# CHAPTER III

# METHODOLOGY

Before the sampling step could take place in May, a survey had been carried out thoroughly to locate the sampling stations using the flow direction as a deciding factor. The stations were located downstream from the disposal site where heavy metals and other improper matters were carried. Reference points have been located upstream from discharged point for referring as background data of each area or canal. The reference points' data, when compared with those of downstream stations, will indicate whether the water in canals have been polluted by the discharged leachate.

## 3.1 Study locations and its sampling stations.

This section will describe some important aspects of both study areas and their surroundings. The description will help readers to visualize roughly about the areas.

### 3.1.1 On-nuch disposal site and its surroundings:

On-nuch disposal site stands on On-nuch road, Praves district of Bangkok. Its 585 rais of land have been fully operated since 1977. There are two 1280 tons/day incinerators, 1-night soil treatment plant, 1-wastewater treatment plant. (BMA., 1988) The only open dumping yard is used as a

major area for disposal. At present, a new 1000 tpd. incinerator is underconstruction. In 1992, about 1500 tons of waste have been dumped here daily. In the backyard, adjacent to the Klong Ta Khe Kob, is the wastewater treatment plant with approximate 130 x 45 x 3 m. waste leachate storage earth pool. This pool could store, approximately, up to 15000 cu.m. of leachate. The leachate will flow through the treatment plant and finally drain to Klong Ta Khe Kob. But in case of overloading of leachate in the pool, workers will pump the leachate to flood the ground surface and drain directly to the canal. Klong Ta Khe Kob join with Klong Song Hong at not too far from the site, and Klong Song Hong connects to Klong Phra Khanong (Fig. 3-1 to 3-4).

The surrounding area of On-nuch disposal site are residential area. In front of the site is On-nuch road with several roadside shops and houses. In the backyard is Klong Ta Khe Kob with some houses besides the canal. Some of them are fishes feeders who use water from Klong Ta Khe Kob and Klong Song Hong for their pools. Some feed chickens, ducks and cows. People in this area, especially canalside residents, still use the canals for their transportation. There is no indication that people in this area use canal's water for their domestic uses.

Klong Phra Khanong, within the sampling range, is one of the moderate size canal with 15-20 m. width and 4-5 m. depth approximately. At upstream a water gate was set up for controlling water level near the office of Praves dis-

Fig. 3-1 Leachate storage pool at the On-nuch disposal site.

Fig. 3-2 Location of Klong Ta Khe Kob.

Fig. 3-3 Location of Klong Song Hong.

Fig. 3-4 Drained leachate from the disposal site to Klong Ta Khe Kob.

trict. Along both sides of the canal are houses and few small factories, such as plastic melting, sawmill and car repairing. Three of them was found within the sampling range. People still use the canal for transportation and for some domestic uses, except for direct consumption. These industries and residents have drained their wastewater directly or through sewage pipe to the canal. The water quality, by estimation, is fair and better than Klong Song Hong and Klong Ta Khe Kob.

3.1.2 Description of sampling stations at On-nuch disposal site.

At On-nuch disposal site, 10 sampling stations have been located. The details of each are listed below:-

- 1 station (station 1) at the leachate storage pool in the disposal site. This station will represent an original characteristics of leachate leached from the dumping yard.

- 1 station (station 2) in Klong Song Hong, about 150 m. prior connects to Klong Ta Khe Kob. This point is the reference point for water from Klong Song Hong (suppose to be non-polluted) before connecting to Klong Ta Khe Kob.

- 3 stations (station 3,4 and 5) in Klong Ta Khe Kob before connecting to Klong Song Hong. Station 3 located upstream from the leachate discharging point. It will represent an reference point for Klong Ta Khe Kob. Station 4, about 50 m. downstream from station 3, located at discharged

point. Station 5 located near to a concrete bridge where connecting the disposal site and parking lots. This station is about 100 m. from station 4. The results of these two stations will indicate the conducted pollutants downstreamly from the disposal site.

- 2 stations (station 6 and 7) in Klong Song Hong, after connecting to Klong Ta Khe Kob. Station 6 at the junction of these two canals. The whole conducted at this station will indicate the rapid changes of water quality after the suspected polluted water from Klong Ta Khe Kob and non-polluted water from Klong Song Hong were combined. Station 7, at the end of Klong Song Hong, will be for the reexamination of water quality in Klong Song Hong to see whether the quality has been changed when the combination occurred and the water mass flew downstream.

- 3 stations (station 8,9 and 10) in Klong Phra Khanong. Station 9 located near to the sawmill. This station is the reference point of Klong Phra Khanong's water quality, because the flow direction is, normally, from station 9 to station 10. Station 8, about 200 m. from station 9, located opposite to Klong Song Hong's mouth. And station 10 located about 100 m. from station 8 downstream near to the plastic melting factory. This station is the last checking point of polluted matter from Klong Song Hong.

All of sampling stations were located in the map as shown in Fig. 3-5.

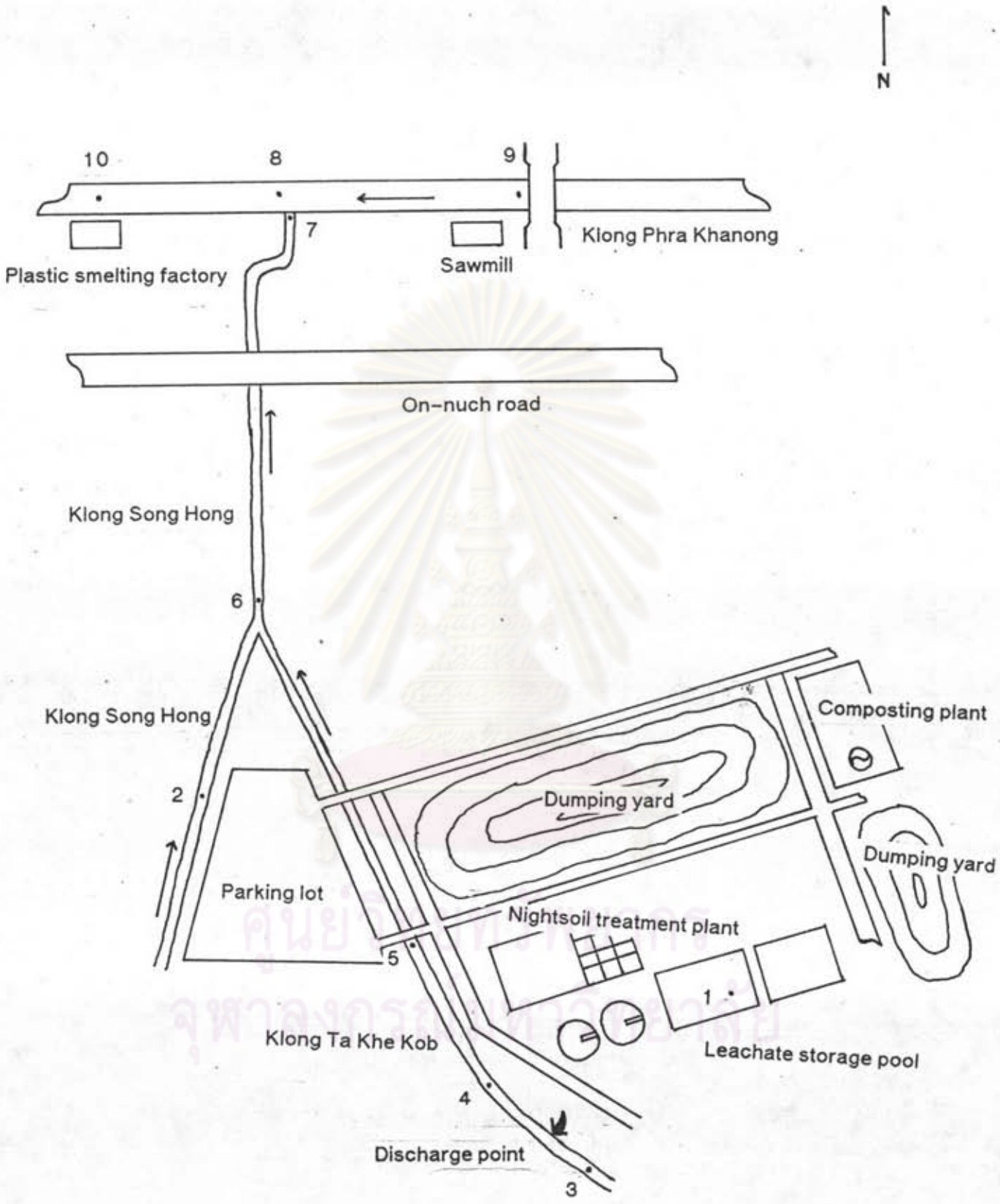


Fig. 3-5 Location of the On-nuch disposal site and its observation stations.
(Not to scale)

3.1.3 Nong Kham disposal site and its surroundings.

Nong Kham disposal site is on Petchakasem 104 Road, Nong Kham district in the south of Bangkok. It has been used for the waste disposal service, under the control of the Department of Public Cleansing, BMA., since 1977. The 463 rais of land include a 1280 tpd. incinerator, 1-night soil treatment plant, one of 220-250 tpd. compost plant, one usable open dumping yard and one transfer station (BMA, 1988). The daily waste dumped here in 1992 is up to 1500 tpd. But another 3000 tons of total generated waste in Bangkok have been transferred by trucks to dispose at Kam Phang San district in Nakorn Pathom province daily. The operation at Kam Phang San is under the concession of Wasaduphan Turakit Co.,Ltd., by using sanitary landfill method, and closely inspected by BMA. At Nong Kham disposal site, there is no leachate storage pool. Only natural shallow earth pool behind the compost plant plays like a storage (Fig. 3-6). In the rainy season, workers will dig small waterways from dumping yard to drain the waste to other unused land within the vicinity. Normally, wastewater from dumping yard will be drained to the adjoining area and lowland, surfacing and seepaging, especially to the big earth pit behind the yard (Fig. 3-7). Eventhough the BMA. have built the earth dyke around the territory but the leachate still disturb surrounding areas to a certain extent. The impact of leachate on water quality in the earth

Fig. 3-6 Leachate storage pool at the Nong Kham disposal site.

Fig. 3-7 Location of the earth pit behind the dumping yard.

pit is not much but some unauthorized persons have illegally disposed their solids, liquids and chemical wastes into the pit. So the water quality declines rapidly until now it is no use for those who live around that area.

In the south of the old dumping yard is Klong Charoensuk. This is the connective canal between Klong Tawee Wattana and Klong Mahasorn. Oftenly flooded leachate from the present dumping yard is drained to this canal. Along the canal banks are houses which also directly drain their waste and wastewater to the canal. The water quality is ranging from low to very low, mostly caused by domestic wastewater.

The site's surroundings are houses of both workers or non-workers whose works involved in the waste disposal activities. Except from these, there are Klong Bang Vak school, Wat Wong Laparam and Thai Television Station Channel 3 standing not too far from the site. The dense of the residence at Nong Kham site is lower than those at On-nuch site. Klong Tawee Wattana is close to the site than Klong Mahasorn. Along the Klong Tawee Wattana are houses and housing estates, rarely small factories can be found. Most of them discharge their wastewater to the canal. The water quality is low and disperse its unpleasant smell too. People cannot use the water for any purpose even transportation because it is always covered by water hyacinth. Both Klong Tawee Wattana and Klong Mahasorn connect to Klong Pasi Charoen at the end.

3.1.4 Description of sampling stations at Nong Kham disposal site.

At Nong Kham disposal site, 7 sampling stations were located. Two of them are in Klong Charoensuk, one in leachate collection pond, one outside earth pit, and the last three stations located along the bank of Klong Tawee Wattana. The details of each station can be found below:-

- Station 1 in Klong Charoensuk inside the disposal site territory. This station can represent a leachate discharged point from disposal site. At the station, the canal width is less than 5 m. and the water surface almost covered by floating plant and water hyacinth together with sunk trash.

- Station 2 was located at leachate collection pool behind the compost plant. The data from this station can represent an original characteristics of leachate from Nong Kham dumping yard.

- Station 3 was located at the earth pit behind the yard. This pit was affected by the leachate from the disposal site where it can drain or seepage to it.

- Station 4 in Klong Charoensuk too. This station was located at the crossing of the canal and Petchkasem 110 road, about 1500 m. from the station 1. Along this range, the canal was covered by aquatic plants. Both of canalsides are houses which discharge their wastewater onto the canal. This station is the downstream sampling for checking the disturbance caused by polluted matters from disposal site.

- Station 5,6 and 7 were located in Klong Tawee Wattana. Station 5 was the closest station to the Petchkasem road. This station was in front of the Kao Wattana Villa's entrance. Station 6, about 200 m. from station 5, was not far from the junction of Klong Tawee Wattana and Klong Charoensuk. Station 7 was located about 70 m. upstream from the station 6. This station can represent a reference point for Klong Tawee Wattana water quality. The flow direction of this canal is from station 7 through station 5 to Klong Pasi Charoen at the end.

Usually, Klong Tawee Wattana is full with water hyacinth. This 20 m. wide canal was loaded by wastewater from canalside houses. The flow direction, as mentioned above, may transverse if the water level in Klong Pasi Charoen is higher than that of Klong Tawee Wattana. This occurrence takes place quite often. The sampling stations location were shown in Fig. 3-8.

3.2 Handling and analysis of samples.

The samples obtained from 10 stations from On-nuch disposal site and 7 stations from Nong Kham. Each site was sampled over 2 periods of time. Each period consisted of 11 days of observation continuously. Some parameters were measured at the station by using field measuring equipments, the rest were handed to the laboratory. Each time one litre of water sample per station was collected in a polypropylene bottle. The samples were chilled at 4 $^{o}$C and were analyzed and finished within 48 hrs. (except the part of an atomic

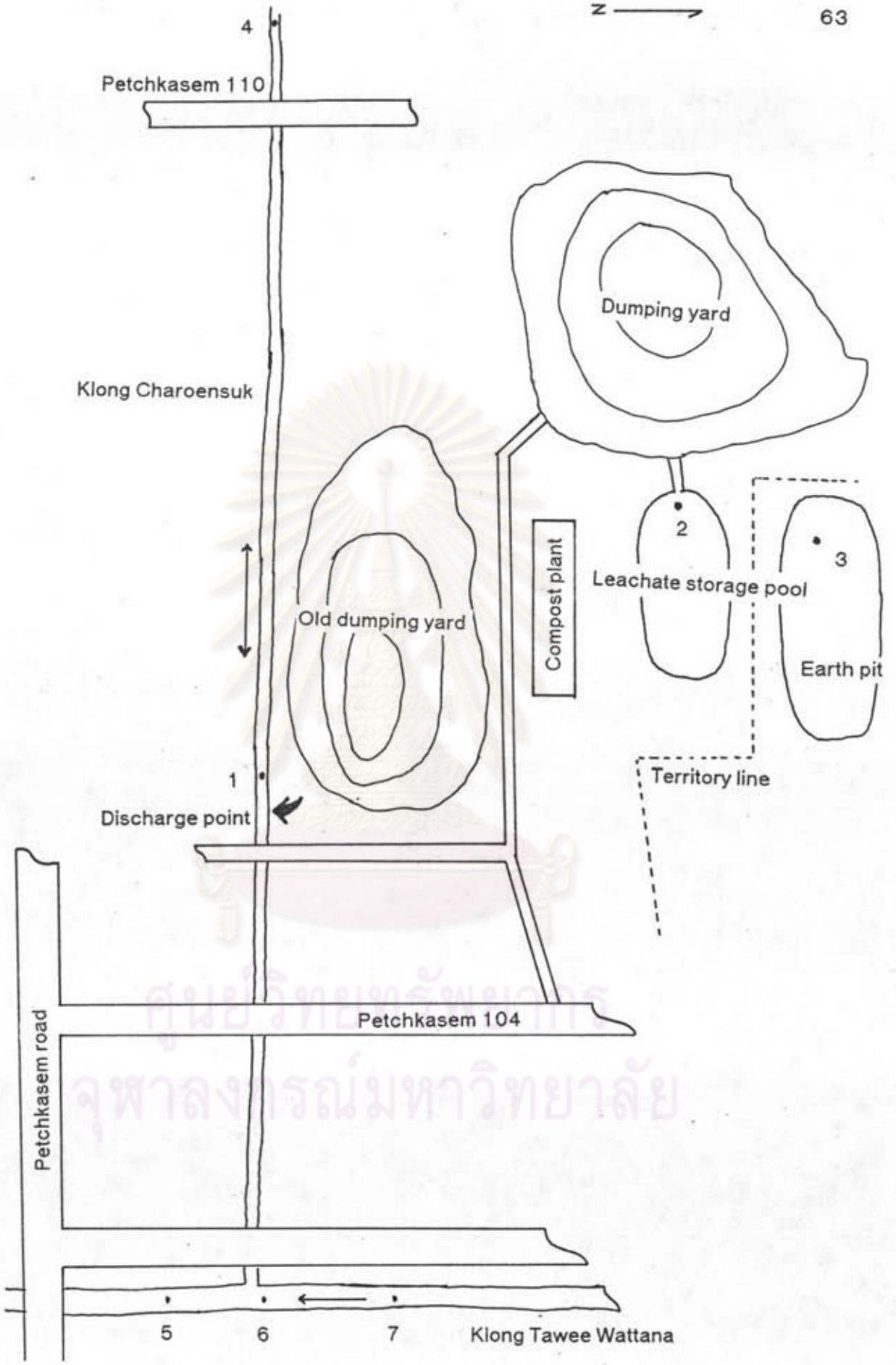


Fig. 3-8 Location of the Nong Kham disposal site and its observation stations.
(Not to scale)

absorption analysis). Methods of measurement and analysis of the 14 parameters are given below:-

1) Dissolved Oxygen: measured at the site by using DO-meter model OXI 96-B of WTW.

2) Temperature: measured by DO-meter model OXI 96-B of WTW (temperature measurement function).

3) Salinity: measured by SCT-meter model 33 of YSI.

4) Conductivity: measured by SCT-meter model 33 of YSI.

5) pH: measured by pH-meter model HA (code 1906) of Lamotte Chemical.

6) Biochemical Oxygen Demand (BOD 5-day): analyzed by the iodometric-titrimetric method.

7) Chemical Oxygen Demand (COD): analyzed by the dichromate reflux method.

8) Suspended solids (SS): analyzed by the filtration method.

9) Dissolved solids (DS): analyzed by the evaporation method.

10) Total solids (TS): obtained by calculation; TS=SS+DS

11) Alkalinity: analyzed by the titrimetric (indicator) method.

12) Mercury: analyzed by the cold vapor atomic absorption method.

13) Cadmium: analyzed by the air/acetylene atomic absorption method.

14) Manganese: analyzed by the air/acetylene atomic absorption method.

The analysis of 12) to 14) were performed using atomic absorption spectrometer manufactured by Varian model 300 (Australia). The analytical methods of parameters number 6)-14) followed the Standard Method for the Examination of Water and Wastewater by APHA, AWWA and WPCF (1986). The quantitative analysis of heavy metals (number 12)-14)) have been pretreated. Nitric acid was used to digest the samples of cadmium and manganese into total metal form. For mercury samples, the attached pretreatment technique in cold vapor method was used.

3.3 Analyses of data

After the field observation were completed, the obtained data were treated statistically. The data were treated and computed for minimum, maximum, mean, median, standard deviation values and standard error. Those obtained values will be found in chapter IV and appendices. Some groups of treated data i.e., heavy metals content, temperature, pH, conductivity, alkalinity and total solids were selected to determine the significant difference and any possibility of correlation. The F-test and Scheffe methods were used to determine the significant difference of each heavy metal content between each station in the same period of observation and between each period of observation at the same station. The possible correlation was determined be-

tween mercury or manganese content with some parameters for example mercury content and temperature, manganese content and conductivity. Results obtained will be discussed in chapter V. The systat and SPSS-PC (studentware) computer packages for statistical analysis were used for those mentioned aspects.