Assessment of the water quality of Shatt AL-Shafiya by the Water Quality Index (Canadian Index) (CCME-WQI)

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Summary

The current study was conducted on the waters of Shatt al-Shafiya, one of the branches of Shatt AL-Diwaniyah of the Euphrates River in the city of AL-Diwaniyah for the period from December 2021 to May 2022, in order to evaluate the validity of the Shatt al-Shafi'i for various uses by some vital evidence, Three sites were identified at a distance of about 19,500 km,Samples were taken monthly, where the study included measuring the values and concentrations of a number of physical and chemical properties of water represented by pH, Dissolved Oxygen, Biological Oxygen Demand, Total Dissolved Solids, Calcium, Magnesium, Chloride, Nitrate, Phosphate), as well as measuring the concentrations of some heavy metals (Zn, Cd, Pb) in water. Bacterial indicators and their impact on water pollution were also studied (The total number of coliform bacteria, and fecal colon).

The results of the study showed that the pH recorded values between (8.92 - 7.1),The dissolved oxygen recorded values between (8.9 - 2.5) mg/l, while the vital oxygen requirement recorded values between (5.6 - 0.5) mg / l,The dissolved solids recorded values between (1230 - 122) mg / liter, while calcium recorded values between (552 - 116.8) mg / liter, while magnesium recorded values between (239.12 - 43.92) The values of chlorides ranged between (1156.4 - 137.2) mg / l, nitrates recorded values between (3.602 - 0.99) mg / l, and phosphates recorded values between (0.0367 – 0) mg/L.

As for the concentrations of heavy metals in water, the study showed that the values of zinc, cadmium, and lead elements ranged between (0.0323 - 0), (0.0516 -0), (0.1103-0) mg/L, respectively.As for the microbial characteristics, the total number of coliform and fecal colon bacteria recorded results that ranged between (1100 - 75), (1100 - 3.6) MPN/100ml, respectively, according toMost Probable Numbe.

The water quality index was applied using twelve factors (pH, dissolved oxygen, biological oxygen requirement, dissolved solids, calcium, magnesium, phosphate, nitrates, chlorides, lead, coliform bacteria, and fecal coliform bacteria The results of the Canadian CCMEQ index showed in the three sites with values ranging (37.84, 49.54, 50.77), respectively, and thus, the Shatt AL-Shafiya waters were classified in the first site of the fifth degree, meaning poor quality (poor) which is It indicates that it is constantly exposed to pollution, while the waters of Shatt AL-Shafiya in the second and third sites were considered as (Marginal), and it is water that is frequently subjected to pollution and is most of the time considered far from ideal.Table (2-4).

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into water unfit for use or undesirable taste and odor, or impure water is the one that has been exposed to water. Due to natural factors that caused it to change in color, taste, smell or turbidity due to the presence of foreign organic substances or stuck in it, and finally water that is not usable, and it contains toxic chemicals or bacteria that make it harmful to public health due to the diseases it causes, which leads to lack

Introduction

Rivers are the main source of drinking water in most cities, as the river irrigates several drinking water complexes and projects, and this water is also used for irrigation and watering works. The division of water in general into pure water usable, that is, free of germs and dissolved mineral substances that give it color or turn it

effects on microorganisms used in heavy water treatment, and their effect on aquatic organisms when they are thrown into water bodies without treatment, they are known as heavy elements (Alloway and Ayres, 1997).Its danger leads to bioaccumulation within the organs of living organisms, and the presence of high concentrations of these elements in the body over time can lead to disorders called metabolic disturbance (Kobori, et al, 2009).Where bacteria and other natural processes, in addition to their stability, which allows them to move long distances from their centers of origin, where heavy elements are considered to have a significant impact on water that belongs to inorganic pollutants (Abboud et al., 2015), cannot decompose heavy elements and the rest of the pollutants.

The use of Bioindicators is one of the best ways to reduce complex data and make it simpler in expressing the quality of life, and the use of water quality indices depends on a number of physical, chemical and biological properties (bacteriology) (poonam et al,2013).

The water quality index is also characterized by the composition of a set of physical and chemical environmental phenomena and their evaluation in a smooth way to know the quality of water, and this has been agreed upon since the middle of the twentieth century (Horton, 1965).The Water Quality Handbook summarizes and presents complex water quality data in a simplified format that is easy to understand for non-specialists (CCME, 2001).In addition, the indicator is applied according to the Canadian model and according to different uses as it is used for different purposes such as drinking, recreation and aquatic life (Mercier, et al, 2004).

Materials & Methods:

Three sites were selected on the beach, which extends at a distance of 19,500 km from the point of entry of the water to the beach, and as shown in the attached map, Figure(1).

of Its efficiency as drinking water or irrigating crops (Fairbridge, 1972).Recently, interest has increased in studying the pollutants resulting from sewage stations, which are the main cause of river pollution and also other pollutants may pour into it, such as waste (factories, car workshops and hospitals) because they negatively affect the river water features. Chemical, Biological and Physical (El-Haddad&Taha, 2004).As different industries and technologies develop, the matter becomes more complex, in addition to the significant expansion in the use of chemical pesticides, toxins, environmentally hazardous waste, disinfectants, sterilization materials, sewage and industrial waste, all of these activities will lead to pollution of water sources, especially rivers, streams, canals and inland lakes. Various pollutants, including toxic metals(Abdul Razzak and sulayman ,2009, Al-Essawi, 2010, Al-Qusayr, 2012).The problem of pollution and its wide spread at multiple levels imposed on researchers and specialists concerned to search for unconventional ways to monitor this phenomenon and as an extension of modern technical development in all fields, remote sensing technology is one of the important tools with accurate competencies in monitoring water pollution from sites different ground, air and space by means of the information and data that this technology carries in a specific time period in a specific area, unlike the traditional means (Al-Fahdawi, 2012).Many minerals are necessary for human, animal and plant health and play a role in biological processes in certain concentrations, such as copper, while no vital role has been discovered in the other part of it, such as lead and cadmium, and most of these elements are highly toxic and unbreakable or decomposing. By microorganisms, and its cumulative effect eventually reaches the human body through the food chain, where it settles in various body tissues such as the liver, blood, kidneys and other organs of the body (Gunnar, et al., 2002).When there are relatively low concentrations of substances that have toxic

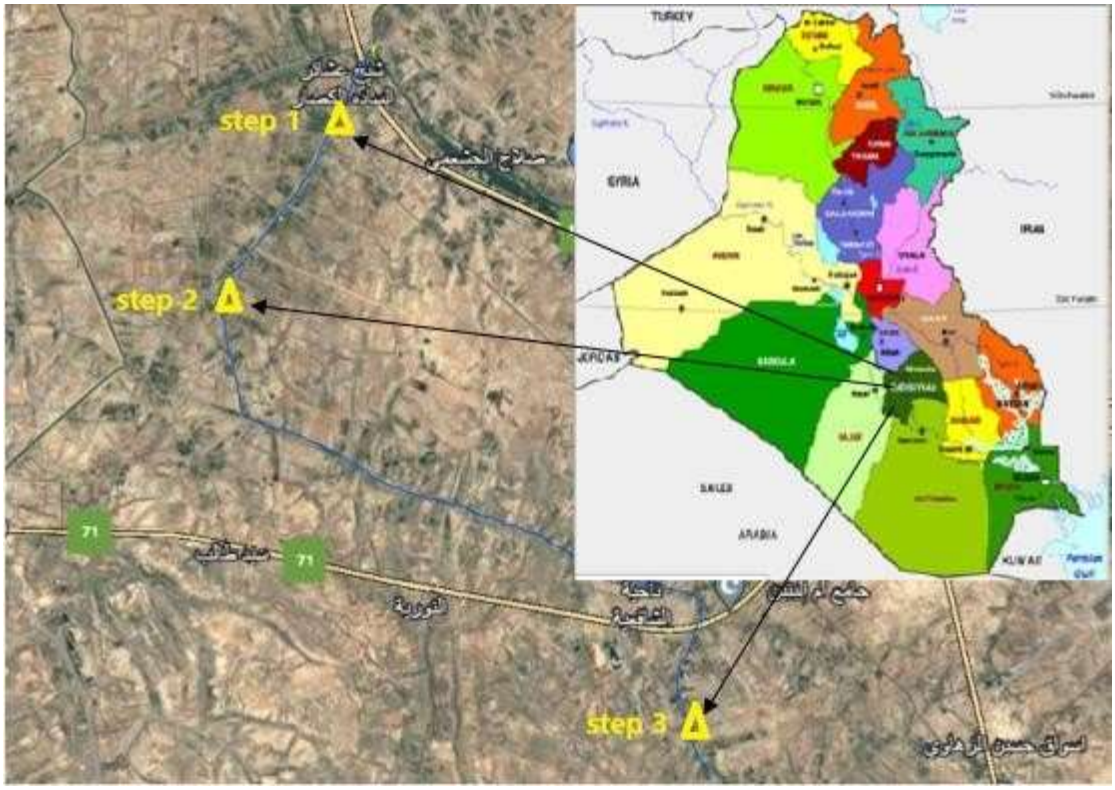

Figure (1) A map showing the study sites for the Shatt al-Shafi'i waters (source: Google Earth).

Field measurements:

pH

The pH is measured directly from the field using a multi meter (Sensodirect 150), which is calibrated before sampling with standard buffer solutions (pH: 4 and 7).

Total Dissolved Solids

The dissolved solids are measured in the field directly by means of a multi meter (Sensodirect 150) by dipping the electrode of the device in the water sample for a certain period where the values are recorded in units of mg / litre.

Dissolved oxygen (DO) and biological oxygen requirement (BOD5)

The biological oxygen requirement is measured by measuring (DO) directly in the field using the electrode method by a multi meter (Sensodirect 150) where the electrode of the device is immersed in water for several minutes, where the values are read It is established in units of mg / liter and this is symbolized by (DO1), while the dissolved oxygen (DO2) was measured after five days of incubation, after keeping the water sample in opaque and tightly

Description of the study sites

1-first site

It is located at the point where the water enters the Shatt in the district of Al-Saniyah near the Shatt Al-Shafi'i pump. It is characterized by a high water level and an increase in its speed. It is characterized by the wideness of the river compared to the rest of the other sites, as it is located at northern latitudes 32° 02'55.0"N and Eastern meridians 44° 46'19.3"E

2- The second site

It is 5,500 km from the first site, and is located at northern latitudes32° 00'25.0"N and 44° 44'28.3"E east longitude. It is characterized by a lower water level and less spaciousness compared to the first site, and there are many agricultural lands around it.

3- The third site

It is 14 km from the second site and it is located in the Shafi'i district near the house of Sayed Majid, where it is located at northern latitudes 31°55'25.3"N and eastern longitudes 44°50'44.9 "E", and is characterized by a lower water level and less wide than the first and second sites.

concentration is calculated in (mg/L) through the following equation:

$$\text{Ca mg/L} = \frac{400.8 \times B \times A}{V}$$

Where

A: The volume of standard EDTA solution needed to saturate the sample (ml).

B: 1 mg of calcium carbonate (CaCo3) (equivalent to 1 mL) of EDTA solution) necessary to reach the final point of dissolving.

V: sample size in ml (APHA, 2005).

Magnesium(Mg)

Magnesium (Mg) values are calculated through the difference between the ratios of total hardness (TH) and hardness of (Ca) as shown in the following equation according to (AOAC, 2005; APHA, 2005).

$$\text{Mg mg/L} = A - B \times 4.88$$

Where

A: is the volume of EDTA for the estimation of hardness

B: is the volume of EDTA for calcium determination

(CL)Chloride

The values of chlorides are measured by taking (50) ml of the sample, and adding to it a solution of potassium chromate (K2CrO4) at a concentration of 1) ml, which is used as a reagent guide, then it is smeared with (0.0141) molar of a standard silver nitrate solution (AgNO3) until the color changes from yellow to yellowish-pink, and then the chloride values are measured in units (mg/L), as in the following equation:

$$\text{CL- mg/l} = \frac{(A-B)(N)\times 35.45}{ml\ of\ sample}$$

Where

A: The standard volume of (AgNO3) solution necessary to clear the sample in (ml).

B: The standard volume of (AgNO3) solution necessary for scaling mineral water in (ml).

closed bottles at a temperature of 20 m, which is measured after shaking the bottle well and calculating the reading and fixing it in units of mg / liter, and through the difference between the two readings, the vital oxygen requirement (BOD5) was extracted, mg / liter, where its values are calculated according to the equation:

$BOD5 = DO_1 - DO_2$

where

DO1: is the value of dissolved oxygen mg / liter of the sample on the first day

DO2: The value of dissolved oxygen in units of mg / liter after five days of incubation.

Laboratory Measurement:

Total suspended solid

The suspended solids are calculated according to the method adopted by the American Health Organization (APHA, 1998), by washing the filter paper (0.45 µm) with distilled water and then drying it at a temperature of 105 m inside the oven for a maximum period of 60 minutes, then cooled and weighed, as this value is considered the first weight (B)), while the second weight (A) is extracted through filtering 100 ml of the water sample. Then the filter paper is returned to the oven, then cooled and weighed for the same period, and the value of TSS is extracted using the following equation:

$$\text{TSS mg/L} = \frac{(A - B) \times 1000}{\text{Volume of sample(ml)}}$$

where

A: The weight of the filter paper after filtering the water sample.

B: Weigh the filter paper before filtering.

Calcium(Ca)

Calcium is calculated by taking 10 ml of a sample of water and it is diluted by adding 50 ml of mineral water, and sodium hydroxide solution NaoH (1 standard) is added at a concentration of (2-1) ml, as well as adding (0.2-0.1) meroxide reagent to it, and sweeping with (0.01) molar of the (EDTA) standard solution to When reaching the last point of scaling, by changing the color from pink to stable violet, the calcium

method), and the culture medium used in the study was Lauryl tryptose broth). Durham tubes containing this medium were incubated at room temperature (20) C. and for (24) hours before use, and tubes that are covered with bubbles are disposed of, according to (WHO, 1985-b) (Al-Azzawi and Al-Mafraji, 1991).

Presumptive test

The tubes are arranged in three rows or nine tubes, where the sample was shaken (25) times, and by using a sterile pipette, 10 ml of the sample to be examined was added to each tube of the nine tubes. , in which the double-concentration Lauryl tryptose broth culture medium was present, then the tubes were shaken gently to disperse the sample evenly in the nutrient medium, then the injected tubes were placed in the incubator at a temperature of (35±0.5) C, with a period of time between (24±2) hours, and at the end of the incubation period, each tube was diagnosed to detect that it contained any growth, whether acid or gas, which changes the color of the medium, and the number of positive tubes was marked. The negative tubes are re-incubated for a period of (48±3) hours, and at the end of the incubation period, the tubes are diagnosed again, and the number of positive tubes is also taught.

Confirmed test

The tubes with positive values are shaken, taking one or more drops of the culture (loopfuls) via a sterile conveyor (loop), to the tubes of the prepared Brilliant green lactose bile broth) culture medium. The tubes were then incubated in the incubator at a temperature of (35±0.5), and for a period of time between (24±2) hours, and the tubes in which growth was evident, i.e., the appearance of gas with turbidity, were diagnosed. The values, while the tubes do not have growth, they are incubated again with a period of time (48±3) hours, and the values are expressed on the basis of the most likely number (MPN/100ml) Most Probable Number (MPN).

Fecal Coliform Count (FC)

Presumptive test

The number of fecal coliforms is calculated, by organizing the tubes in three rows, consisting of nine tubes, and containing the EC Medium (pre-prepared and sterilized), and by using a sterile

N: molarity of silver nitrate standard solution (APHA, 2005).

NO3)(Nitrate

The nitrate values are calculated according to APHA (1999), using concentrated hydrochloric acid (HCL) N1) with a volume of (1) ml added to the diluted form (50 of water). mineral and 5 ml of the sample), and as a result it is measured using a UV-spectrophotometer, with a wavelength (220 nm), and in units of mg/L.

Phosphate(PO4)

Phosphate values are calculated by using the ascorbic acid method, adding the compound reagents in an amount of 8 ml which are (ammonium molybdate, ascorbic acid, concentrated sulfuric acid (5N), antimony potassium tartrate), then It was shaken and left for ten minutes, as its blue color appears and the values are calculated by a spectrophotometer with a wavelength of 700 nm and these values are measured in mg/L units. According to (APHA, 1999).

Heavy Metals in Water (pb)

Samples are calculated according to the method of Hassan and Abbawi (1990), by adding 100 ml of water sample in a sterile glass beaker with distilled water, as well as adding nitric acid in a volume of 5 ml , and then evaporated, by means of a hot plate without reaching a boil at 85 C until the volume is reduced to 10 ml, then the sample is cooled and added to a graduated flask about 50 ml, and diluted with deionized water and left to settle overnight to displace the substances that cannot dissolve, then the solutions are kept in sterile polyethylene flasks, and kept in the refrigerator until the time they are used later for measurement by atomic absorption spectrometer, and their value is calculated by the following equation:

$$\text{Concenation mg/L} = \frac{\text{Sample size after concentration} \times \text{read device}}{\text{Sample volume}}$$

Microbial Tests:

Total Coliform (TC)

The total number of coliform bacteria was calculated by (multiple fermentation tubes

3-(Amplitude): It is expressed in (F3) and it indicates the amount of exceeded tests, and it is calculated at two levels:

First: The first level: It is expressed by the number of times the individual values exceed the standard limits and this process is called deviation, and it is expressed by the following equation:

$$\text{Excursion} = [\frac{Exceeded\ Check\ Value}{\text{Sxceeded Value}}\text{-}]\text{-}1$$

In the event that the result of the transcendent test is higher than the standard value, it is measured by inverting the ratio:

$$\text{Excursion} = [\frac{\text{Sxceeded Value}}{Exceeded\ Check\ Value}]\text{-}1$$

Second: The second level: It is the amount of the set (individually exceeded tests), which is evaluated by summing the individual deviations, and dividing it by the total number of examinations, (overdone and not exceeded), and this level is called (Normalization of Excursion)It is abbreviated as (nse).

The capacitance (F3) is measured according to the following equation:

$$\text{F3} = \frac{nes}{0.01\ \text{nes} + 0.01}$$

After extracting the three factors, the Canadian index (CCME) is measured, as in the following equation:

$$CCME\ WQI = [\frac{\sqrt{F1 + F2 + F3}}{1.732}] - 100$$

Constant (1.732): Its purpose is to modify the value of the index and make it restricted between)100-0.0)The water quality was divided into five parts, according to (Kumar, al et, 2014) according to Table (1) below:

pipette 10 ml of The sample to be examined was placed in each of the nine tubes, then the tubes were shaken gently to disperse the sample evenly in the nutrient medium, then the injected tubes were placed in the incubator at a temperature of (35±0.5) C, and for a period of time Between (24±2) hours, and at the end of the incubation period, each tube was diagnosed to detect that it contained acid or gas, and the number of positive tubes was marked.

Confirmed test

through the tubes that showed positive values, a drop was taken from the cultured (loopfuls) through a sterile transporter (loop), to the tubes of EC Medium (pre-prepared and sterilized), then the tubes were incubated. The injected in the water bath at a temperature of (44.5 ± 0.2) C, and for a period of time between (24 ± 2) hours, within (30) minutes after implantation, and the tubes that cleared were diagnosed. Growth, that is, the appearance of gas with turbidity, and recording the values, and the values were expressed on the basis of the most likely number of water sample (MPN) MPN/100ml (Most Probable Number)) by comparing it with Water tables.

The Canadian Index (CCME WQI)

The Canadian Index (CCME WQI) is characterized by high accuracy, as it is calculated after specifying the variables, time period and standard criteria, where the results of the guide are found by calculating the following three factors:. (Al-Saffawi, 2018c; Salman et al., 2015).

1- (SCOPE): It is expressed in (F1) and it refers to the percentage of variables whose values are not equivalent to the standard criteria set for the sample (the exceeded variables), and it is expressed by the following equation:

$$\text{F1} = [\frac{\text{Number of overridden variables}}{\text{Total number of variables}}]\times 100$$

2- (Frequency) It is expressed as (F2) and refers to the percentage of tests whose values are not identical with the standard criteria set for the sample (exceeded tests) and it is expressed by the following equation:

$$\text{F2} = [\frac{\text{Number of examinations passed}}{Total\ Nummber\ of\ examinations}] \times 100$$

Table (1) shows the values, classification, and degree of water quality for the Canadian Index.(CCME,2001)

WQI	**44-0**	**59-45**	**79-60**	**94-80**	**100-95**
classification	**(Poor)**	**(Marginal)**	**(Fair)**	**)Good(**	**(Excellent(**
Degree	**5**	**4**	**3**	**2**	**1**
the description	**Water is constantly polluted and is far from ideal at all times**	**Water is frequently polluted and is often far from ideal**	**Water is sometimes protected, but sometimes polluted, and it is sometimes far from ideal**	**Water is less protected, and its specifications rarely stray from ideal**	**The water is well protected and unpolluted, and it is close to ideal water**

The results of the current study showed that the pH levels tended to be light basal and this is consistent with the aforementioned Iraqi water characteristics, where the lowest pH level was recorded in the third site during May 7.1, for the year 2022 and its highest levels In the third location during January of the year 2022 with a degree of 8.92, and it was the most valuable in the low-temperature months, and this is consistent with what Venkatesharaju, et al, (2010) indicated, that the pH It increases in basicity, as a result of the decrease in decomposition levels during the cold months, while in the hot months it decreases, and is due to the activity of microorganisms such as bacteria, which leads to increased decomposition, and the tendency of pH to acidity and neutrality when pollution is limited (Al Nasih, 1993)

Statistical Analysis

The statistical analysis of the results and the studied variables was conducted according to the statistical models in the computer as in the SPSS 20.0 program to test the least significant difference LSD at a significant level (P≤ 0.01,0.05)

Results and discussion

pH:

pH recorded its lowest level in the third site during May 2022, 7.1, and its highest level in the third site during January 2022, 8.92, Figure (2).

The results of the statistical analysis showed that there were significant differences between the months of the study, Table (2) , while there were no significant differences between sites at the level of significance (p = 0.05), Table (3).

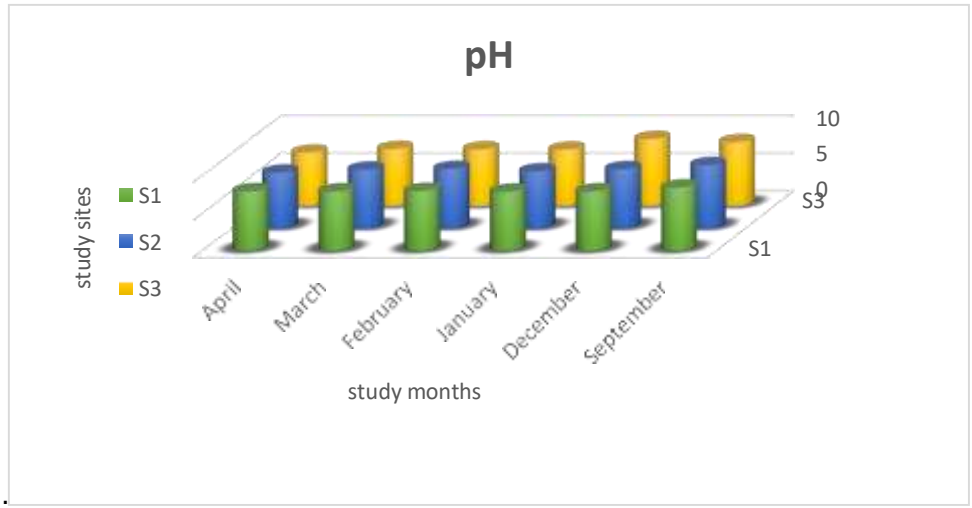

Figure (2) Monthly changes in pH values during the study period (December 2021 - May 2022)

to its essential importance in water for the living of aquatic organisms, fish and breathing processes, in addition to the self-purification process that occurs naturally by microorganisms that prevents the formation of undesirable odors. Important properties that affect water quality and are essential for a natural balance,It is noted during the study that its values increased during the cold months and decreased during the hot months, In addition to temperature, there are many factors that affect the values of dissolved oxygen in water, in terms of rise or fall, as in the density of plankton, the amount of pollutants, the speed of flow, air currents, and compounds dissolved in water (Suleiman et al, 2009), (Sharma, et al, 2012).

Dissolved oxygen

Dissolved oxygen recorded its lowest level in the third site during May 2022, 2.5 mg/L, and its highest level in the second site during January 2022, 8.9 mg \ L , figure (3).

The results of the statistical analysis showed that there were significant differences between the months of the study, Table (2) , while there were no significant differences between the study sites at the level of significance ($p<0.05$), Table (3).

Dissolved oxygen is considered a necessary guide to the state of pollution in fresh water, due

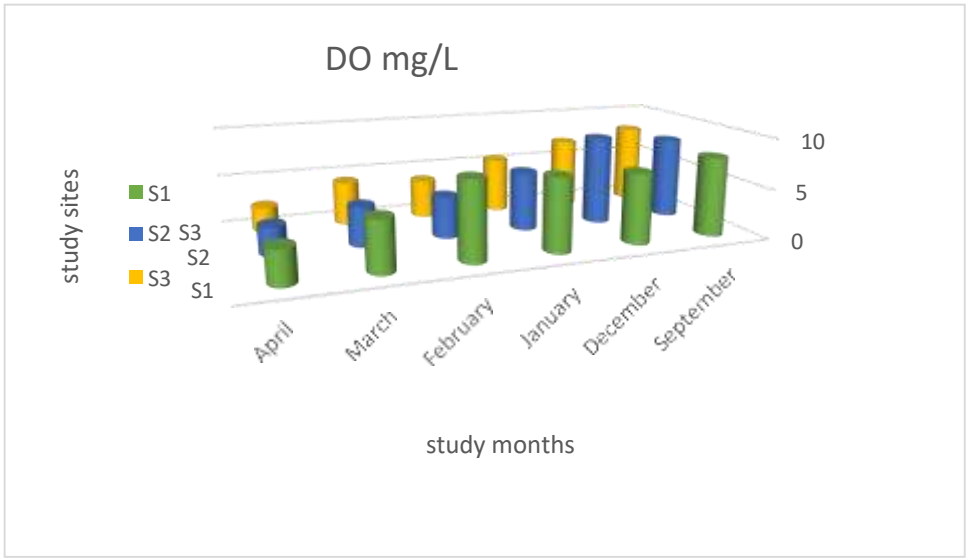

Figure (3) Monthly changes in dissolved oxygen concentrations (mg/L) during the study period (December 2021 - May 2022).

was recorded in the first site in March of 2022, (5.6). mg/L, Figure (4).

Biological Oxygen Demand (BOD)

its lowest level was recorded during May of 2022 in the third site, (0.5) mg/L, and its highest level

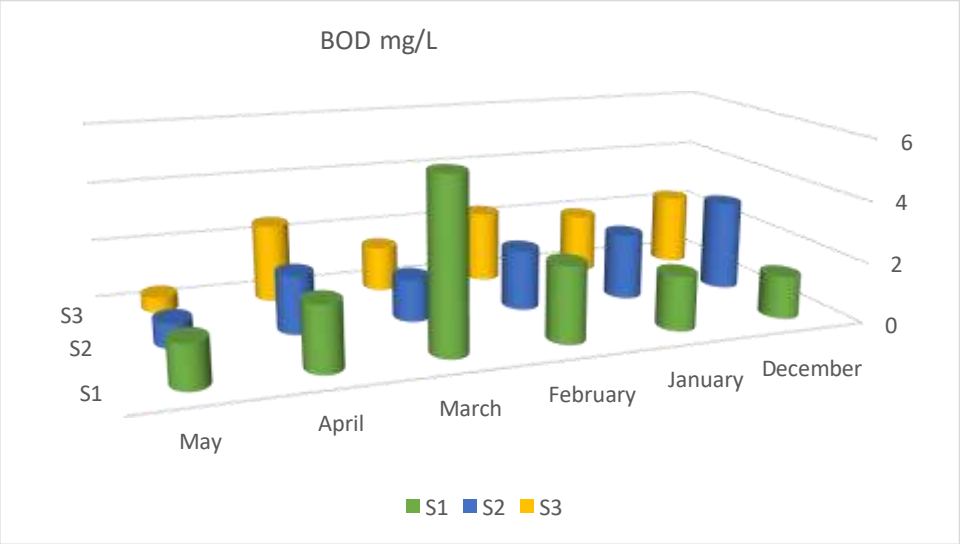

Figure (4) Monthly changes in the BOD concentrations (mg/L) during a periodStudy (December 2021 - May 2022)

studies that showed a decrease in the vital oxygen requirement in the winter months, such as a study (Salman, 2006, Al-Ghanimi, 2011, and Al-Qusayr, 2012).

Total Dissolved Solids

Its lowest level was recorded in the second site during March of the year 2022, (122) mg / liter, and its highest value was recorded in the first site during the month of April of the year 2022, (1230) mg/L, Figure (5)

The results of the statistical analysis showed that there were significant differences between the months of the study Table(2), and there were no significant differences between the study sites at the level of significance ($p<0.05$), Table(3).

The biological oxygen requirement reflects the amount of dissolved oxygen depleted by aerobic organisms and that biodegrading organisms increase the biological oxygen requirement and dissolved oxygen depletion (Abida&Harikrishna, 2008). In this way, it contrasts with many

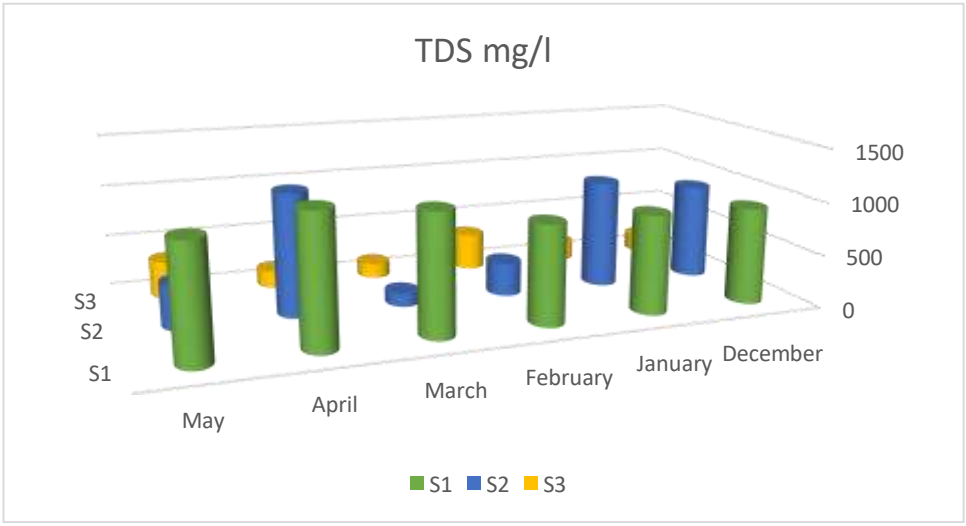

Figure (5) Monthly changes in the concentrations of dissolved solids (mg/L) during the study period (December 2021 - May 2022)

specific system, but rather depends on the chemical composition of the land and the nature through which the water flows, and on the quality of the waste and the chemical composition of the water. Industrial and household waste is a necessary source of water pollution with solid materials. (JEMAI, 1998).

Calcium(Ca)

The lowest value of calcium was recorded in the first location during January 2022, 116.8 mg/L, and the highest value reached in the second location during February 2022, 552. mg/L, Figure (6)

The results of the statistical analysis showed that there were significant differences between the months and locations of the study, Table(2),Table(3).

The dissolved solids present in water are considered one of the most important main pollutants of water. They are found in varying quantities and forms. They can be found in water in a dissolved form, as they consist of negative ions of compounds connected with ions of positive elements and may form solids suspended in the body of water itself. The chemical composition of the solid materials that are present in the water does not follow a

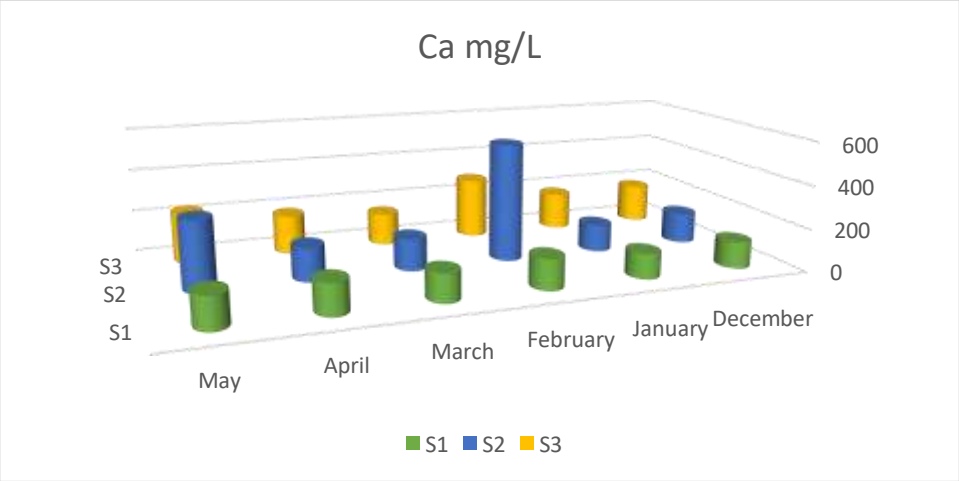

Figure (6) of the monthly changes in calcium concentrations (mg/L) during the study period(December 2021 - May 2022)

oxidation position in water, and it is one of the alkaline earth metals, and the source of magnesium in water is clay minerals and industrial pollutants, and it is the second most important carbonate mineral after calcite is the mineral dolomite (Mark,2015).

The lowest level was recorded in the first location of February 2022, (43.92) mg/L, and its highest level was during May 2022 in the third location, (239.1) mg/L, Figure (7)

The results of the statistical analysis showed that there were significant differences between the months of the study, Table(2),and there were no significant differences between the study sites, Table(3), at the level of significance ($P<0.05$).

Magnesium (mg)

Magnesium is one of the important elements as food for animals and plants, and it has one

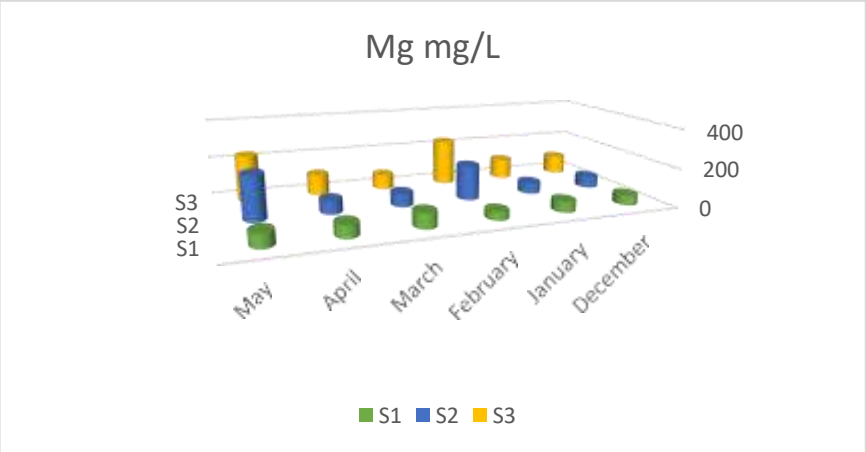

Figure (7)Monthly changes in magnesium concentrations (mg/L) during the study period (December 2021 - May 2022)

Chlorides: Chloride(CL)

its lowest level was recorded during December 2021 in the first site, at 137.2 mg/L, and its highest level was 1156 mg/L in the second site during May of the year. 2022, Figure (8).

The results of the statistical analysis showed that there were significant differences between the months and locations of the study, Table(2),Table(3),respectively, at the level of significance ($p<0.05$).

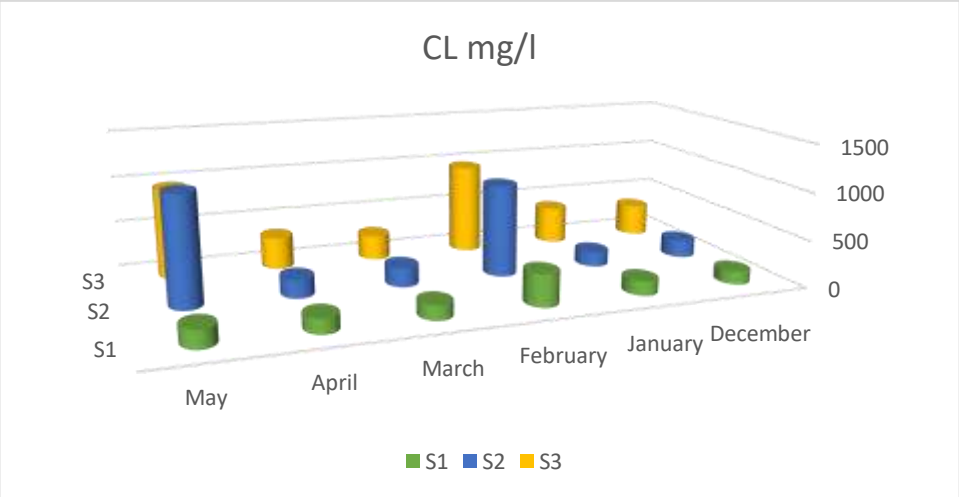

Figure (8)Monthly changes in chloride concentrations (mg/L) during the study period (December 2021 - May 2022)

ions, and the reason for its presence in the natural environment of water is through the disintegration of chemical industry waste and salt deposits (Peters , 1989).

Nitrate(NO3)

The lowest level was recorded during May of 2022 from the second site, 0.99 mg/l, and its highest value during February of 2022 from the first site, 3.602 mg/l, figure (9).

The results of the statistical analysis showed that there were significant differences between the months of the study, Table(2),and there were no significant differences between the study sites, Table(3),at the level of morale ($P < 0.05$(.

Table salt that appears in water depends primarily on the values of the chloride ion in the water, as if it contacts with other chemical compositions, such as calcium and magnesium

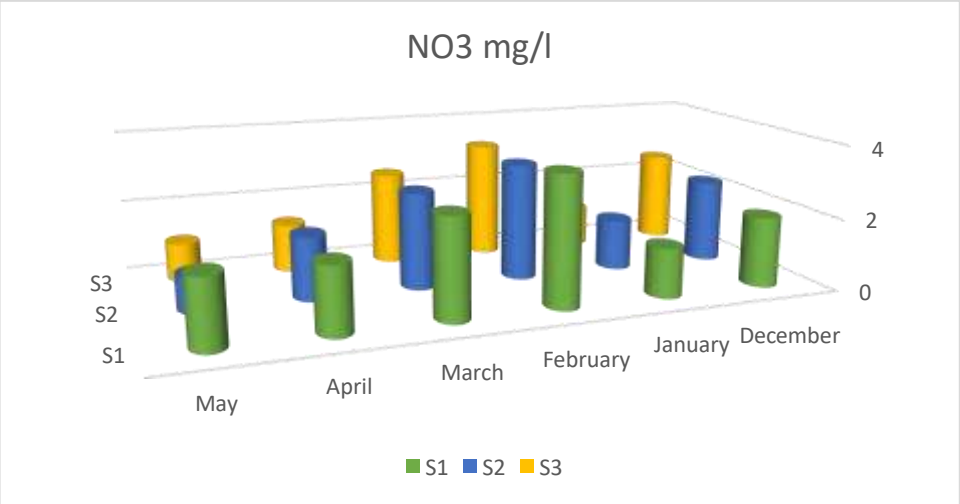

Figure (9)Monthly changes in nitrate concentrations (mg/L) during the study period (December 2021 - May 2022)

nitrification, and a rise in human and agricultural activities.

Phosphate (PO4)

The lowest level of phosphate was recorded during the month of February of 2022 from the first site, and in March of 2022 in the first, second and third site, as well as in April of 2022 in the first site, zero mg / liter And its highest level during December of 2021 in the first site was 0.037 mg/L, Figure (10).

The results of the statistical analysis showed that there were significant differences between the months of the studyTable(2),and there were no significant differences between the study sites, Table(3),at the level of morale ($P < 0.05$).

Nitrates showed a variation in their concentrations according to the different months of the study, due to human and agricultural additions, as well as to the transformation of amino acids into ammonia and then into nitrates through a process called

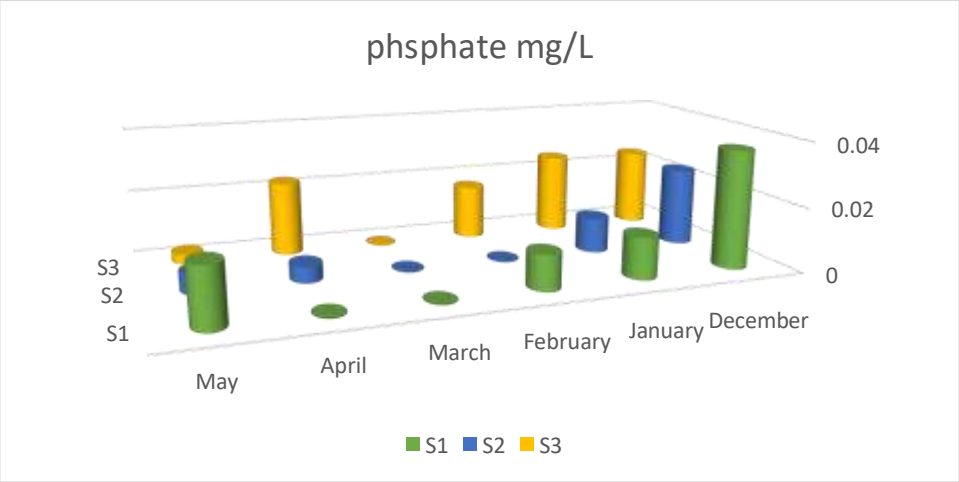

Figure (10) monthly changes in phosphate concentrations (mg/L) during the study period (December 2021 - May 2022)

phosphates, which are plant nutrients, and can become harmful when increased fertilization of plants that live in water, and cause a state of eutrophication. Sanitary, chemical fertilizers, and detergents thrown into the beach as a result of washing cars, and processing vegetables and fruits, where the natural value of phosphate is

The results of the statistical analysis showed that there were significant differences between the months of the studyTable(2), and there were no significant differences between the study sites, Table(3),at the level of morale ($P < 0.05$).

Phosphate is an essential element for living things, and it is found in rocks, such as inorganic

The lowest level of lead for the waters of Shatt al-Shafiya was recorded in the second and third sites in January 2022, the first and third sites in March and May 2022, and in the first and second sites in April 2022 it was zero mg/liter. And its highest level in the second site for the month of May 2022, 0.1103 mg/L, Figure (11).

about 0.02 mg / l, and this value is the factor that determines the growth of plants (Laws, 1993).

Lead (pb)

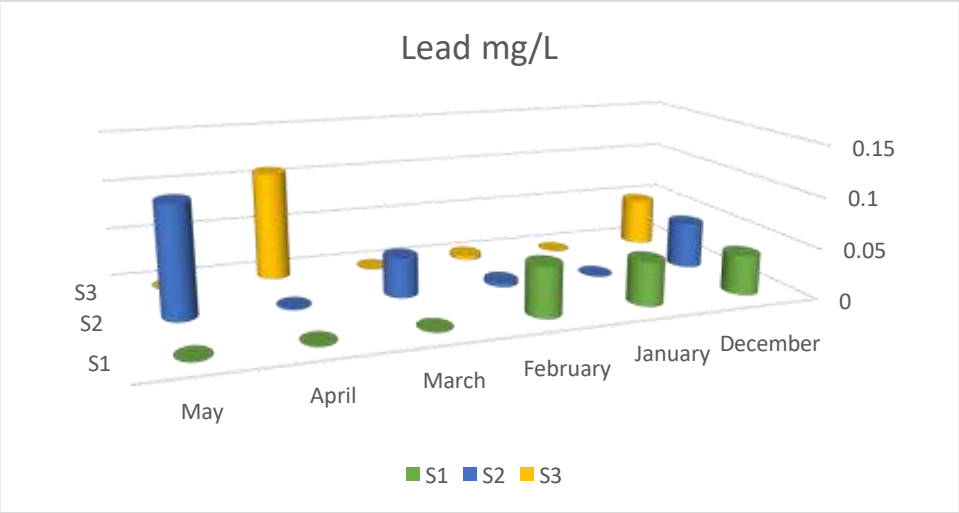

Figure (11) Monthly changes in lead concentrations in water (mg/L) during the study period(December 2021 - May 2022)

the main reason for the rise in the value of lead In the water environment.Also, the reason for the discrepancy in lead values between sites is attributed to the amount of pollutants carried by water, including urban pollutants, and the heavy water being thrown into the river in abundance without treatment, in addition to its transport with dust and the stability of a proportion of it in the river.

Total number of colon bacteria (TC)

Coliform bacteria (TC) recorded the lowest value in the second site for the month of January 2022, 75 MPN/100ml, and it reached its highest level in all sites for both December 2021 and April 2022, and the third position for the month of January 2022, the second position for the month of February 2022, and the first and second position for the month of March MPN/100ml 1100, 2022, Figure (12).

The results of the statistical analysis showed that there were no significant differences between the months and locations of the study, Table(2),Table(3),respectively, at the level of significance ($P<0.05$).

Lead is a highly toxic trace element that has the ability to affect the entire food chain, and is not limited to accumulation in individuals only, and it causes damage to living organisms and humans (David, et al, 2003).Where it was noted through the results of the current study that the highest value of lead was recorded in the second location for the month of May, and the reason for its rise in this location may be due to the fact that these areas are characterized by continuous traffic, which indicates that motor fuel may be

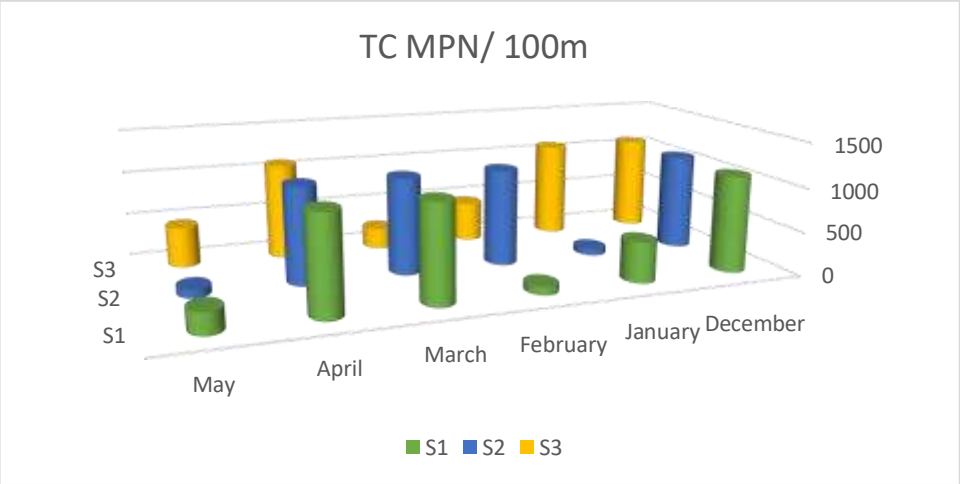

Figure (12) Monthly changes in the total number of colon bacteria (MPN/100ml) duringStudy period (December 2021 - May 2022)

The discrepancy in the concentration of coliform bacteria is due to the influence of the population, villages, districts, and areas adjacent to the water of the beach, and the pollutants it poses from agricultural drainage and sewage water, which would increase these numbers, in addition to the low speed of the river run-off as a result of the low water level.

Faecal coliform (FC)

It recorded its lowest level in the first site for the month of April 2022, at 3.6, MPN/100 ml, and its highest level in the third site for both December 2021 and January 2022 1100 MPN/100ml, Fig. (13**).**

The results of the statistical analysis showed that there were significant differences between the months of the study, Table(2),and there were no significant differences between the study sites, Table(3),at the level of significance ($P<0.05$).

This group usually represents bacteria that enter the water through sewage and bacteria that drift with soil into the water during rainy and flood seasons (Al-Fatlawi, 2007). Finding the total number of bacteria is a necessary test for bacterial tests in water that give an estimate of the total number of bacteria in the water sample, but do not give an indication of faecal contamination or health damage (WHO, 2006).

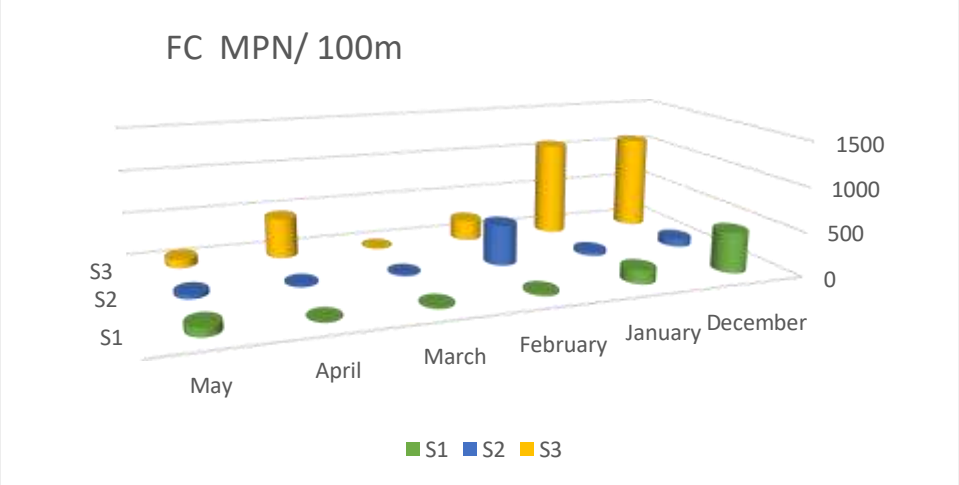

Figure (13) Monthly changes in the total number of fecal coliform bacteria (MPN/100ml) During the study period (December 2021 - May 2022)

The results of the statistical analysis showed that there were no significant differences

and districts adjacent to Shatt al-Shafiya, The level of oxygen, the nature of the bottom and the speed of flow may also have a primary role in increasing the numbers of these bacteria in these sites, in addition to the diversity of pollution sources to which the river is exposed, with the diversity of service and human activities.

between the months of the study and the study sites, Table(2), Table(3), respectively, at the level of significance (P<0.05).

This indicates that the increase in the number of bacteria is a result of the effect of the waste that is thrown out by the countryside, villages,

Table (2) shows the concentration of physicochemical properties, heavy metals and bacteria for the months of study of the Shatt al-Shafiya water during the study period, the first line (average), and the second line (standard deviation).

Variables / months	DO	BOD	pH	TDS	PO_4	NO_3	CL	Mg	Ca	Pb	FC	TC
December	8.07 ± 0.15A	2.27 ± 0.81AB	8.43 ± 0.06A	668.67 ± 428.3A	0.029 ± 0.007A	2.28 ± 0.25A	224.07 ± 107.9A	71.24 ± 25.8A	150.93 ± 30.2A	0.045 ± 0.0002A	551 ± 509.6A	1100 ± 0A
January	7.67 ± 1.07A	2.00 ± 0.2AB	8.22 ± 0.61C	719.67 ± 460.9A	0.016 ± 0.008AB	1.31 ± 0.13B	237.81 ± 142A	73.85 ± 29.06AB	140.80 ± 32.3A	0.015 ± 0.003A	431 ± 581.8A	545 ± 517.7AB
February	6.27 ± 0.91AB	2.30 ± 0.26AB	7.64 ± 0.18B	538.00 ± 350.3A	0.009 ± 0.009BC	3.37 ± 0.17C	764.40 ± 364.8B	154.53 ± 100.1AB	328.00 ± 206.9B	0.019 ± 0.003A	241 ± 218.5A	551 ± 509.6AB
March	5.27 ± 2.2CD	2.83 ± 2.4AB	7.78 ± 0.22BC	469.00 ± 581.2A	0.000 ± 0C	2.68 ± 0.07A	209.72 ± 56.9A	74.18 ± 5.07AB	144.00 ± 11.2A	0.013 ± 0.02A	7.33 ± 3.5A	813.33 ± 496AB
April	4.43 ± 0.55D	2.20 ± 0.36AB	7.75 ± 0.15BC	852.67 ± 594.8A	0.009 ± 0.0012BC	1.65 ± 0.21B	232.59 ± 99.6B	80.35 ± 24.4AB	161.07 ± 20.6A	0.037 ± 0.06A	158.20 ± 261.3A	1100 ± 0A
May	2.87 ± 0.4D	0.90 ± 0.46AB	7.47 ± 0.4B	618.00 ± 399.4A	0.009 ± 0.008BC	1.31 ± 0.4B	769.61 ± 514B	178.93 ± 95.1B	235.20 ± 86.4AB	0.037 ± 0.005A	76.33 ± 28.8A	264.33 ± 184B
LSD	2.64	1.90	0.57	850	0.014	0.499	483.1	105.8	166.9	0.072	614.2	653

Table (3) shows the concentration of physicochemical properties, heavy metals and bacterial properties of the study sites of Shatt Al-Shafiya water during the study period, the first line (average), and the second line (standard deviation).

Variables / Sites	DO	BOD	TDS	pH	PO_4	NO_3	CL	Mg	Ca	Pb	FC	TC
S1	6.38 ± 1.84 a	2.47 ± 1.59a	1040.83 ± 128.6 c	7.97 ± 0.21 a	0.013 ± 0.014 a	2.24 ± 0.81 a	188.16 ± 77.5 a	60.19 ± 12.1b	134.93 ± 12.6a	0.022 ± 0.025 a	123.43 ± 174.3 a	682.17 ± 472a
S2	5.63 ± 2.48 a	1.88 ± 0.74a	660.67 ± 428.6 b	7.82 ± 0.34 a	0.008 ± 0.009 a	2.07 ± 0.84 a	481.51 ± 458 a	111.10 ± 74ab	241.6 ± 168a	0.033 ± 0.043 a	109.50 ± 174.4 a	761.33 ± 524a
S3	5.27 ± 2.09 a	1.90 ± 0.79a	231.50 ± 97.9a	7.86 ± 0.69 a	0.015 ± 0.0011a	1.99 ± 0.93 a	549.44 ± 327 a	145.26 ± 73.5a	203.47 ± 49.4a	0.027 ± 0.045 a	499.50 ± 490a	743.33 ± 398.8 a
LSD	1.96	1.36	325.5	0.51	0.007	0.265	403.7	74.6	124.8	0.047	406.3	423.2

clear in the second and third sites that it is located in the fourth degree, i.e. barefoot (Marginal), table (1), and this is due to the high proportions of calcium, magnesium and other substances,Total Dissolved solids, dissolved oxygen, biological requirement for oxygen, chlorides, lead, coliform bacteria, and fecal colon for all three sampling sites. Thus, the Shatt al-Shafiya water must be treated to remove physical, chemical and bacterial impurities.

Some studies in Iraq, using the Canadian evidence, indicated that the water quality in the Tigris and Euphrates rivers ranges between poor and marginal (AL-Janabi, et al, 2012; and AL-Heety, et. al, 2011). Soil erosion can be reduced by watershed management technology, which reduces the percentage of Total dissolved solids and turbidity in the water, which threatens aquatic life.

The water quality index (Canadian Index) (CCME WQI)

The water quality index (Canadian Index) (CCME WQI) was applied using twelve factors of physical, chemical, bacterial properties and some heavy metals in the study sites such as (pH, dissolved oxygen, biological oxygen requirement, and Total dissolved solids) , calcium, magnesium, phosphate, nitrates, chlorides, lead, coliform bacteria, and fecal coliform bacteria), and the total number of individual tests was seventy-two for each table. Where its calculated levels were in the three sites (37.84, 49.54, 50.77) Table (4), (5) and (6), respectively.

The Canadian index of the Shatt al-Shafiya waters was calculated and it was found that the first site is located in the fifth degree, and this water is of poor quality (Poor)), while it became

In the study of AL-Rekabi and AL-Ganemi (2015), to assess the validity of the Euphrates water for drinking purposes, where the values were recorded in all studied stations between (71.83-36.4), and this indicates that the level of quality of Water at the study site (acceptable - poor).

In the study Rabee, et al,(2014), who examined the quality of wastewater in Al-Radwaniyah 2 of the city of Baghdad using the Canadian Index (CCMEQI), where the values were recorded In all the studied sites (weak), the deterioration of wastewater is attributed to the high levels of turbidity, magnesium, dissolved solids, and fecal coliform bacteria in this area.

Table (4) shows the water quality variables and the objectives used in calculating the Canadian Index in the first site.unit ppm

Variables / Months	pH	TDS mg/l	DO mg/l	BOD mg/l	Ca mg/l	Mg mg/l	P04 mg/l	NO3 mg/l	Cl mg/l	Pb mg/l	TC MPN/ 100m	FC MPN/ 100ml
December 2021	8.4	916	7.9	1.4	124.8	51.72	0.0367	1.9511	137.2	0.0395	1100	460
January 2022	7.88	939	7	1.8	116.8	55.63	0.013	1.376	152.88	0.0436	460	150
February 2022	7.84	942	7.3	2.5	144	43.92	0.011	3.602	343	0.0499	93	23
March 2022	7.94	1140	7.8	5.6	131.2	77.11	0.0	2.773	154.84	0.0	1100	11
April 2022	7.87	1230	5	2.1	144	63.44	0.0	1.840	154.84	0.0	1100	3.6
May 2022	7.9	1078	3.3	1.4	148.8	69.29	0.018	1.874	186.2	0.0	240	93
IQS 2001,1998	6.5-9	1000	5	2	200	150	0.1	45	250	0.01	200	200
CCME	37.84											

Table (5) shows the water quality variables and the objectives used in calculating the Canadian index in (the second site).unit ppm

Variables / Months	Ph	TDS mg/l	DO mg/l	BOD mg/l	Ca mg/l	Mg mg/l	P04 mg/l	NO3 mg/l	Cl mg/l	Pb mg/l	TC MPN/100 ml	FC MPN/100 ml
December 2021	8.3	1095	8.2	3	144	61.48	0.0244	2.3232	190.12	0.0466	1100	93
January 2022	7.86	1030	8.9	2.2	128	58.56	0.011	1.419	158.76	0	75	43
February 2022	7.57	318	5.9	2	552	180.56	0.0	3.242	980	0.0041	1100	460
March 2022	7.88	122	4.1	1.4	148.8	68.32	0.0	2.683	205.8	0.0392	1100	7
April 2022	7.80	1161	3.9	1.9	155.2	69.29	0.005	1.759	197.96	0.0	1100	11
May 2022	7.4	417	2.8	0.8	321.6	228.38	0.006	0.990	1156.4	0.1103	93	43
IQS 2001 and 1998	6.5-9	1000	5	2	200	150	0.1	45	250	0.01	200	200
CCMEW	49.54											

Table (6) shows the water quality variables and the objectives used in calculating the Canadian index in the third site.unit ppm

Variables / Months	pH	TDS mg/l	DO mg/l	BOD mg/l	Ca mg/l	Mg mg/l	P04 mg/l	NO3 mg/l	Cl mg/l	Pb mg/l	TC MPN/100m	FC MPN/100m
December 2021	8.5	174	8.1	2.4	184	100.52	0.0245	2.5517	344.9	0.0488	>1100	1100
January 2022	8.92	190	7.1	2	177.6	107.36	0.025	1.124	401.8	0	>1100	1100

February 2022	7.51	354	5.6	2.4	288	239.12	0.017	3.257	970.2	0.0043	460	240
March 2022	7.53	145	3.9	1.5	152	77.10	0	2.595	268.52	0	240	4
April 2022	7.59	167	4.4	2.6	184	108.33	0.023	1.351	344.96	0.1095	1100	460
May 2022	7.1	359	2.5	0.5	235.2	239.12	0.003	1.077	966.24	0.0	460	93
IQS 2001 , 1998	6.5-9	1000	5	2	200	150	0.1	45	250	0.01	200	200
CCME QW	50.77											

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