

Assessment the performance of water treatment plants in Baghdad governorate using GIS

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BSTRACT

Water is essential to a solid society and feasible growth. Water demand is increasing due to increasing population density, fast urbanization, industrialization, and agriculture. The Tigris River supplies drinking water to nine water treatment plants in Baghdad, therefore monitoring their chemical and physical properties is important. 15 parameters (pH, Tur., TDS, EC, TH, Alk., Ca²⁺, Mg²⁺, Fe²⁺, Cl⁻, SO₄²⁻, NH₃, NO₃⁻, NO₂⁻, PO₄³⁻) from treated water were measured in 2009 and 2019 and compared their values to Iraqi and WHO findings. The results show The value of turbidity in 2009 at center 8 was 11.2 which is exceeded the allowable limits this is might be absent the coagulation process, as well as the high concentration of the turbidity in the Tigris river at that time, meanwhile the value of alkalinity, was 159.75(mg/l) in 2019 at center 2 . however the remaining results were inside as far as possible.

Keywords: Water treatment, water quality parameters, WHO standards, GIS

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1. Introduction

For the whole human race, water is considered one of the most essential natural resources. The increasing population and economic activity have led to huge demands of water. The decline in surface water supply quantity and quality is due to water contamination and improper water resources management [1] Water treatment plant studies are handled with every aspect, like physical, chemical & bacteriological of water characteristics, that gives the first indication to assess the water treatment plant and best method to treat the water [2].

Water, the principle constituent of biological system is a valuable public resource and a great normal asset might be as rain water, ground water, surface water (for example streams, lakes, oceans, etc.), and ice sheets. The surface water is the main types of water for human exercises like drinking water, agribusiness, industry, hydropower age and other different areas of the economy. On the planet, perhaps the most essential ecological issue is water quality weakening that came about because of the climatic change and expanded contamination [3]. Developing consideration had been seen during the last a very long time in, water quality evaluation of various streams by dissecting the physicochemical and organic boundaries of water and observing the spatial and fleeting varieties.

The water content can be quantified by some mixture of physical, chemical, and biological properties and measurements. When THESE certain parameters exceed a certain level, they may have adverse consequences on human wellbeing [4][5]. River tributaries can have a direct effect on characteristics physical-chemicals of river due to the discharging huge quantities of domestic and Industrial water without treatment [6]. Climate change, population increase, rising water shortages, demographic shifts, minimal environmental understanding, water and land-use disputes and urbanization put on demonstrate raising water challenges[7].

Remote sensing is the method of collecting photographs and details at a distance, somebody do not have to get in contact. This is done by data processing bodies[8], and then applying them in our everyday life. In this way, it allows numerous technological endeavors to thrive [9].

GIS has many applications on water source and sewage treatment services are identified, Groundwater simulation and hydrology, water and drainage networks and inventories, Flooding modeling, hydraulic modeling for surface layer and settlements in river [10][11]. GIS (Geographic Information System) has various categories of such as Mathematical, Spatial, Spatial monitoring. Analyzing spatial trends by Integration of the technology allowed this to be feasible. Databases is another factor which provide the opportunity to evaluate and simulate this model[10].

2. Case study

Tigris Stream is the fundamental wellspring of savoring water Baghdad city, as well as the water of the Tigris Waterway, is using for agricultural and industrial purposes. The Tigris enters north of Baghdad near the Al-Karkh water treatment plant, the length of the stretch of the river is around 65 kilometers[12].

The data of the physical and chemical of the supply water from nine water treatment plant centers have been collected from the Baghdad Mayoralty, Ministries of Health and Water Resources for two years 2009 and 2019. These data reflect the composite monthly values of 15 indicators in figure 1. The satellite image of Baghdad is taken from the Landsat 8 satellite on 2/12/2019.

Table 1. shows the name and coordinate of the water treatment plants centers

Centers	Names	X	Y	Elevation (m.a.s.l.)
S1	Al-Karkh	438563.6	3718466	32
S2	East Tigris	439014	3697737	30.12
S3	Al-Sader	437899	3694420	29.71
S4	Al-Karama	440037.2	3691317.8	29
S5	Al-Wathba	441611	3690418	28.36
S6	Al-Qadisiyah	441483.4	3682765.8	27.65
S7	Al-Dora	442461.8	3680584.3	27
S8	Al-Wahda	448222.5	3683676	26.1
S9	Al-Rashed	449174.6	3683082.8	26



Figure 1. The audit area map for the centers along the Tigris Stream in Baghdad city (Source: Landsat 8)

3. Results and discussion

Hydrogen Ion Concentration (pH): for 2009 the most extreme worth of pH was recorded 7.67 at center 5 while the base worth was 7.39 at center 7. In the 2019 the most extreme worth of pH was recorded 7.79 at center 5 while the base worth of pH was 7.25 at center 9. For the two years the pH esteems were inside the suitable principles as displayed in figure 2.

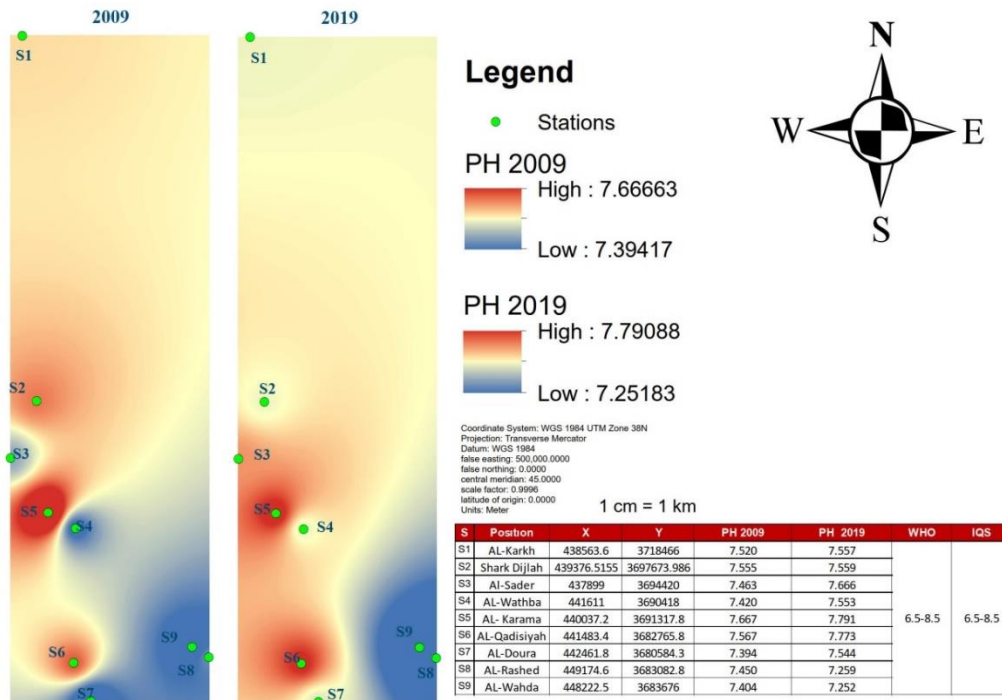
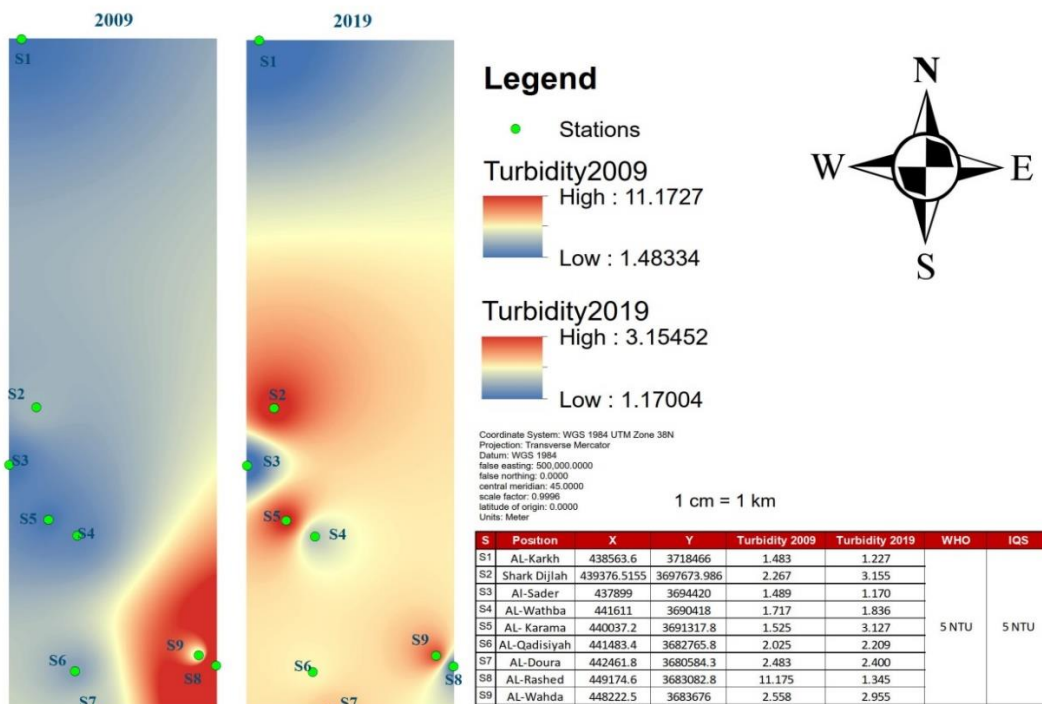


Figure 2. Spatial distribution of pH

Turbidity (Tur.): the maximum concentration of turbidity in 2009 was 11.7 NTU at center 8 this value exceeds the allowable standards, while the minimum value was 1.48 NTU at center 3. In 2019 the maximum value of turbidity was 3.15 NTU at center 2 and the base worth was 1.17 NTU at center 3, both values were within the allowable standards as shown in figure.



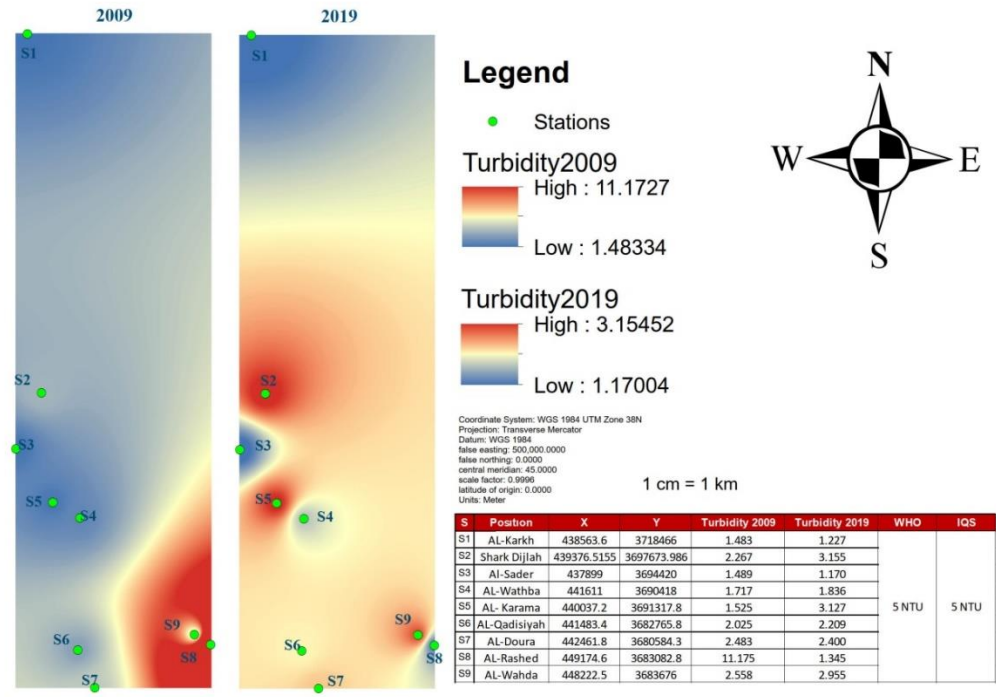


Figure 3. Spatial distribution of turbidity

Total solids (TD): the maximum concentration of total solid in 2009 was 593.24 (mg/l) at center 9 and smaller worth was 423.08 at center 1. In 2019 the most extreme worth was 610 (mg/l) at center 3 and smaller worth was 455.18(mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

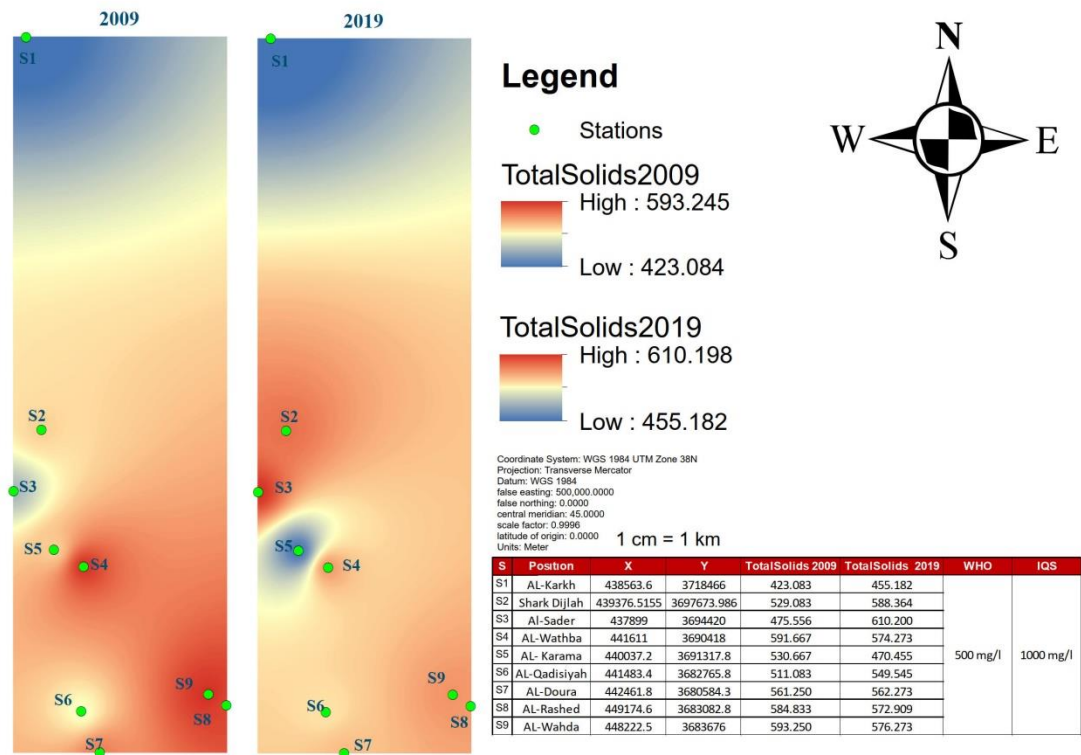


Figure 4: Spatial distribution of total dissolved solids

Electrical Conductivity (EC): the maximum concentration of Electrical Conductivity in 2009 was 886.33 μ S/cm at center 9 and minimum value was 657 μ S/cm at center 1. In 2019 the maximum value was 882.89 μ S/cm at center 3 and minimum value was 455.18(mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

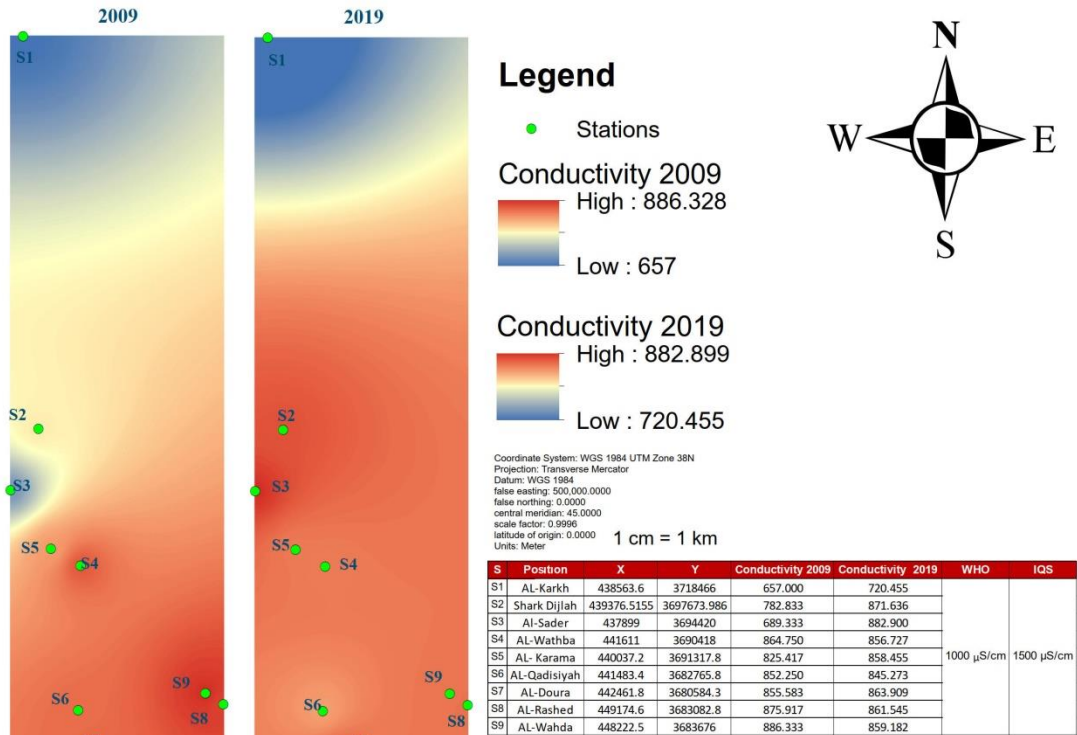


Figure 5: Spatial distribution of electrical conductivity

Total Hardness (TH): the greatest convergence of all out hardness in 2009 was 334.25 (mg/l) at center 4 and smaller worth was 256.22 (mg/l) at center 3. In 2019 the greatest worth was 326.91 (mg/l) at center 2 and smaller worth was 289.3 (mg/l) at center 1. For the two years the qualities were inside as far as possible as displayed in figure.

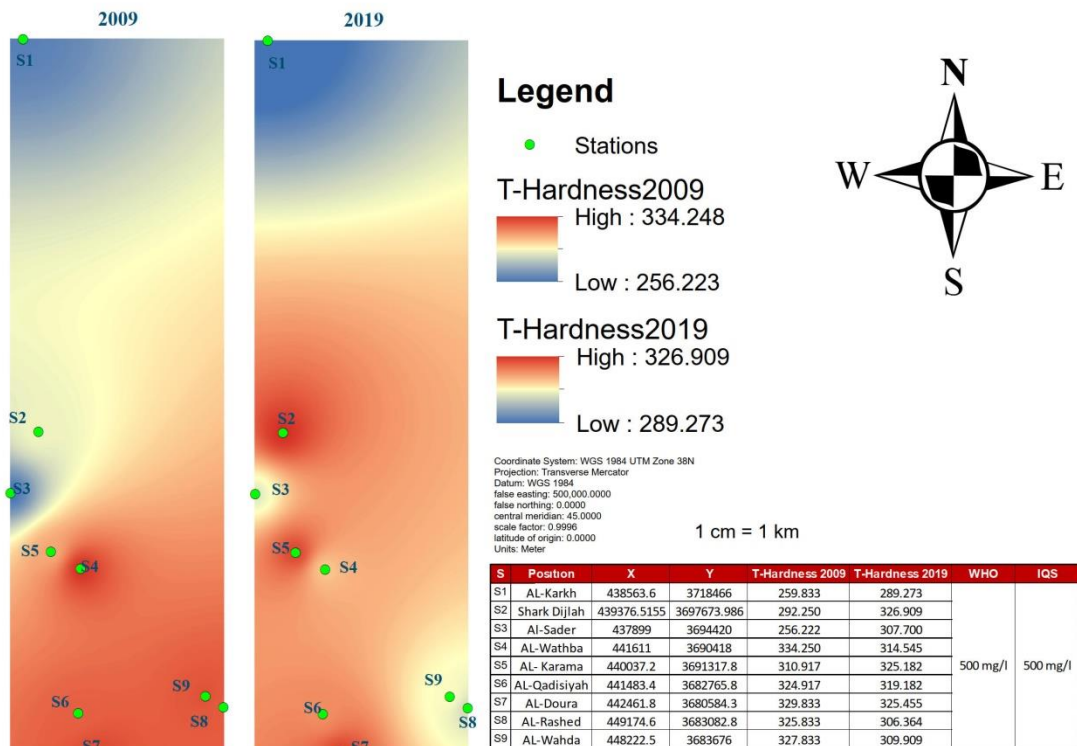


Figure6. Spatial distribution of total hardness

Total Alkalinity (Alk.): the most extreme centralization of all out Alkalinity in 2009 was 144.75 (mg/l) at center 6 and smaller worth was 125.25 (mg/l) at center 1 the qualities were inside as far as possible as displayed in figure.

possible. In 2019 the most extreme worth was 159.75 (mg/l) at center 2 this worth somewhat surpass as far as possible, and smaller worth was 130.64 (mg/l) at center 1, as displayed in figure.

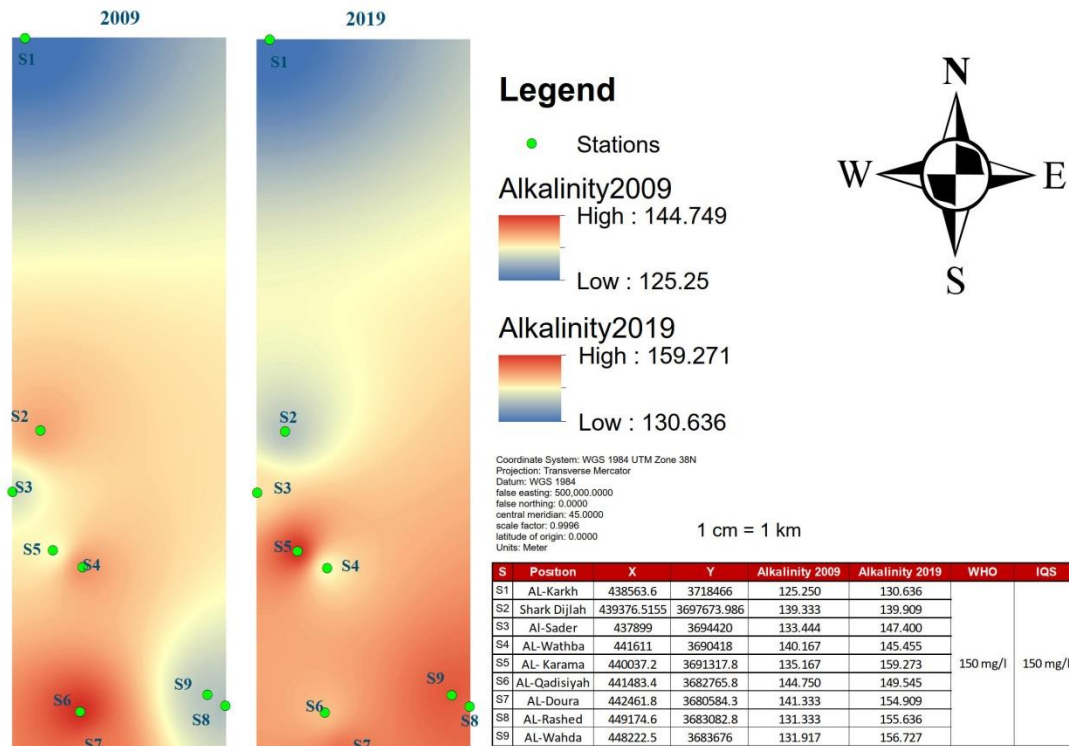


Figure7. Spatial Distribution of total alkalinity

Calcium (Ca²⁺): the maximum concentration of Calcium in 2009 was 87.03 (mg/l) at center 4 and smaller worth was 63.78 (mg/l) at center 3. In 2019 the most extreme worth was 89.36 (mg/l) at center 9 and smaller worth was 66.18 (mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

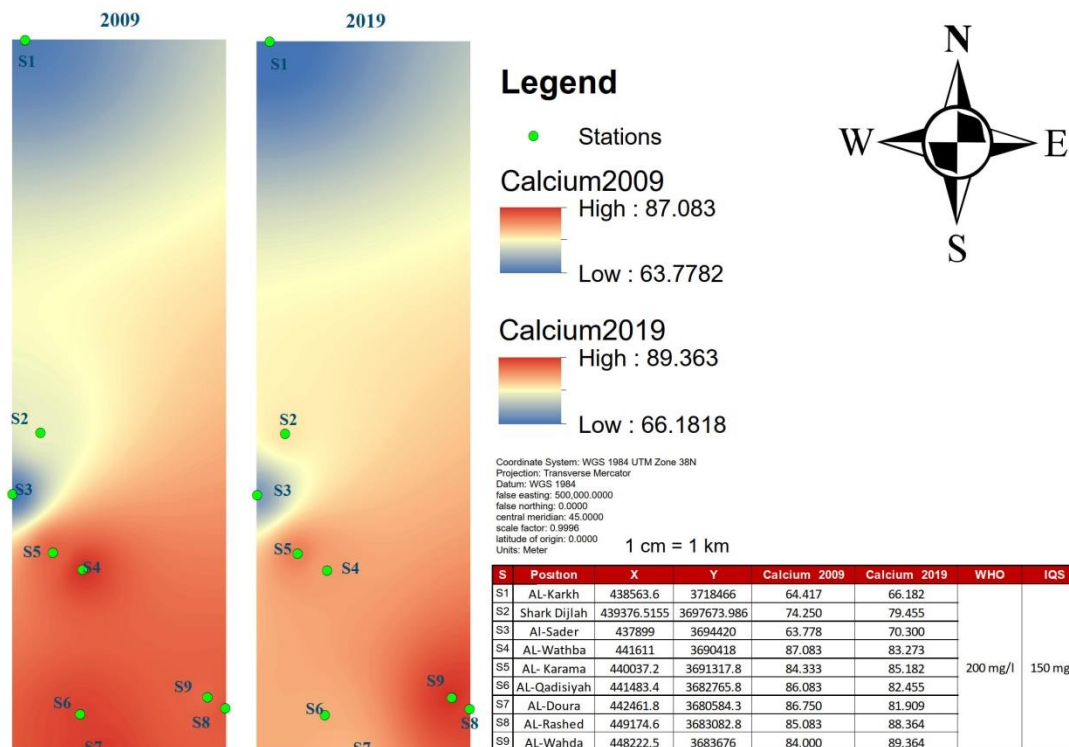


Figure 8. Spatial distribution of calcium

Magnesium (Mg²⁺): the maximum concentration of magnesium in 2009 was 33.17 (mg/l) at center 6 and minimum value was 23.44 (mg/l) at center 3. In 2019 the maximum value was 32.3 (mg/l) at

center 3 and minimum value was 21.18 (mg/l) at center 9. For the two years the values were within the allowable limits as shown in figure.

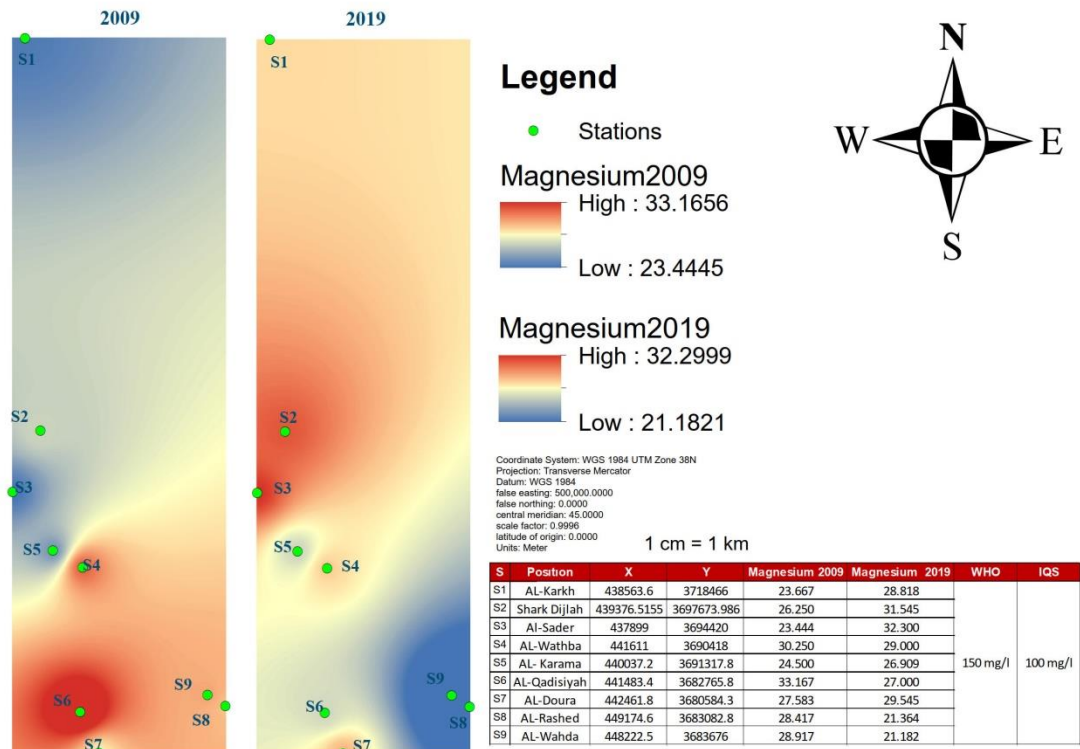


Figure 9. Spatial distribution of magnesium

Iron (Fe⁺²): the maximum concentration of iron in 2009 was 0.23 (mg/l) at center 8 and smaller worth was 0.04 (mg/l) at center 7. In 2019 the greatest worth was 0.18 (mg/l) at center 5 and smaller worth was 0.04 (mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

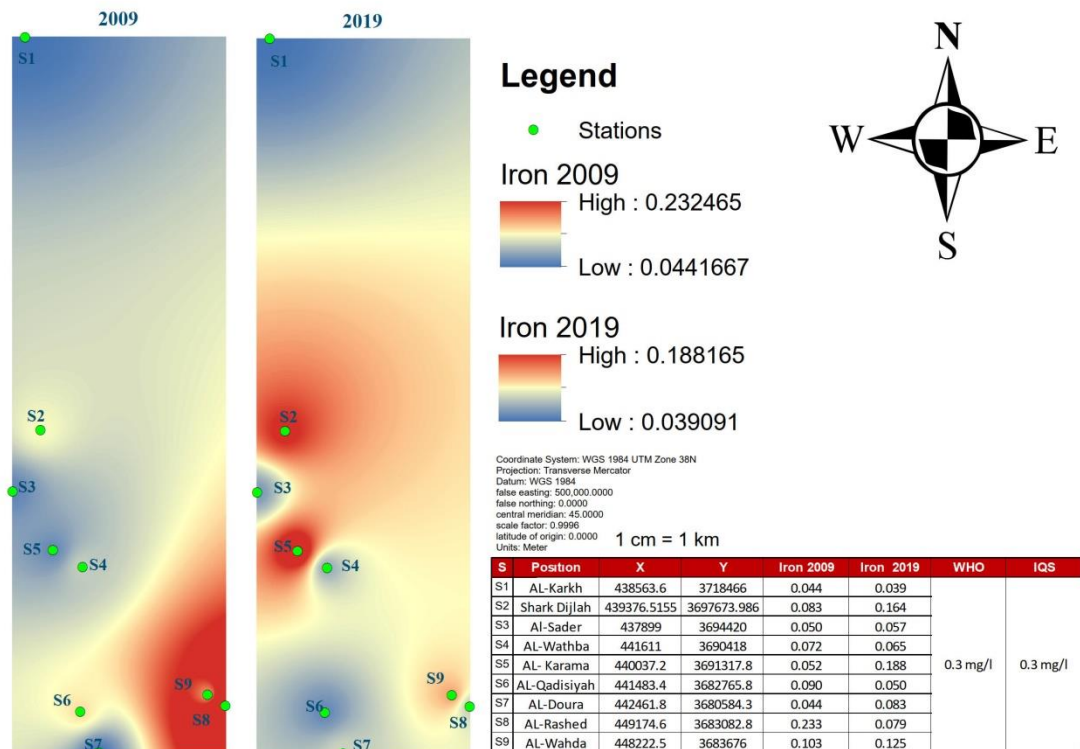


Figure 10. Spatial distribution of iron

Chloride (Cl⁻): the maximum concentration of chloride in 2009 was 72.5 (mg/l) at center 9 and smaller worth was 45.7 (mg/l) at center 1. In 2019 the greatest worth was 70.5 (mg/l) at center 5 and smaller worth was 45 (mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

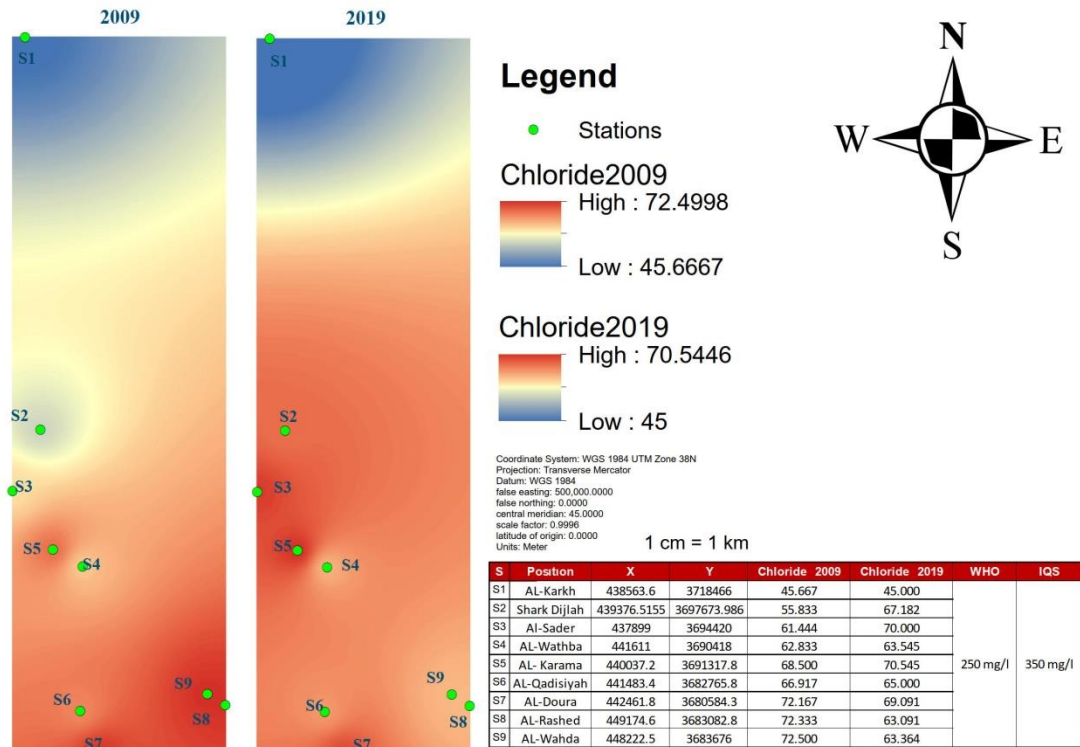


Figure 11. Spatial distribution of chloride

Sulfate (SO₄²⁻): the maximum concentration of sulfate in 2009 was 224.75 (mg/l) at center 4 and smaller worth was 131.67 (mg/l) at center 1. In 2019 the greatest worth was 222.36 (mg/l) at center 6 and smaller worth was 124 (mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

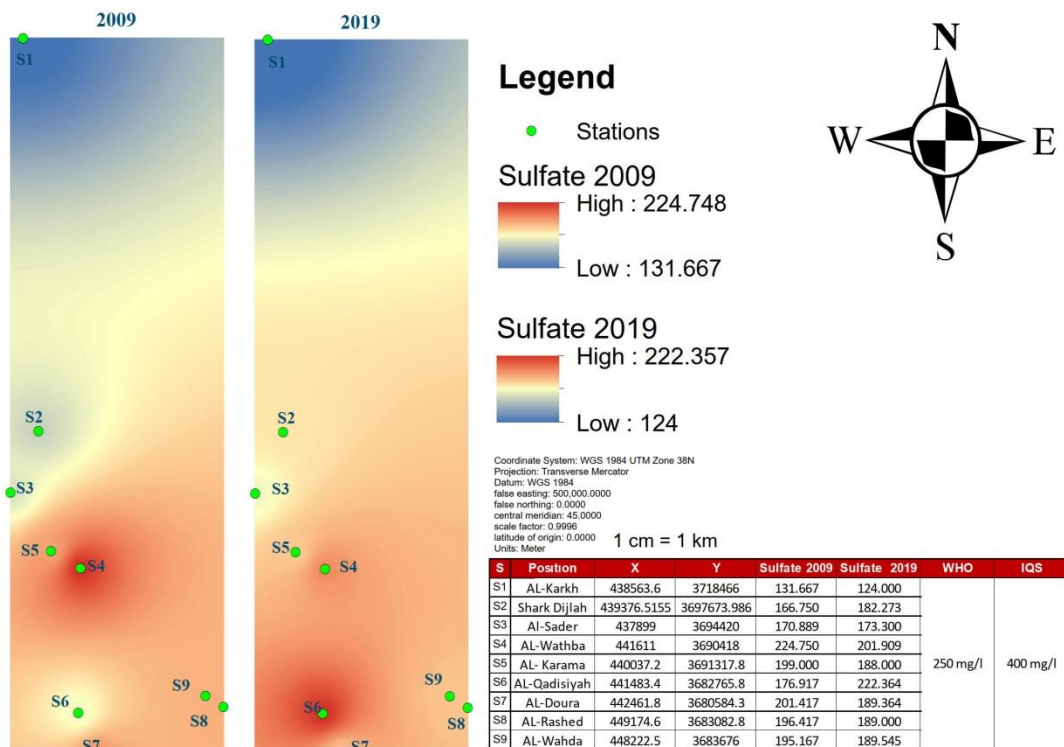


Figure 12. Spatial distribution of sulfate

Ammonia (NH₃): the maximum concentration of ammonia in 2009 was 0.02 (mg/l) at center 4 and smaller worth was 0.01 (mg/l) at center 2. In 2019 the most extreme worth was 0.065 (mg/l) at center 8 and smaller worth was 0.01 (mg/l) at center 1. For the two years the values were within the allowable limits as shown in figure.

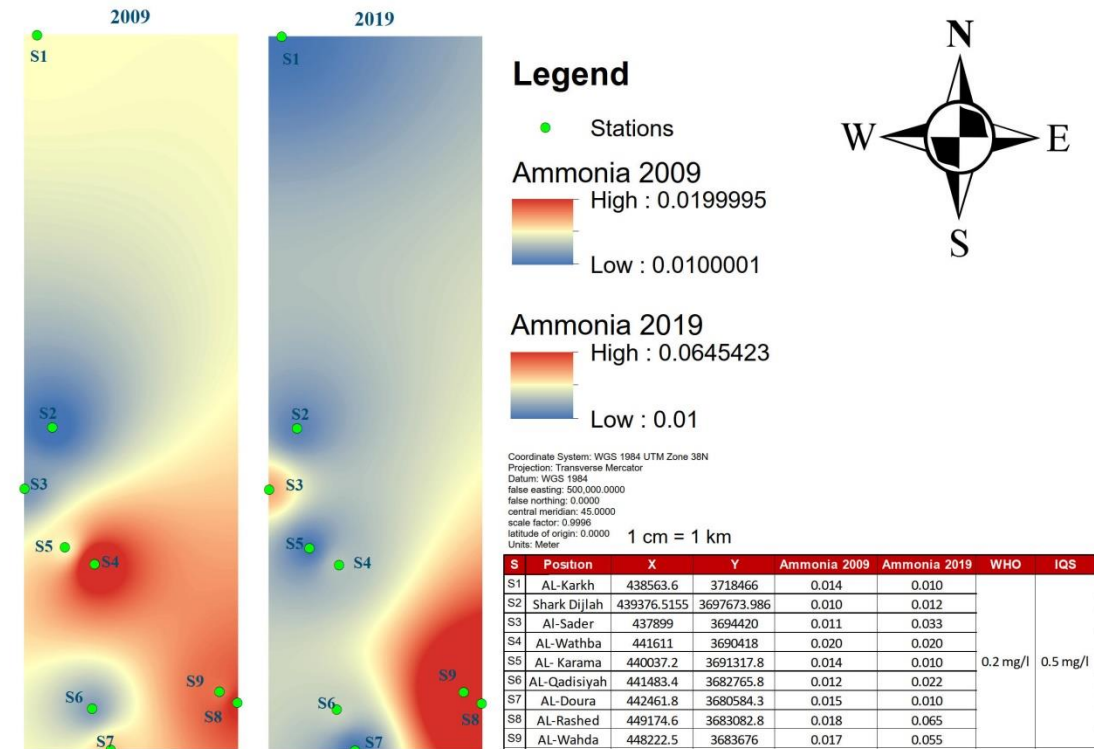


Figure 13. Spatial distribution of ammonia

Nitrate (NO₃⁻): the most extreme convergence of nitrate in 2009 was 0.90 (mg/l) at center 4 and smaller worth was 0.72 (mg/l) at center 5. In 2019 the best worth was 1.46 (mg/l) at center 7 and smaller worth was 0.65 (mg/l) at center 3. For the two years the qualities were inside as far as possible as displayed in figure.

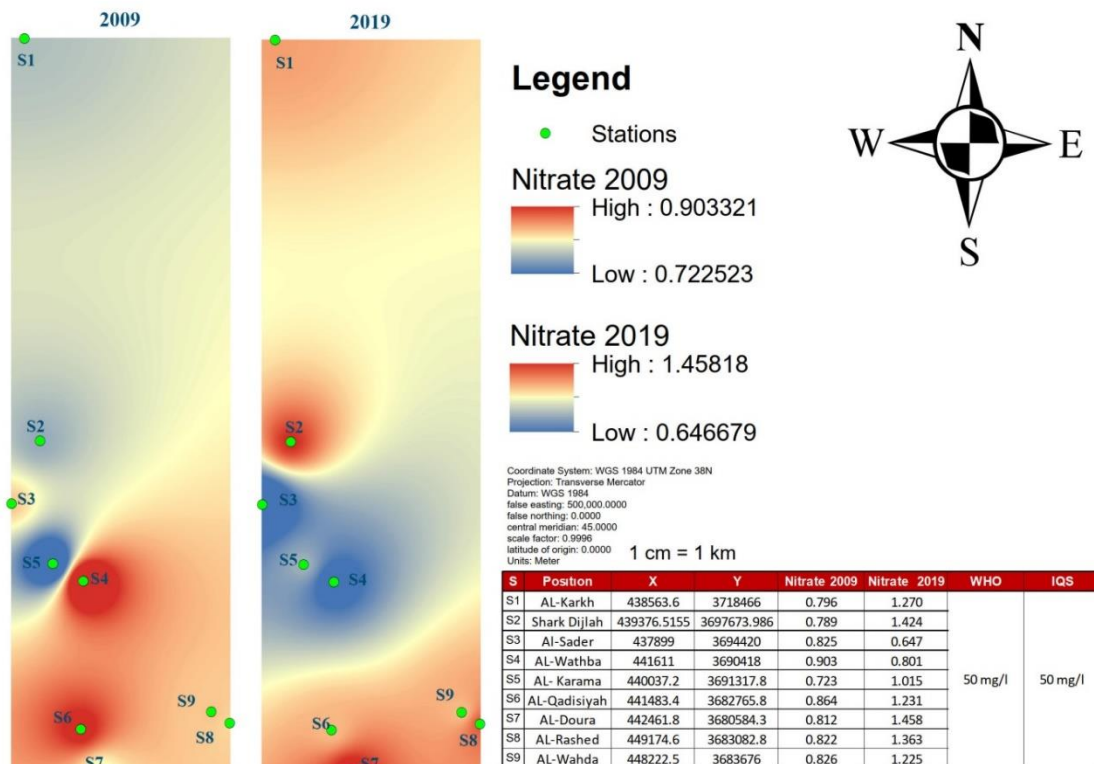


Figure 14. Spatial distribution of nitrate

Nitrite (NO₂⁻): the maximum concentration of nitrite in 2009 was 0.003 (mg/l) at center 9 and minimum value was 0.001 (mg/l) at centers 1, 2 and 3. In 2019 the maximum value was 0.005 (mg/l) at centers 8 and 9 and minimum value was 0.001 (mg/l) at centers 1, 3, 4, 5 and 7. For the two years the values were within the allowable limits as shown in figure.

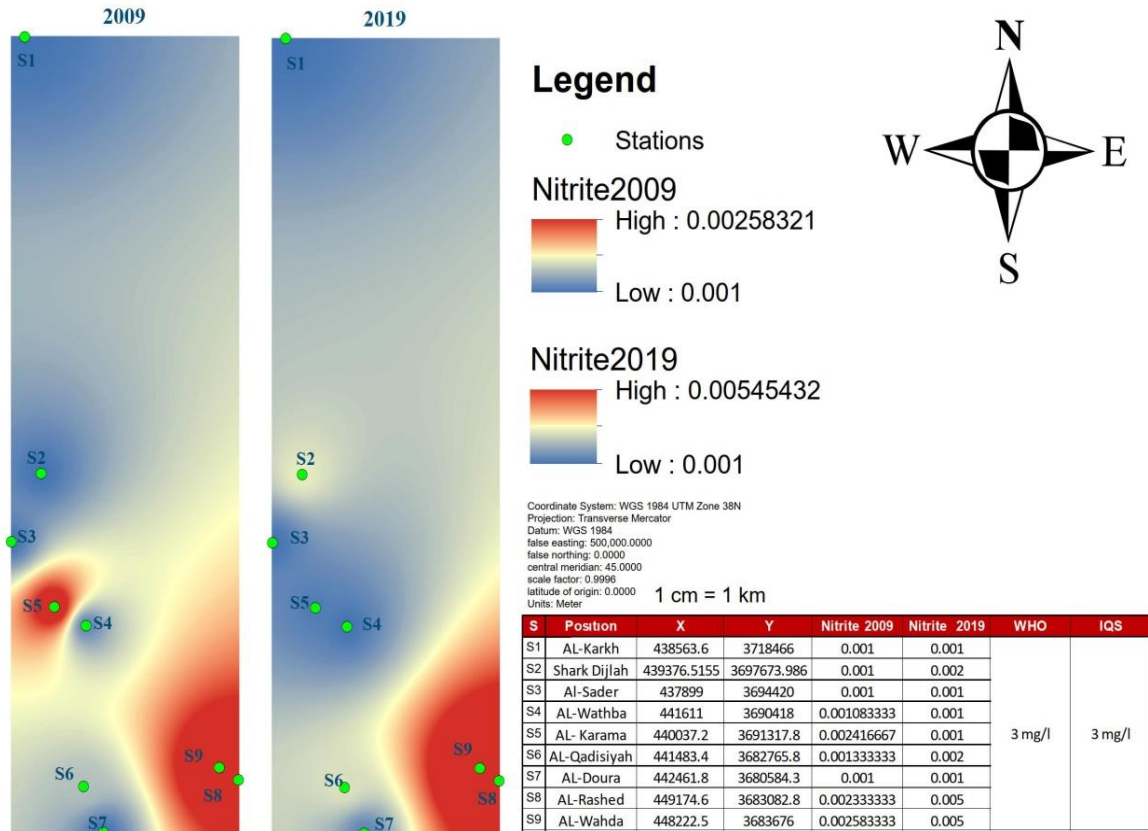


Figure 15. Spatial distribution of nitrite

Phosphate (PO₄³⁻): the maximum concentration of phosphate in 2009 was 0.067 (mg/l) at center 7 and smaller worth was 0.01 (mg/l) at center 2. In 2019 the greatest worth was 0.08 (mg/l) at center 8 and smaller worth was 0.01 (mg/l) at centers 2, 3 and 4. For the two years the values were within the allowable limits as shown in figure.

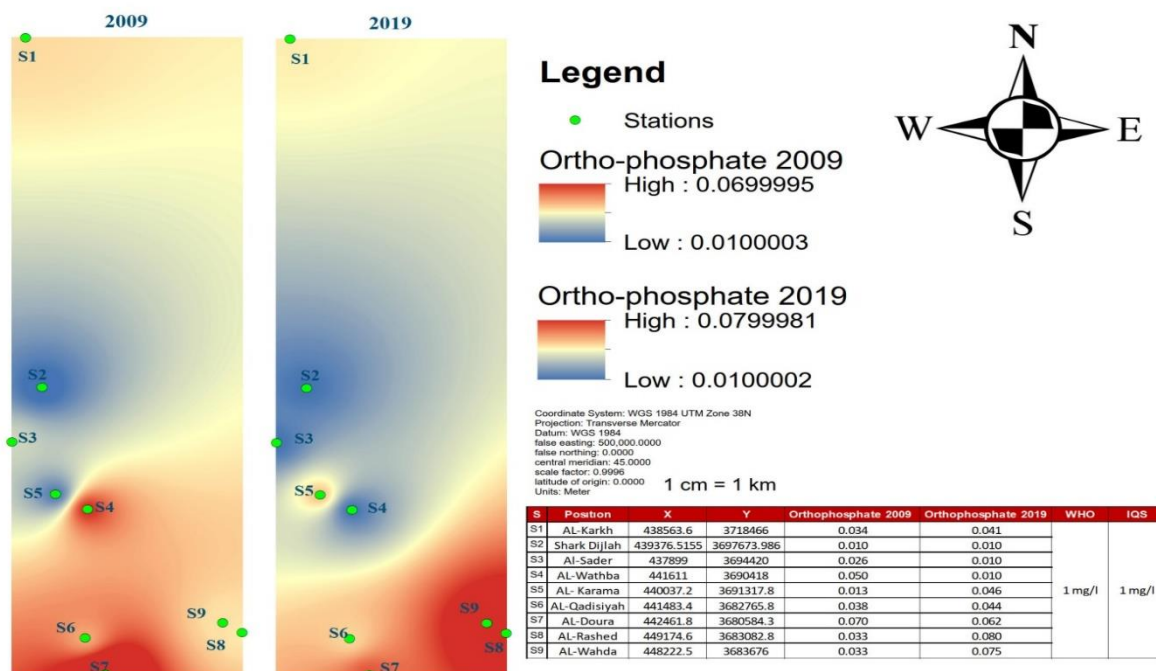


Figure 16. Spatial distribution of phosphate

4. Conclusion

In this study Evaluation has been made by using the spatial distribution of GIS for fifteen physical and chemical parameters of nine water treatment plants in Baghdad take their water from Tigris River in the two years 2009 and 2019 and compare their results with WHO standards These parameters are ('pH', 'Tur'.,'TDS', 'EC', 'TH', 'Alk', 'Ca+2', 'Mg+2', Fe+2, 'Cl⁻', SO₄-2, 'NH₃', 'NO₃⁻', 'NO₂⁻', 'PO₄⁻³'). The value of turbidity in 2009 at center 8 was 11.2 which is exceeded the allowable limits this is might be absent the coagulation process, as well as the high concentration of the turbidity in the Tigris river at that time, meanwhile the value of alkalinity, was 159.75(mg/l) in 2019 at center 2 . however, the remaining results were within the allowable limits.

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