Database for Total Petroleum Hydrocarbon in Industrial Wastewater Generated at Sabhan Area in Kuwait

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Overview

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Introduction

- Kuwait is a modern industrialized nation that meets most of its domestic, commercial and industrial water needs by desalination of seawater.

- Kuwait is in is in dire need of an integrated water resources management scheme that includes aspects of water conservation and reuse wherever possible. The foundation block of such a management scheme is a sound database of all potential sources of water supply, supply locations, use, after-use discharge, recycle potential, reuse, environmental impacts, and sustainability of the national resources and developmental systems.

- One of the major sectors involved in such a scheme is industrial (petroleum and non-petroleum) water use and wastewater generation, including areas of after-use discharges, wastewater quality at origins and discharge points, locations of discharge and/or reuse, and recycle potential.

- *A basic and comprehensive database utilizing ArcGIS in this sector is presently lacking in the country. A comprehensive, centralized, well formatted and compiled data system on the type and quality of industrial wastewater produced with specifics of location, quality, provision of treatment and discharge and/or reuse in the country is presently missing.*

Objective of the Study

- The objective of the study was to determine the quality and quantity of petroleum and non-petroleum industrial wastewater from different sources at Sabhan area, in Kuwait over a period of one year as well as developing a database of such characteristics and attributes using geographic information system (GIS) technique.

Mobilization and Survey of Industries

- The part of this task, the procurement of instruments, associated training, and experimental supplies was completed.

- Field survey was conducted during which a specially designed questionnaire was distributed among the targeted industries.

- Industries in Kuwait are mainly distributed in three areas, namely Kuwait City, Sabhan, and Shuaiba industrial areas. Shuaiba industrial area represents factories of petroleum wastewater origin, while the other sites (Kuwait City, Sabhan) represent factories of non-petroleum wastewater origin.

Location Map of the Study Areas
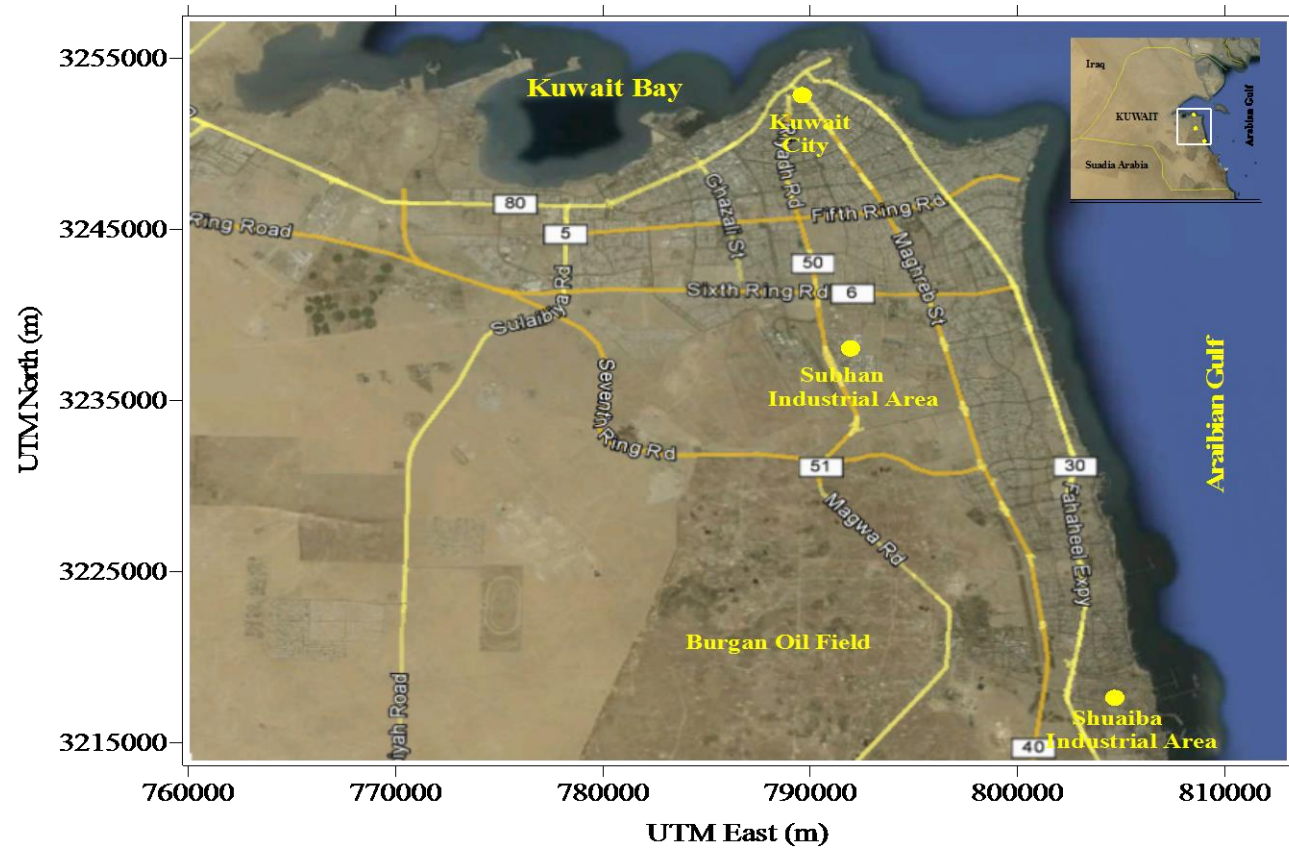
English Field Survey for Industries

Survey Questions	Circle Answer or Fill Blank
Letter from Public Authority for Industry (PAI) provided?	Yes /No
Letter to factory representatives/owner provided? (include name of representative)	
What is the name of factory?	
Where is the location of factory area?	
Factory coordinates;	
Industrial purposes of water use (if other please specify):	
Factory activities/productions?	
Factory category?	
Number of production lines active?	
Sampling point(s) coordinates;	
Has the surveyor examined the sampling point?	Yes /No
Is there a need for any personal protective equipment (PPE)?	Yes /No
Flow meter available?	Yes /No
If a flow meter is not available, will the factory allow installation?	Yes /No
Depth of sampling point?	Yes /No
Sampling method?	

English Field Survey for Industries

Survey Questions	Circle Answer or Fill Blank
Is there sufficient space to collect samples at the location?	Yes /No
Is there sufficient space to perform fluid measurements?	Yes /No
Can the factory accommodate 20 mo. of sampling?	Yes /No
Does the factory produce sufficient industrial wastewater flow for sampling?	Yes /No
Does the factory perform pretreatment on wastewater before discharge?	Yes /No
Is there any data within the past 5 years on the quality of discharge?	Yes /No
Is there any data within the past 5 years on the quantity of discharge?	Yes /No
Is the industrial wastewater discharge mixed with domestic wastewater?	
Methods of wastewater discharge?	
How many tankers/week are sent to Wafra Industrial Wastewater Plant?	
Does the factory participate in industrial wastewater reuse?	Yes /No
Pretreatment of wastewater streams (if other please specify):	Yes /No
Total freshwater consumption in factory:	Yes /No
Number of wastewater streams	
Raw materials used	
Are there any adverse environmental impacts of industrial wastewater?	Yes /No

Industrial Wastewater Sampling and Laboratory Analysis

- Based on the field surveys of the targeted industries, the total number of factories and sites to be visited for wastewater sampling and associated measurements was determined.

- Industrial Wastewater samples were collected from 41 Sites/ Factories distributed as followed: 10 factories at Kuwait City, 14 factories at Sabhan Industrial area and 17 factory at Shuaiba Industrial area.

- Field wastewater measurements were carried out for all sites including Temperature, pH, Electrical conductivity (EC), dissolved oxygen (DO)and oxidation Reduction potential (0RP) parameters.

- The collected samples were analysed according to Standard Methods for the Examination of water and Wastewater (APHA, 2017) for physical, chemical, biological, organic, heavy metals, toxicity and microbial (bacteria, viruses, fungi)parameters.

Collection of Industrial Wastewater Samples

Onsite Wastewater Field Measurements near Factory Collection Point

Laboratory Instruments
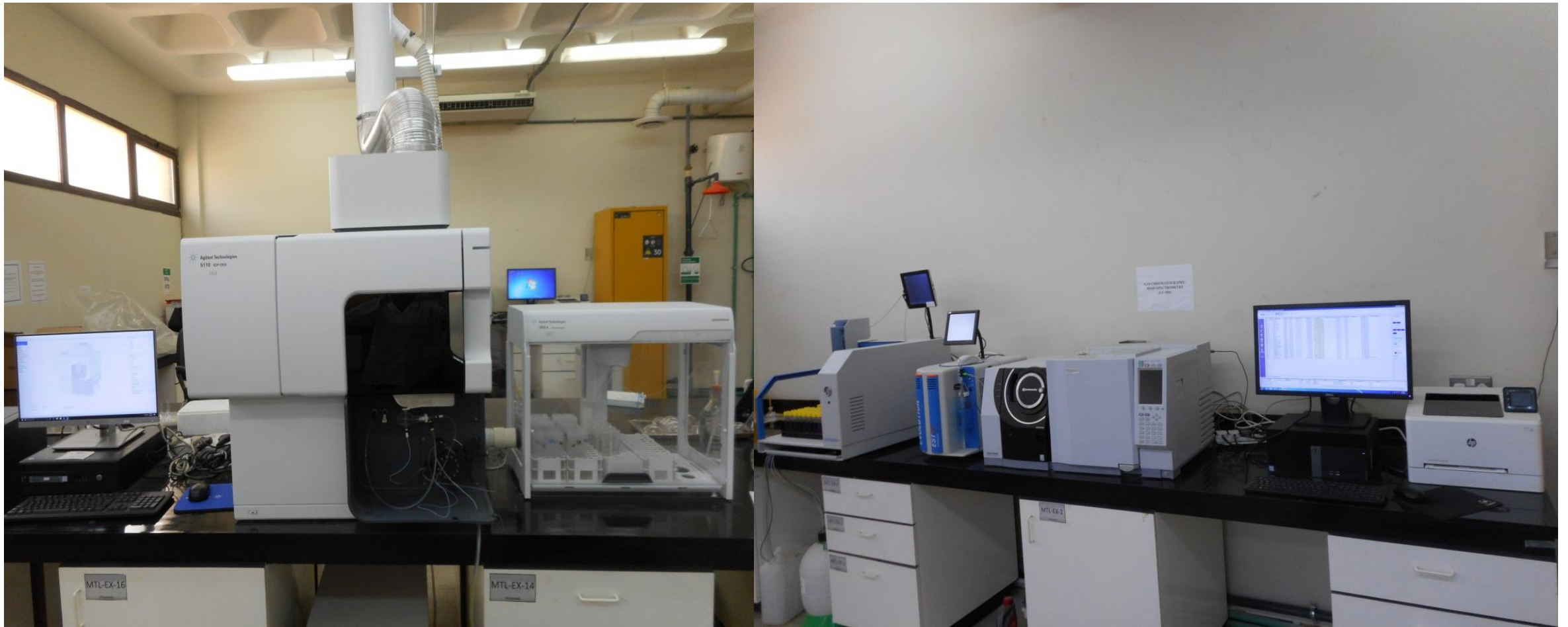
Preparation of Database and Data Entry

- All factories from which wastewater samples are being collected were coded.

- Excel spread-sheet database was prepared and was continuously updated with obtained field and laboratory results.

- ArcGIS software was used to convert the Excel database into GIS database, from which a number of GIS maps were produced.

Selected Factories Names, Codes and Coordinates

Serial No.	Factory/Site name	Sample Code	Factory/Site Coordinates (UTM)	
			North	East
1	Al-Yasra Company	NP07-SB04	29.2438987	48.0093041
2	Petra Food Manufacturing Company	NP08-SB01	29.2255592	48.0028326
3	Al-Mejhem Global Group Company	NP09-SB01	29.2327471	48.0025814
4	Kuwait Flour Mills and Bakery Company	NP09-SB02	29.2272129	48.0033348
5	Gulf Pastries Manufacturing Company	NP09-SB03	29.2388726	48.0049314
6	Refreshment Trading Company (Coca Cola)	NP11-SB01	29.2396461	48.0007190
7	United Beverage Company (Pepsi)	NP11-SB02	29.2329353	48.0009185
8	Al-Sayer Soft Drink Factory (RC Cola)	NP11-SB03	29.2335895	47.9977508
9	Carton Industries Company	NP12-SB01	29.2302470	48.0089239
10	Gulf Insulating Material Plant Company-1	NP14-SB01	29.2255583	48.0127323
11	Gulf Insulating Material Plant Company-2	NP14-SB02	29.2383767	48.0075050
12	Kuwait Aluminum Extrusion Company	NP15-SB01	29.2256665	48.0091978
13	Al-Bahar Industries	NP19-SB01	29.2266184	48.0077132
14	Sabahan Factory	NP19-SB03	29.2298120	48.0120292

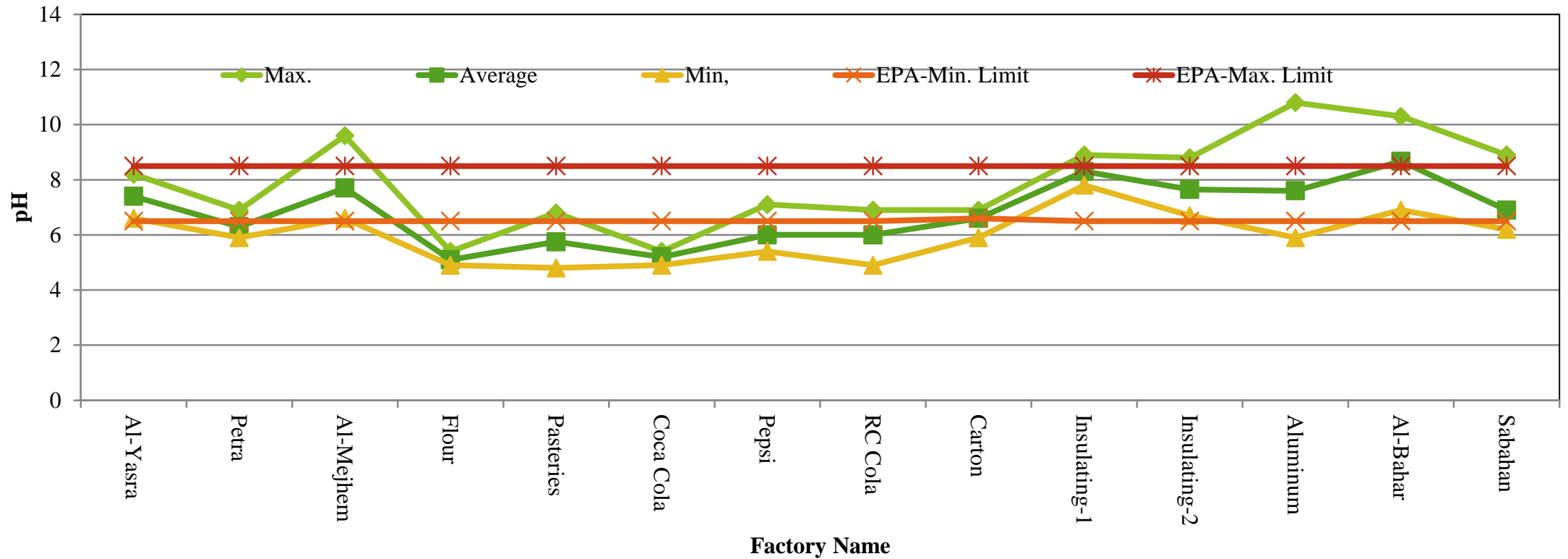# Location Map of Selected Factories at Sabhan Industrial Area
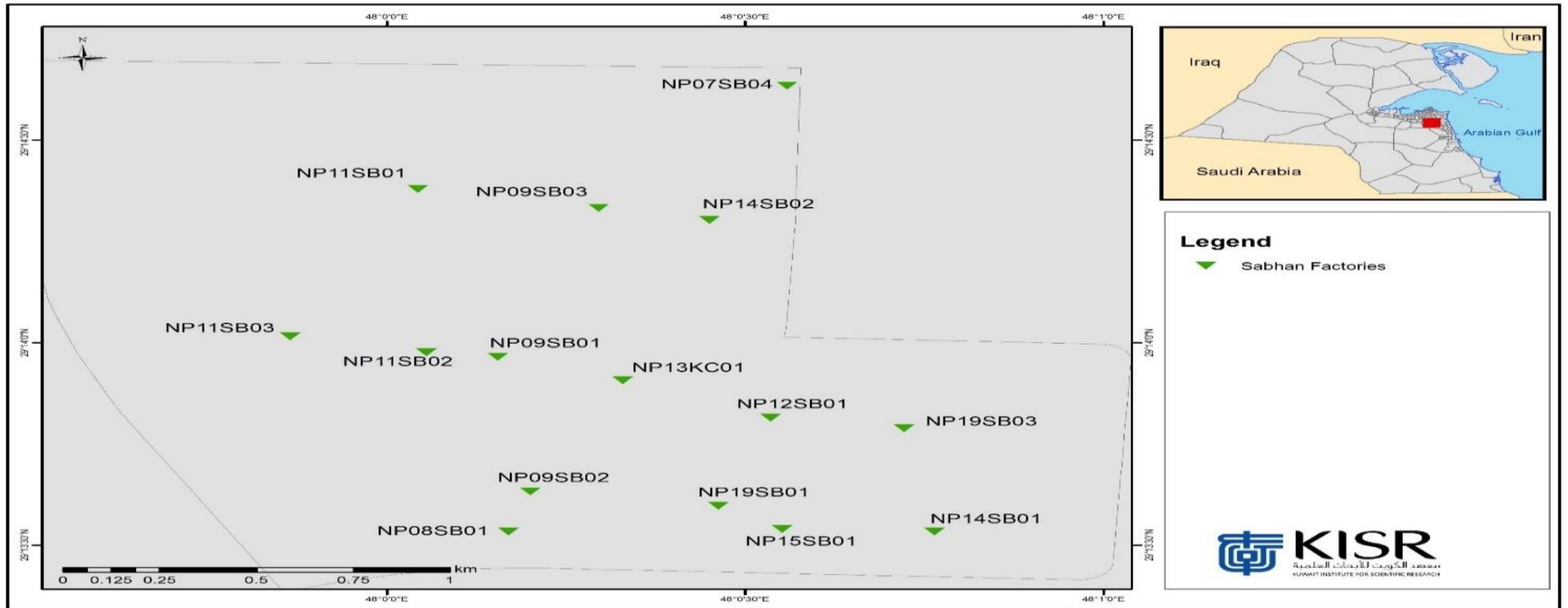
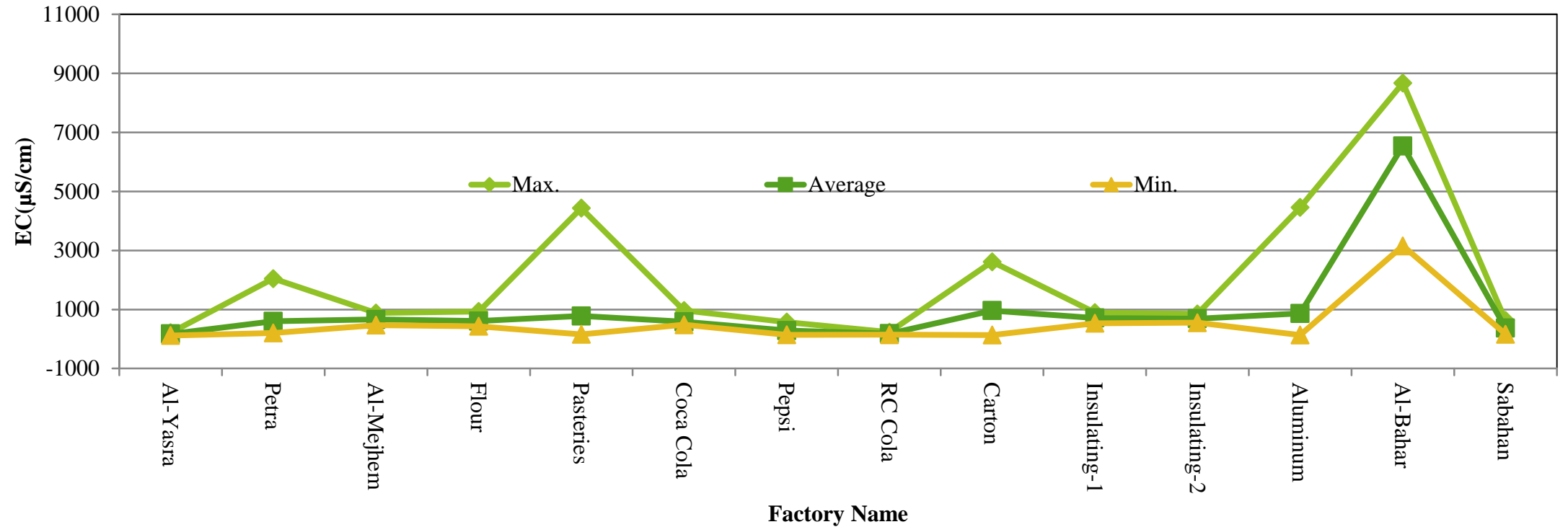Quantities of Freshwater and Wastewater for each Factory of Sabhan Industrial Area
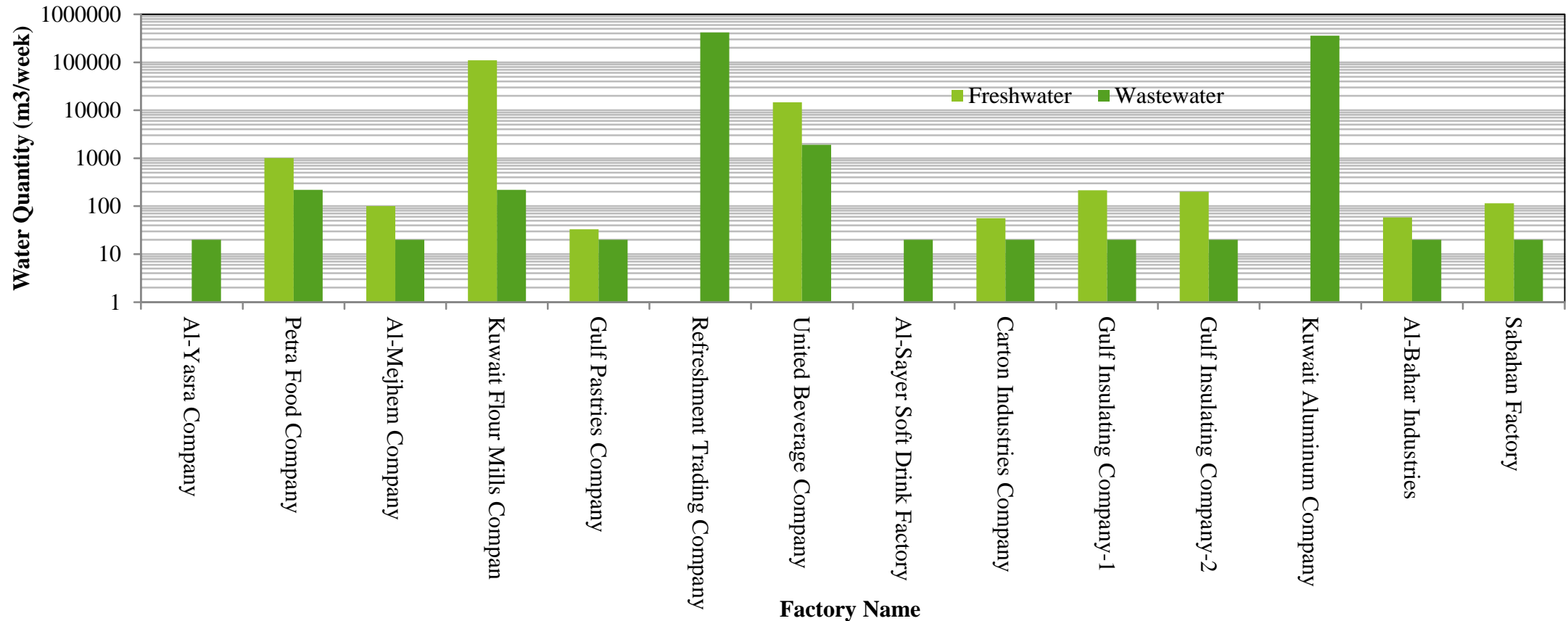
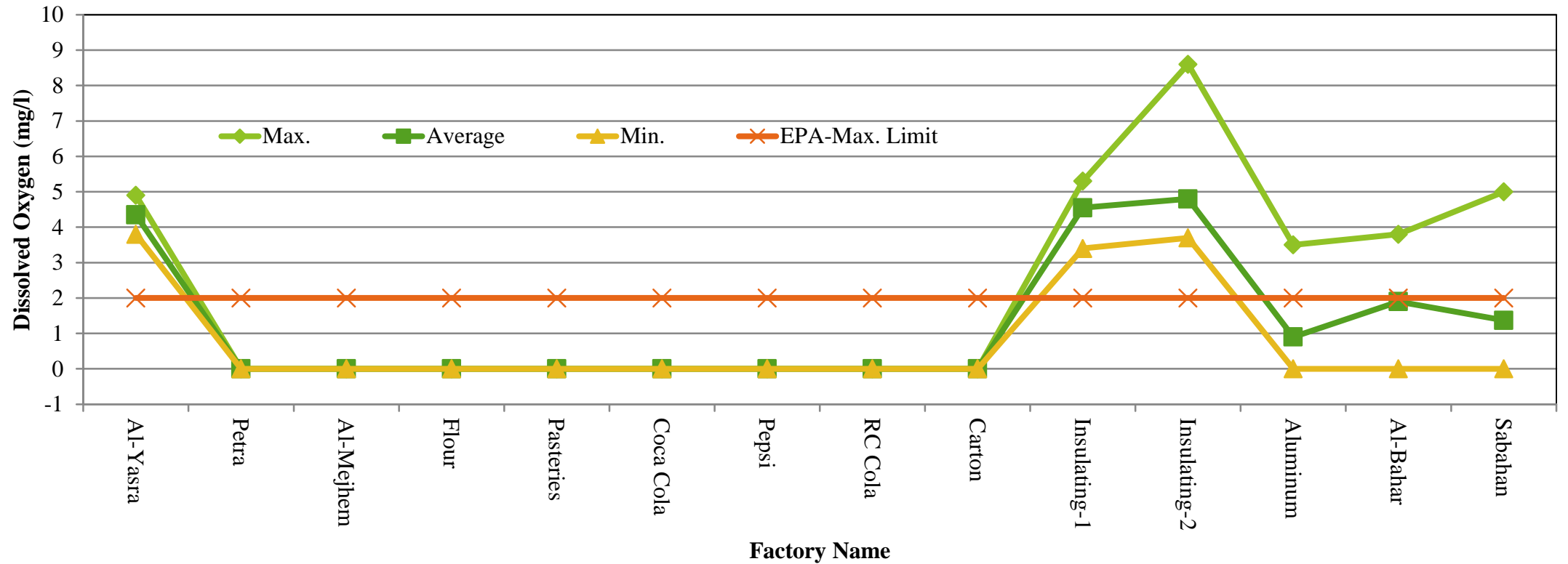# Changes in pH values of wastewater for Sabhan factories

Changes in Electrical Conductivity Values of Wastewater for Sabhan Factories
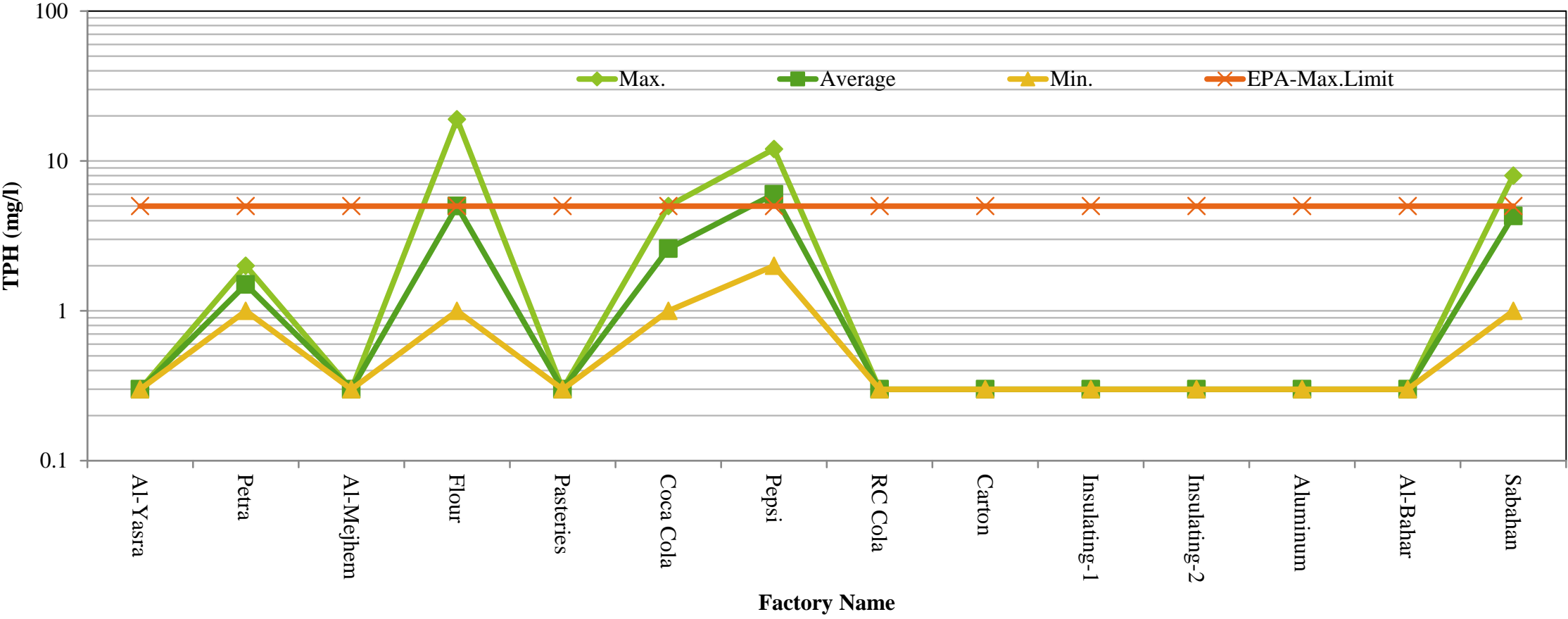
Changes in Oxidation Reduction Potential Values of Wastewater for Sabhan Factories
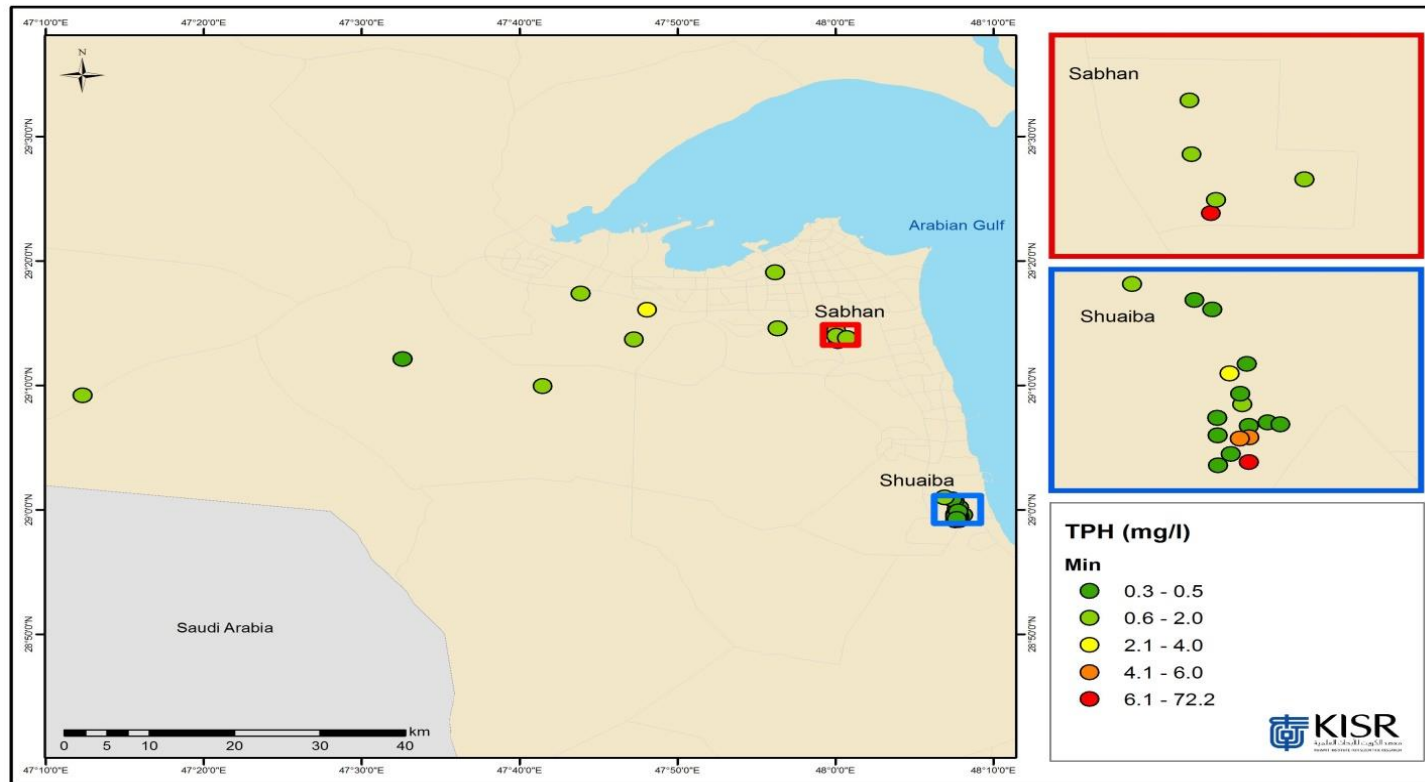
Changes in Dissolved Oxygen Values of Wastewater for Sabhan Factories
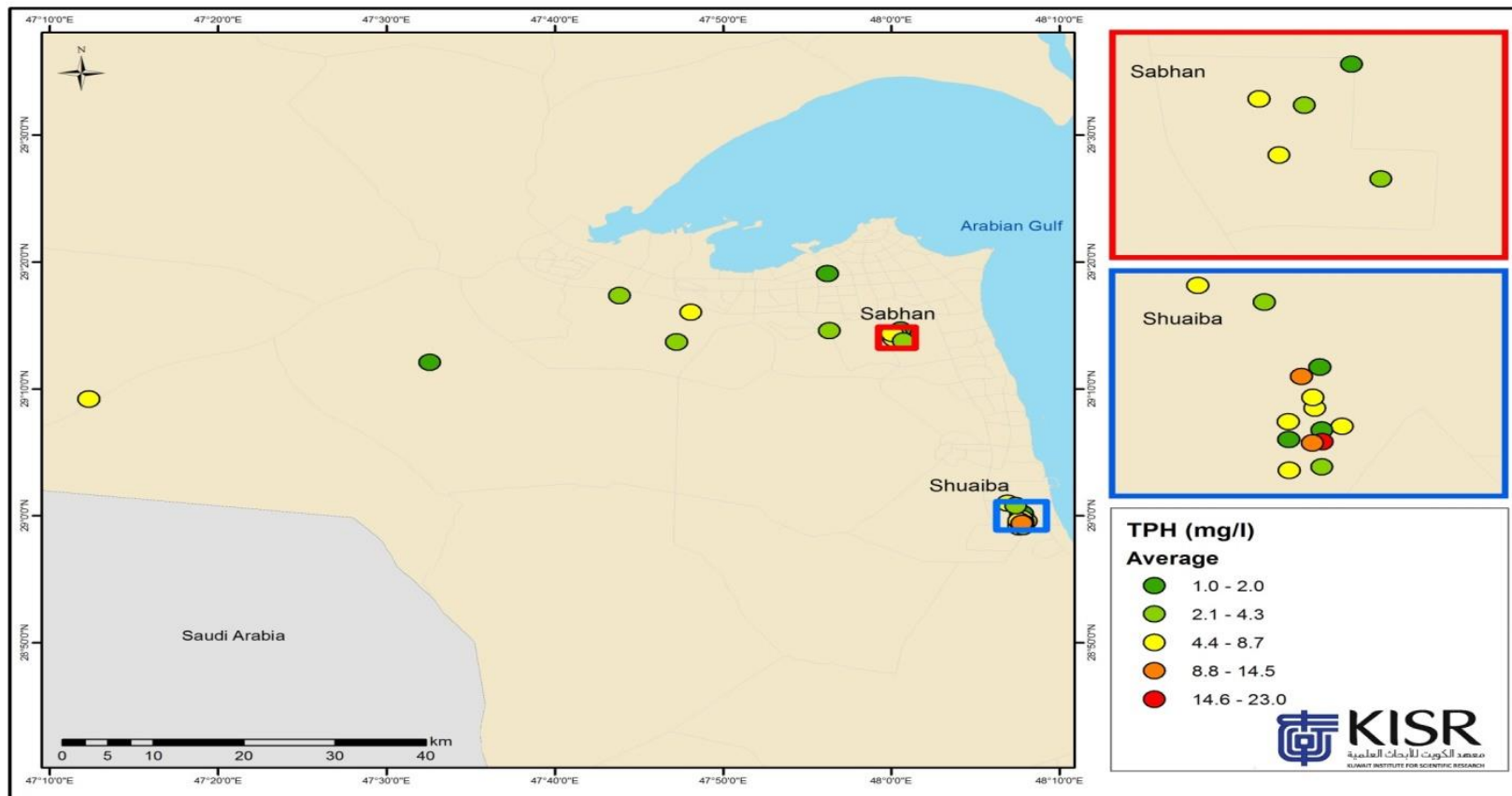
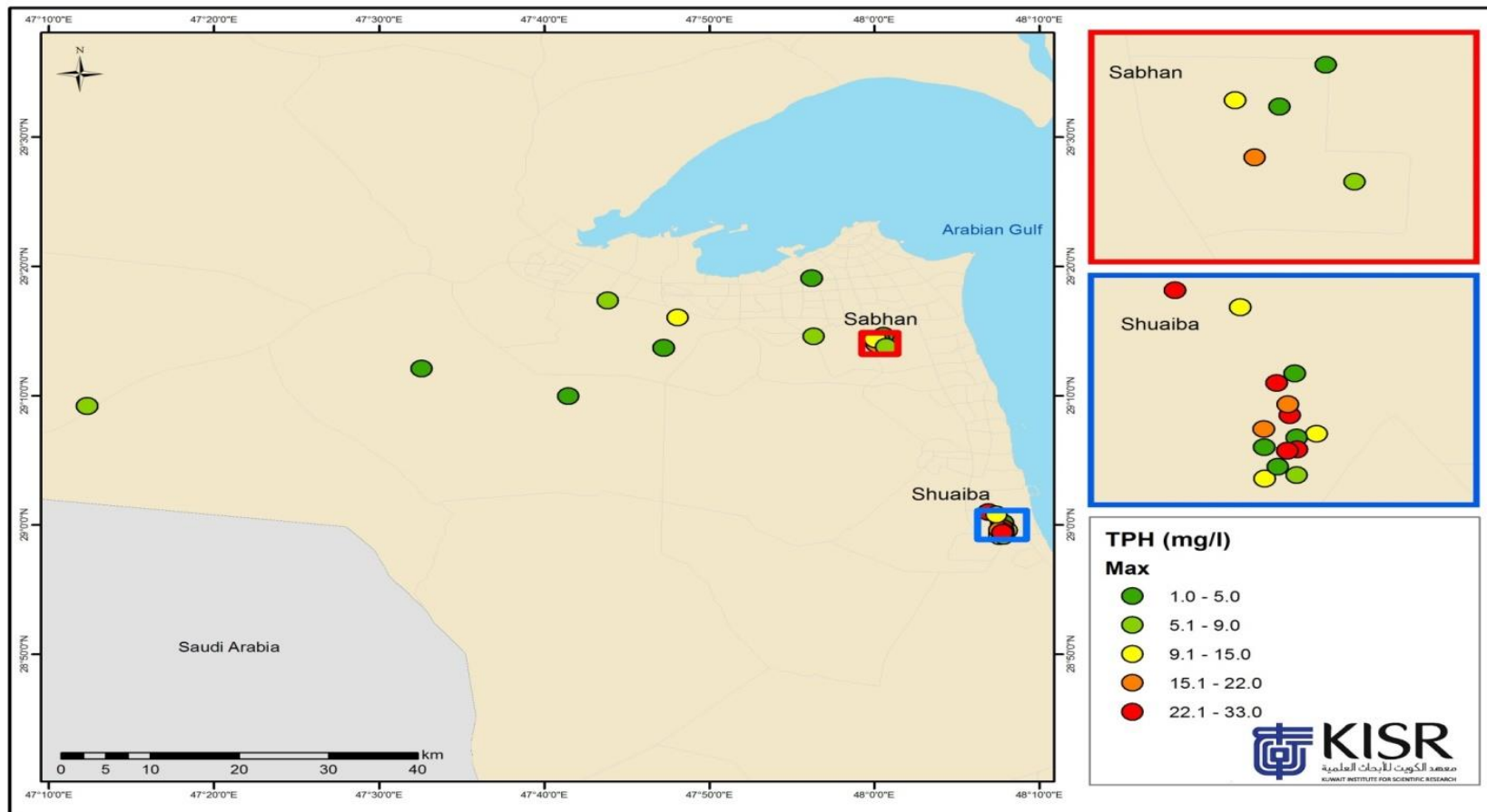# Changes in TPH Values of Wastewater for Sabhan Factories

Distribution Map of Minimum Values of TPH (mg/l) in Wastewater for Various Industries in Kuwait

Distribution Map of Average Values of TPH (mg/l) in Wastewater for Various Industries in Kuwait

Distribution Map of Maximum Values of TPH (mg/l) in Wastewater for Various Industries in Kuwait

Conclusions

- A field study was carried out to collect data on the quality and quantity of petroleum and non-petroleum industrial wastewater from different sources in Sabhan area, Kuwait and developing a database for the target industries using ArcGIS technique.

- The laboratory results of total petroleum hydrocarbon indicated that their concentrations in the raw wastewater are meeting KEPA irrigation water standards for landscaping and greenery except for those values of TPH (> 5 mg/l) for three factories (Flour, Pepsi and Sabhan).

- The obtained field data suggest that only a few industries use on-site wastewater treatment systems.

Recommendations

- Collection data regarding quantity and quality of industrial wastewater for petroleum and nonpetroleum sectors should be continue for long monitoring period and for all parameters.

- The development of industrial database should be updated every two years by Public Authority Industry (PAI).

- Onsite treatment systems should be installed to treat the industrial wastewater for group of industries of similar sources.

Acknowledgements