
Corpus
Christi

Estela Garcia
*Administrative Assistant III/
Recycling Coordinator*

Solid Waste Service
P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1970



City of
Corpus
Christi

Douglas Pelko
Administrative Assistant II

Solid Waste Services Department
2525 Hygeia-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1968



BEST AVAILABLE COPY



**City of
Corpus
Christi**

Victor S. Medina, P.E.
Water Superintendent

P.O. Box 9277
(5352 Ayers-Blk) RA)
Corpus Christi, Texas 78469-9277
(512) 857-1888
Fax (512) 857-1889



**City of
Corpus
Christi**

Valerie H. Gray
Water Construction Superintendent

Water Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1880



**City of
Corpus
Christi**

Hubert R. Hall
Water Production Superintendent

Water Division
P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1871 (512) 242-9131
Fax (512) 241-7209



**City of
Corpus
Christi**

Eduardo Garana, P.E.
Assistant Water Superintendent

Water Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1881



BEST AVAILABLE COPY

69



City of
Corpus
Christi

Wayne R. Cockroft, P.E.
Wastewater Superintendent

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1800 FAX (512) 857-1889



2419158



City of
Corpus
Christi

Bhaskar Patel, P.E.
Wastewater Treatment Superintendent

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1806 FAX (512) 857-1889



City of
Corpus
Christi

Foster D. Crowell
Assistant Wastewater Superintendent

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1800 FAX (512) 857-1889



BEST AVAILABLE COPY

76



City of
Corpus
Christi

Juan Lerma
Field Representative

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1815 FAX (512) 857-1889



City of
Corpus
Christi

Olga Rodriguez
Plant Supervisor II

Department of Public Utilities
Wastewater Services Division
1300 Saratoga P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 855-7821



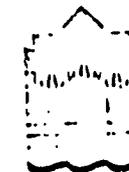
BEST AVAILABLE COPY



City of
Corpus
Christi

Julian Buentello
Plant Supervisor I

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1818
Fax (512) 857-1889



City of
Corpus
Christi

Wesley Mackenzie
Plant Supervisor III

Department of Public Utilities
Wastewater Services Division
501 5th P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 855-7821



71



City of
Corpus
Christi

A.C. (Lonnie) Dearman
Superintendent of Landfills

Sanitation Division
P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 854-3164



City of
Corpus
Christi

Danny N. Ybarra, P.E.
Facilities Superintendent

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1805 FAX (512) 857-1889



City of
Corpus
Christi

Mercedes M. Salinas
Administrative Assistant II

Public Utilities
P.O. Box 9277
(5352 Ayers-Bldg. 8A)
Corpus Christi, Texas 78469-9277
(512) 857-1840



City of
Corpus
Christi

Ron Strahlendorff
Compliance Investigator

Department of Public Utilities
Wastewater Services Division
5352 Ayers-P.O. Box 9277
Corpus Christi, Texas 78469-9277
(512) 857-1804 FAX (512) 857-1889



BEST AVAILABLE COPY

Gary A. Jeffress, Ph.D., RPLS (512) 994-2720
Director, Geographic Information Science
Blucher Institute FAX (512) 994-2715

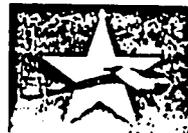


Corpus Christi State University

The Island University

6300 Ocean Drive, Corpus Christi, Texas 78412
A Member of The Texas A&M University System

Dr. Steven S. Barnes (512) 991-8692
Director, National Spill Control School
and Professor of Chemistry FAX (512) 994-2737



CORPUS CHRISTI STATE UNIVERSITY

6300 Ocean Drive, Corpus Christi, Texas 78412
A Campus of The Texas A&M University System

BEST AVAILABLE COPY

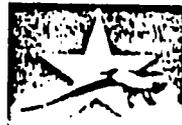
David A. Jensen (512) 991-8692
Associate Director FAX (512) 994-2737
National Spill Control School



CORPUS CHRISTI STATE UNIVERSITY

6300 Ocean Drive, Corpus Christi, Texas 78412
A Campus of The Texas A&M University System

Roy D. Coons (512) 991-8692
Instructor FAX (512) 994-2737
National Spill Control School



CORPUS CHRISTI STATE UNIVERSITY

6300 Ocean Drive, Corpus Christi, Texas 78412
A Campus of The Texas A&M University System

Hoechst Celanese

Dr. Peter K. Eckardt
Manager of
Piloting Services

Research Division
Hoechst Celanese Corporation
Corpus Christi Technical Center
1901 Clarkwood Road
PO Box 9077
Corpus Christi, TX 78469
512 242 4197
Fax 512 242 4208

Hoechst [H]

Hoechst Celanese

Les Wade
Manager
Environmental Technology/
Customer Technical Services

Chemical Group
Hoechst Celanese Corporation
Corpus Christi Technical Center
1901 Clarkwood Road
PO Box 9077
Corpus Christi, TX 78469
512 242 4291
Fax 512 242 4087

Hoechst [H]

Hoechst Celanese

Kenneth A. Roberts
Regulatory Affairs
Group Leader

Research Division
Hoechst Celanese Corporation
Corpus Christi Technical Center
PO Box 9077
Corpus Christi, TX 78469-9077
512 242 4512
Fax 512 242 4161

Hoechst [H]

Hoechst Celanese

George C. Seaman
Engineering Associate

Chemical Group
Technical Center
PO Box 9077
Corpus Christi, TX 78469-9077
512 242 4564
Fax 512 242 4161

Hoechst [H]

Hoechst Celanese

Wolfgang Horz
Process Engineer

Chemical Group
Hoechst Celanese Corporation
Corpus Christi Technical Center
1901 Clarkwood Road
PO Box 9077
Corpus Christi, TX 78469
512 242 4166
512 242 4109

Hoechst [H]

BEST AVAILABLE COPY

74



Port of Corpus Christi Authority
 P. O. Box 1541 (78403)
 222 Power Street (78403)
 Corpus Christi, Texas
 Office: (512) 882-5633
 FAX: (512) 882-7110

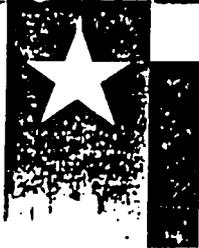
Ed Allemus
 Director of
 Trade Development



TONY DUNN
 Technological Superintendent

Sherwin Plant
 REYNOLDS METALS COMPANY

P. O. Box 9911
 Corpus Christi, TX 78408
 (512) 643-8531
 777-2304



Rodolfo (Rudy) L. Delgado
 Vice President and
 Foreign Trade Director

**Corpus Christi Bay Area
 Economic Development
 Corporation**

512-883-5571
 1201 N. Shoreline, P.O. Box 640
 Corpus Christi, Texas 78403
 Fax 512-883-5027

Corpus Christi Bay Area
 Discover It

Res.: 512-991-8955



ARLON BOATMAN

Health & Safety Manager
 Sherwin Plant
 REYNOLDS METALS COMPANY

P.O. Box 9911
 Corpus Christi, TX 78408
 (512) 777-2256
 Fax (512) 777-2607



Al Ballowe
 Recycling Supervisor
 Corpus Christi District

4414 Agnes (78405)
 P.O. Box 270310
 Corpus Christi, Texas 78427-0310

(512) 883-8470
 Fax: (512) 854-2111



Chemical Waste Management, Inc.

Corpus Christi Waste Treatment Facility
 P.O. Box 9295
 Corpus Christi, TX 78469
 512/852-8284

Zelner Houchin
 General Manager

BEST AVAILABLE COPY



Chemical Waste Management, Inc.

Corpus Christi Waste Treatment Facility
 P.O. Box 9295
 Corpus Christi, TX 78469
 512/852-8284

Timothy J. Martin
 Environmental Manager

John K. Likarish
President

ENCYCLE
PROTECTING TOMORROW... TODAY

A Subsidiary of
ASARCO

ENCYCLE/TEXAS, INC.
5500 Up River Road
Corpus Christi, TX 78407
512-289-0300
512-289-7415 FAX

Elizabeth Payne
Environmental Manager

ENCYCLE
PROTECTING TOMORROW... TODAY

A Subsidiary of
ASARCO

ENCYCLE/TEXAS, INC.
5500 Up River Road
Corpus Christi, TX 78407
512 289 0300
512 289 6713 FAX

James W. O'Neill
Executive Vice President
Sales and Marketing

ENCYCLE
PROTECTING TOMORROW... TODAY

A Subsidiary of
ASARCO

ENCYCLE/TEXAS, INC.
5500 Up River Road
Corpus Christi, TX 78407
512-289-0300
512-289-7415 FAX

Carla Wallace
Administrative Assistant
Executive Office

ENCYCLE
PROTECTING TOMORROW... TODAY

A Subsidiary of
ASARCO

ENCYCLE/TEXAS, INC.
5500 Up River Road
Corpus Christi, TX 78407
512 289 0300
512-289-7415 FAX

S. Rick Gilbert
Technical & Business
Development Manager

ENCYCLE
PROTECTING TOMORROW... TODAY

A Subsidiary of
ASARCO

ENCYCLE/TEXAS, INC.
5500 Up River Road
Corpus Christi, TX 78407
512-289-0300
512-289-7415 FAX

BEST AVAILABLE COPY

76



Texas Ecologists, Inc.

A Subsidiary of US Ecology, Inc.

Larry Reiter
Site Engineer

512/387-3518
TX WATS 1-800-242-3209

P.O. Box 307
Robstown, Texas 78380



TEXAS WATER COMMISSION
District 12

MICKEY GARZA

Field Investigator
Field Operations Division

Commerce II
Area Code 512
851-8484

Suite 47
4410 Dillon Lane
Corpus Christi, Texas 78415-5326

BEST AVAILABLE COPY



Port of Corpus Christi Authority
P. O. Box 1541 (78403)
222 Power Street (78401)
Corpus Christi, Texas
Office: (512) 882-5633
FAX: (512) 882-7110

(See Reverse)

Greg Brubeck, P.E.
Deputy Director of Engineering Services

77

Mayor and City Council Membors

Mayor Mary Rhodes

Dr. Jack Best
Edward A. Martin
Clif Moss
Betty Jean Longonia
Cezar Galindo
David Noyola
Dr. David McNichols
Melody Cooper

City Staff

Júan Garza, City Manager

Bill Hennings, Group Manager/Public Works and Utilities
Tom Utter, Group Manager/Development Services
Jorge Garza, Group Manager/Administration Services
Joe Montez, Management and Budget Director
Rosie Vela, Finance Director
Victor Salas, Utilities Office Business Manager
Wayne Cockroft, Wastewater Superintendent
Foster Crowell, Assistant Wastewater Superintendent
Bhaskar Patel, Wastewater Treatment Superintendent
Ron Strahlendorff, Compliance Investigator
Keith Rodriguez, Engineer Assistant II
Victor Medina, Water Superintendent
Eduardo Garana, Assistant Water Superintendent
Hubert Hall, Production Superintendent
Valerie Gray, Water Construction Superintendent
James Dodson, Regional Water Coordinator
Mercedes Salinas, Administrative Assistant III
Steve Klepper, Public Works Financial Officer
Norma Ramirez, Executive Secretary/Public Works & Utilities
Marcus C. Garcia, Stormwater General Foreman
Carl Crull, Engineering Director
Brandol Harvey, Planning Director

ANNEX 6

List of Documents Received

1. **City of Corpus Christi, Texas**
 - 1.1 **Annual Budget, Fiscal Year 1992 - 1993**
 - 1.2 **Comprehensive Annual Financial Report, For the Fiscal Year Ended July 31, 1992**
 - 1.3 **Corpus Christi Policy Statements, An Element of the Comprehensive Plan**
 - 1.4 **Utilities Business Office Division**
 - 1.5 **Utility Financial Issues & Trends: An Overview of the City of Corpus Christi Wastewater and Water Utilities, Prepared for The Delegation from Samut Prakarn, Thailand**
 - 1.6 **1993 Facility Profile**
 - 1.7 **Commercial and Industrial Waste Disposal and Pretreatment Ordinance, City of Corpus Christi, Wastewater Division, June 1992**
 - 1.8 **Wastewater Collection System Overview, Water Utilities Wastewater Division**
 - 1.9 **Emergency Preparedness Plan, August 1, 1991**
 - 1.10 **Building Inspection Department,**
 - 1.10.1 **Permit Fee Schedule, August 12, 1991**
 - 1.10.2 **Permit and Administrative Fee Schedule**
 - 1.10.3 **Plan Review Checklist**
 - 1.10.4 **Various Forms and Permit on Electrical Inspection**
 - 1.11 **Broadway Treatment Plant Process Design, TWC Permit # 10401-05, NPDES Permit # TX0047066**
 - 1.12 **Corpus Christi Deepwell, Facility Fact Sheet**
 - 1.13 **What to Do In Case of Chemical Emergency, What are some Types of Chemical Emergencies? Brochure**
2. **College of Science and Technology and the National Spill Control School, Corpus City State University:**
 - 2.1 **The Conrad Institute for Surveying and Science,**
 - 2.2.1 **Meeting and Presentation Notes for Samut Prakarn Delegation on August 23, 1993**
 - 2.2.2 **Oil and Hazardous Materials Spill Response Exercises Slides**
 - 2.2 **MSDS Pocket Dictionary, National Spill Control**
3. **U.S. Department of Transportation**
 - 3.1 **1990 Emergency Response Guidebook, Guidebook for First Response to Hazardous Materials Incidents, Dot P 5800.5: Research and Special Programs Administration**
 - 3.2 **1987 Emergency Response Guidebook, Guidebook for First Response to Hazardous Materials Incidents, Dot P 5800.5: Research and Special Programs Administration**
 - 3.3 **1989 Emergency Response Guidebook, Hazardous Materials**

4. **Federal Emergency Management Agency, Washington, D.C. 20472: Are You Ready ?, Your Guide to Disaster Preparedness**
5. **Lab Safety Supply**
 - 5.1 **1993 General Catalog, Spring/Summer Edition**
6. **Fisher Scientific, Safety Products Division**
 - 6.1 **The Fisher Safety Products Reference Manual**
7. **Ericsson GE Mobile Communications Inc:**
 - 7.1 **AEGIS™, Advance Digital Technology, Understanding AEGIS**
 - 7.2 **EDACS, Enhance Digital Access Communications System, Understanding EDACS**
8. **Centers for Disease Control**
 - 8.1 **Pocket Guide to Chemical Hazards, NIOSH, U.S. Department of Health and Human Services, Centers for Disease Control, National Institutes for Occupational Safety and Health**
9. **USEPA**
 - 9.1 **Drinking Water Handbook for Public Officials, Office of Water, EPA 810-B-92-016, December 1992**
 - 9.2 **Decision-Makers Guide To Solid Waste Management, Solid Waste and Emergency Response (OS-305), EPA/530-SW-89-072, November 1989**
 - 9.3 **Sites for Our Solid Waste, A Guide for Effective Public Involvement, Solid Waste and Emergency Response (OS-305), Policy, Planning and Evaluation (PM-221), EPA/530-SW-90-019, March 1990**
 - 9.4 **Let's Reduce and Recycle: Curriculum for Solid Waste Awareness, Solid Waste and Emergency Response (OS-305), EPA/530-SW-90-005, August 1990**
 - 9.5 **Chemicals in Your Community, A guide to the Emergency Planning and Community Right-to-Know Act, September 1988**
10. **Federal Register**
 - 10.1 **Part II: Environmental Protection Agency: 40 CFR Parts 257 and 258, Solid Waste Disposal Facility Criteria; Final Rule, Wednesday October 9, 1991**
11. **Hoechst Celanese, Corpus Christi Technical Center**
12. **Texas Register**
 - 12.1 **Title 31, Natural resources and Conservation, Part IX. Texas Water Commission, Chapter 330, Municipal Solid Waste**
13. **Federal Emergency Management Agency**

- 13.1 In Time of Emergency, A Citizen's Handbook, H-14/October 1985
- 13.2 Hurricane Awareness, Action Guidelines for School Children
- 13.3 When You Return to a Storm Damaged Home, Disaster Assistance Programs

- 14. Texas Ecologists, Inc., Visitor/Contractor on-Site Authorization

- 15. Encycle Booklet

- 16. Reynolds Metals Company, Sherwin Alumina Plant
 - 16.1 Pollution Prevention Plan
 - 16.2 Spill Reporting
 - 16.3 Mercury Hazard Procedures: Recovery Procedures for Metallic Mercury
 - 16.4 Memorandum: Presentation on City Planning - Outline
 - 16.5 Planning Commission and Staff Recommended Plan for City Council Adoption, July 14, 1993, City of Corpus Christi Planning and Development Department

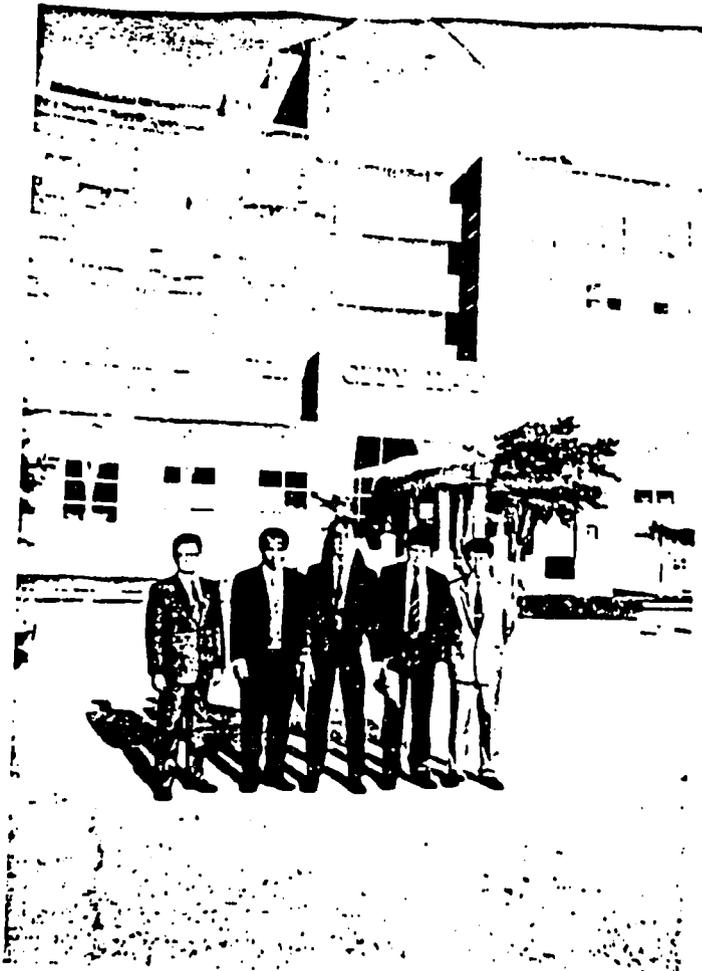
- 17. Emergency Information Systems International, Computerworld Smithsonian Award Winner, Handouts

- 18. Port of Corpus Christi, Handouts

ANNEX 7

Photographs of Visit to Corpus Christi

A handwritten signature or set of initials in the bottom right corner of the page, consisting of a large, stylized 'S' followed by a smaller 'P' and a checkmark-like symbol.



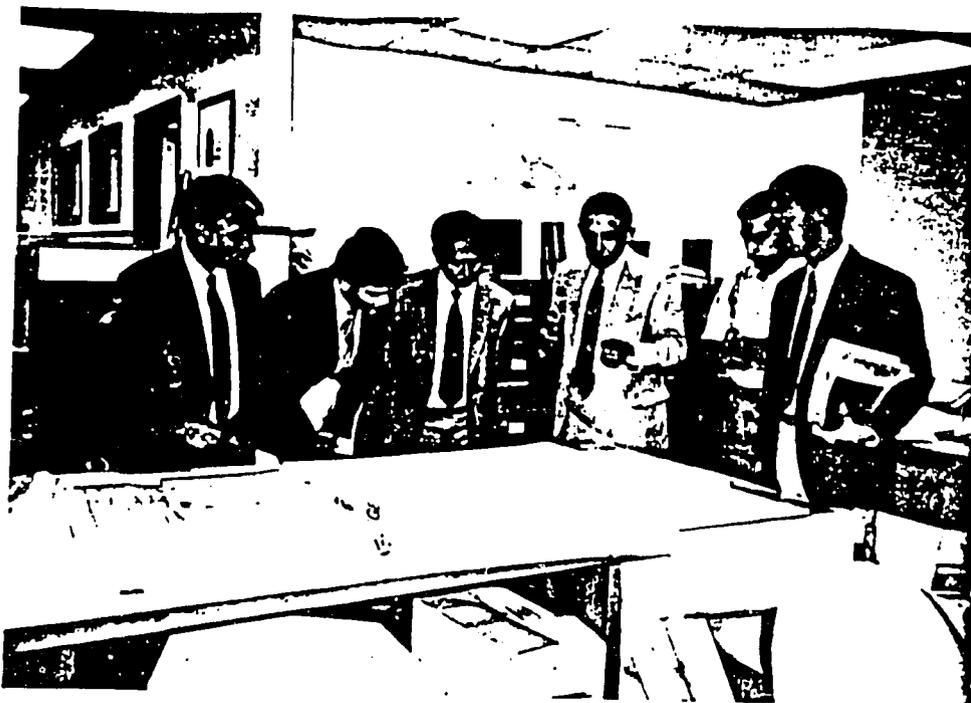
A photograph of the Samut Prakarn Team in front of the City Hall, Corpus Christi.

BEST AVAILABLE COPY



A Pose inside the Council Chamber.

89



Victor Medina, Water Superintendent explaining the Geographical Information System (GIS) Development to the visiting team.

BEST AVAILABLE COPY



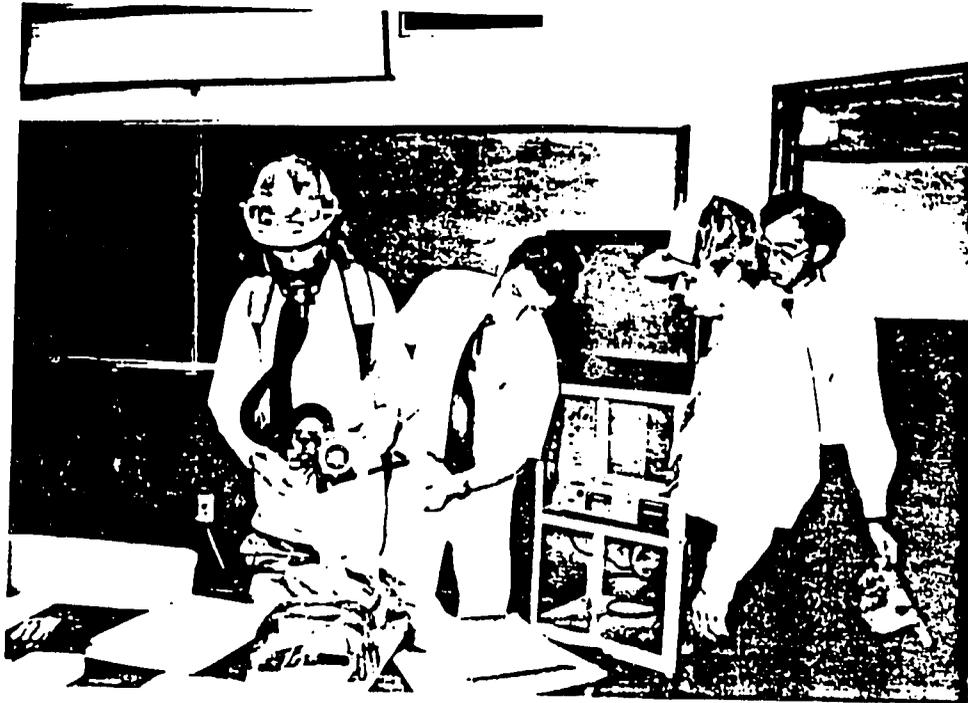
Robert T. Bruner, Director of Solid Waste briefing on Landfill Construction.



The delegation visiting landfill sites for Domestic Waste (above) and Hazardous materials waste (below).

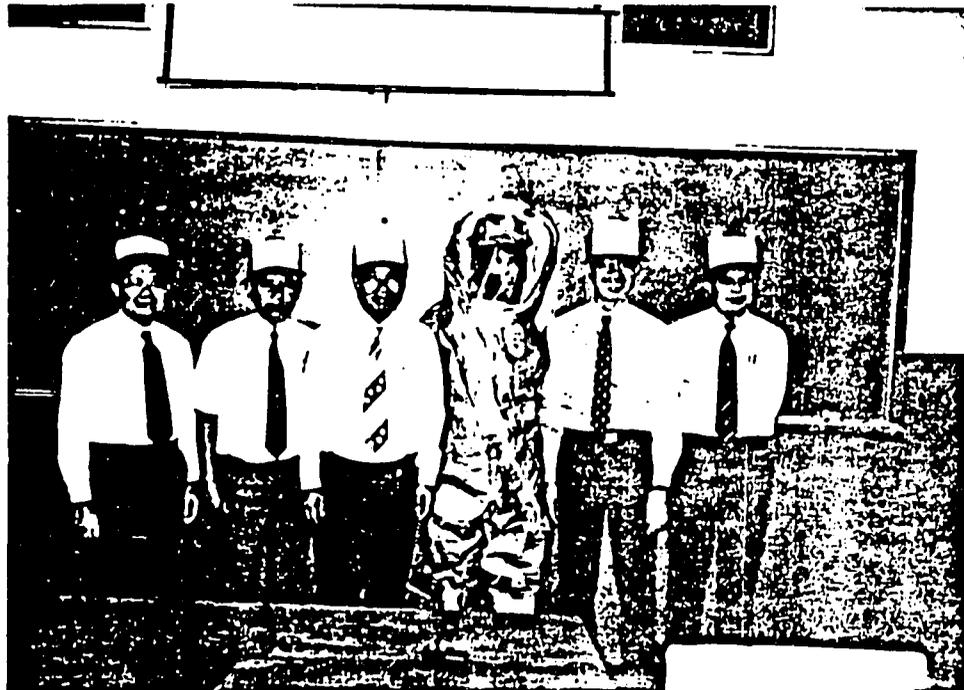


BEST AVAILABLE COPY

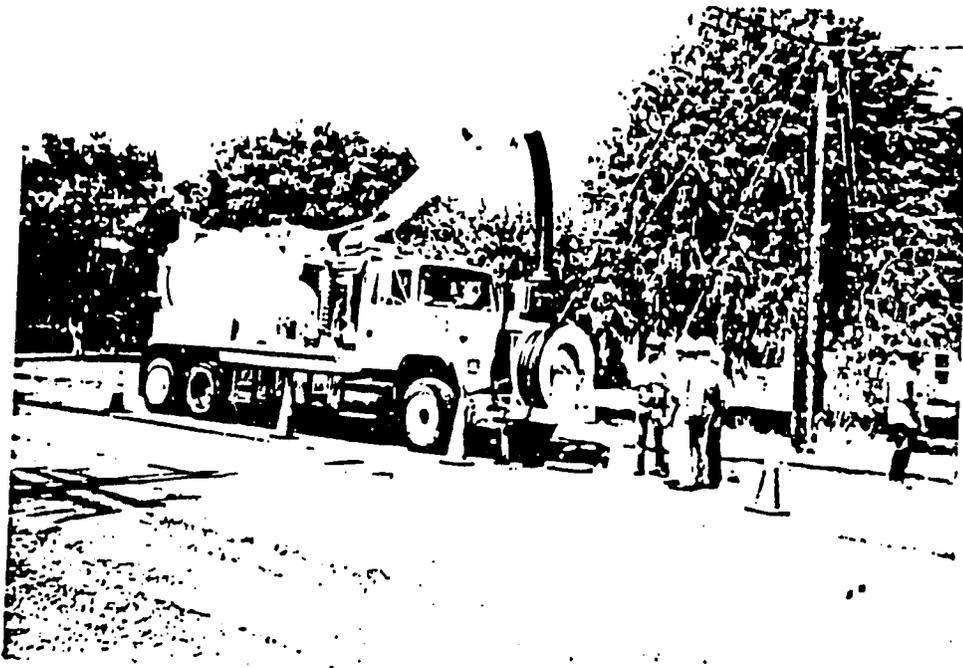


Assistant Mayor, Prasert Wongaroon and Chaiwat Thamrongrisook, City Manager observing David Jenson of the National Spill Control School putting on a Hazardous Materials Suit, assisted by Steven S. Barnes, Director.

BEST AVAILABLE COPY

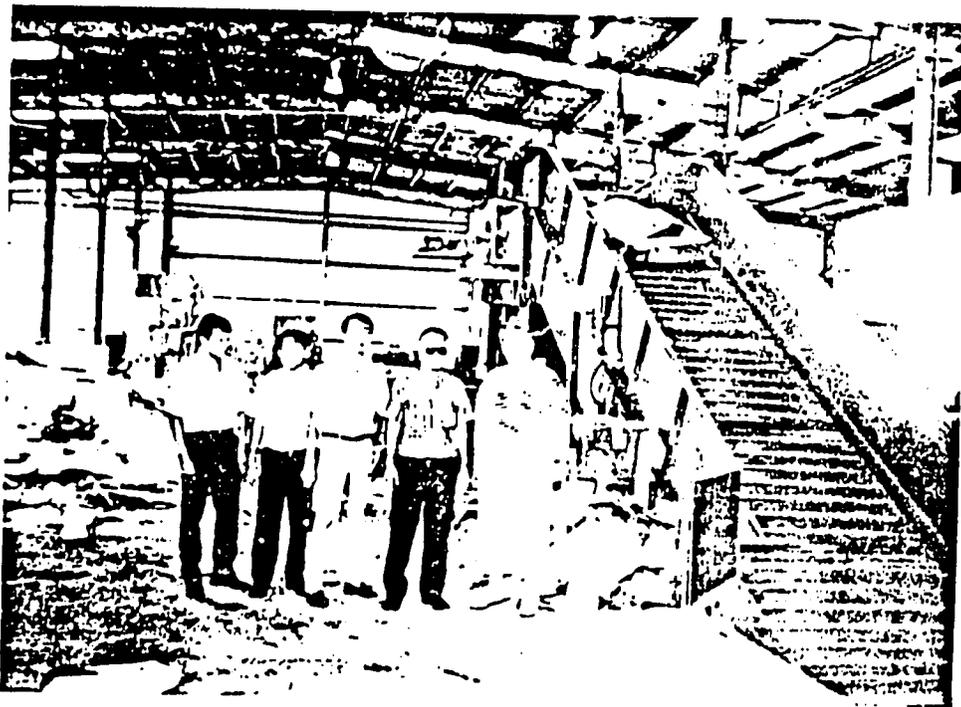


The Delegation and a Man from Outer Space ?



The Delgates observing the Drainage Cleaning Operation using Modern Equipment.

BEST AVAILABLE COPY



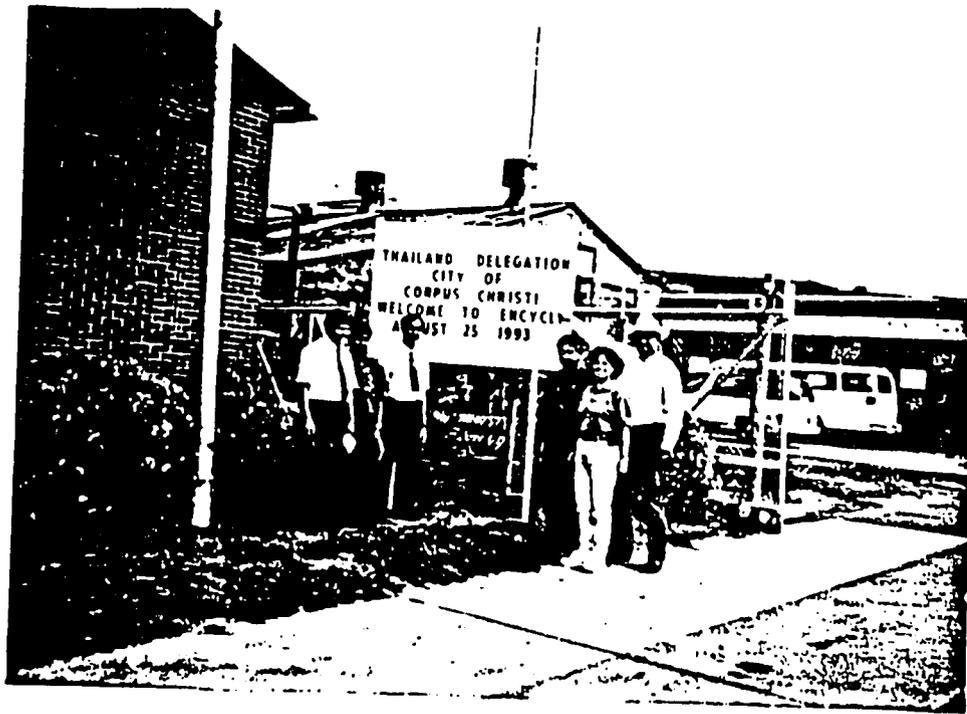
A Visit led by Estela Garcia, to a Waste Recycling Plant.



Bhaskar Patel (hands on hip) with the Thai Team learning the Use of a "High Tech" Telescopic Video Camera Technique for Tunnel's Interior Inspection.

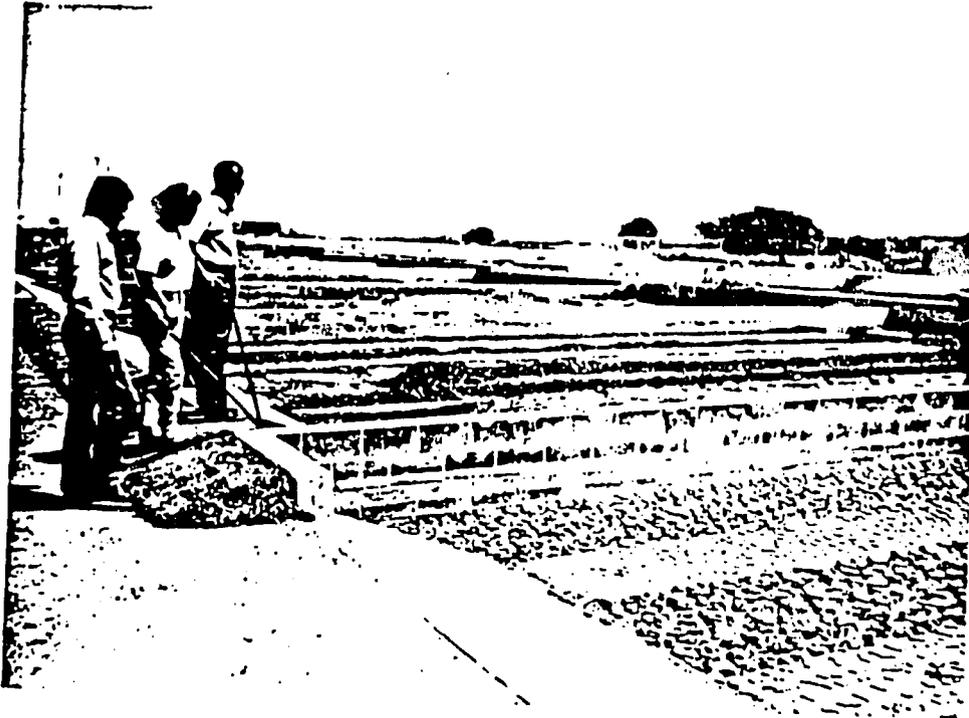
BEST AVAILABLE COPY





The team was very warmly received at every place of visit.

BEST AVAILABLE COPY



City Manager and Engineer from Samut Prakarn observing the Sludge Drying Bed.

96

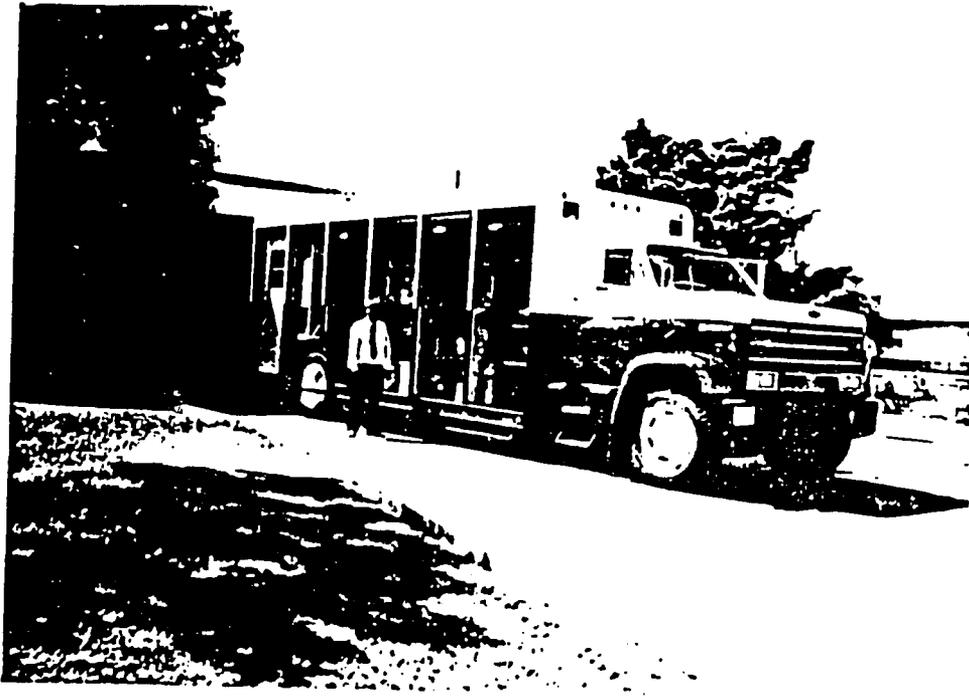


Assistant Mayor working on Computer Aided Management of Emergency Operation (CAMEO) Program.

BEST AVAILABLE COPY.



A Chemical Wash for the City Manager after the Visit !



Assistant Mayor most fascinated with the Capability of the Mobile Hazmat Van, totally supported by the City Manager expressed the Need for similar unit for Samut Prakarn.



BEST AVAILABLE COPY