

**ENVIRONMENTAL ASSESSMENT OF DRINKING WATER QUALITY IN MODERN RESIDENTIAL COMPLEXES IN NASIRIYAH CITY**

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**ABSTRACT**

Water is the foundation of life, directly linked to the lives of humans, animals, and plants. Therefore, it must be preserved and maintained to preserve the balance of its ecosystem. This system is suffering from a clear and noticeable decline due to pollution in drinking water, which is one of the most complex problems threatening life in general. Through field studies and laboratory samples of the reality of residential complexes to study some of the physical and chemical properties of drinking water belonging to water purification plants and government stations in the center of Nasiriyah district, This was done by measuring some variables and comparing them to standard values. Some physical and chemical properties were studied, such as electrical conductivity (EC), pH, total dissolved solids (TDS), turbidity (NTU), and temperature. The research also addressed finding the concentration of some chemical elements, such as suspended solids (TSS), chlorides (Cl), sulfates (SO<sub>4</sub>), calcium (Ca), and magnesium (Mg). Comparing them with local and international standards and determining the extent of their compliance, and whether they fall within the parameters or exceed the parameters and standards.

The study demonstrated clear pollution resulting from changes in the physical and chemical properties of certain elements, negatively impacting the lives of living organisms in general and humans in particular.

**KEYWORDS:** Environmental Assessment, Drinking Water, Physical And Chemical Properties.

**INTRODUCTION:**

This method specifically focuses on evaluating green buildings at every stage, including design, construction, operation, and maintenance. This approach aims to help designers and builders identify and implement strategies that enhance the efficient use of natural resources in the project's surroundings. To meet current needs without compromising the ability of future generations to meet their own, this approach also seeks to increase performance and design effectiveness within the context of sustainable urban initiatives.<sup>1)</sup>Therefore, the study addressed a range of methods that specialize in assessing the environmental reality of residential complexes that have a high degree of impact on the environment and climate.

**Research Problem:** The research problem represents the first step in scientific research, and it can be formulated as a question that needs an answer. The problem can be summarized in the following question: Analysis of improving the environmental performance of modern residential complexes)

**Research Hypothesis:** Reaching a solution to the problem requires assuming hypotheses that can be preliminary, unproven solutions. Their purpose is to help in reaching good results, and the main hypothesis could be as follows: (The best application Standards and use of environmental assessment strategies in modern residential complexes.

**Research Objective:** The study aims to analyze and evaluate the strategies for implementing environmental assessment standards in modern residential complexes, and By evaluating building technologies, which works on Improving the quality of the internal and external environment in residential complexes directly impacts the physiological health of the population. This study aims to understand the reality of residential complexes in depleting quantities of water, which necessitates the adoption of environmental assessment standards that reduce the negative impact on the environment and follow new scientific methods in adapting to the climate through planting trees that work to soften and improve the city's air quality.

**Scope of the Research:** The city of Nasiriyah represents the spatial boundaries of the study, and this city includes the 43 residential neighborhoods in the district center. Located in the southern part of Iraq within the Dhi Qar Governorate, the district lies between latitudes 22°30' and 26°31' North, and longitudes 21°45' and 33°46' East. Geographically, it is bordered by the districts of Al-Shatra and Al-Gharraf to the north, Suq Al-Shuyukh and Al-Fadhilah to the south, Al-Bathaa and Al-Muthanna Governorate to the southwest, Ur to the southeast, and Sayyid Dakhil and Al-Islah to the east.

**Environmental determinants of water quality suitable for human and agricultural use according to Iraqi and World Health Organization standards (WHO mg/L**

unit of measurement	Environmental determinants		Properties and elements	T
	Global	Iraqi		
-----	8.5-6.5	6-9.5	pH	1
CM/MS	2000	2000	electrical connection (EC)	2
mg/l	1000	1500	Total dissolved salts (Tds)	3
NTU	5	5	Turbidity (NTU)	4
M	Less than 35	Less than 35	temperature (temp)	5
Mg/l	60	60	Suspended solids (TSS)	6
mg/l	200	400	Sulfates (SO <sub>4</sub> )	7
mg/l	200-300	350	Chlorides (CL)	8
mg/l	200	150	Calcium (Ca)	9
mg/l	150	100	Magnesium (Mg)	10

Source: 1- Ministry of Health, Environmental Legislation, System for the Protection of Rivers from Pollution, No. (25) of 1967 and amended by the Department of Environmental Protection and Improvement for the year 1998.

2- World Health Organization, Drinking Guidelines - Water Quality, Fourth Edition, 2017.

3- Abbas Zghair Muhaysin Al-Maryani, Geography of the Environment and Pollution, First Edition, Al-Mizan Press, Iraq 2016, p. 130.

**Environmental assessment of drinking water quality at spatial and temporal monitoring sites in modern residential complexes in Nasiriyah city (physical and chemical characteristics).**

The physical properties of water are an important factor in determining its quality and suitability, and they give an idea of the water's content of organic and inorganic elements and compounds. Temperature affects the course of chemical reactions, metabolic processes in the aquatic environment, and the solubility of gases.<sup>2</sup>

**1. Environmental assessment of drinking water quality for suspended solids (TSS)**

These are solid materials that do not have the ability to dissolve in water because they remain suspended or move within it. Most of them are inorganic salts, which are considered one of the water quality criteria that determine the total concentration of dissolved solids in a water sample. Some organic compounds and minerals are added to them. Inorganic materials are a source of dissolved solids, and they vary in size according to the type of base material (rocks and soil) that forms them. Their most important components are sodium, calcium, magnesium, chloride, bicarbonate, and others.<sup>3)</sup>

It is evident from the field study Analysis of laboratory samples to assess the concentrations of suspended solids in drinking water at monitoring points (6) in modern residential complexes and to determine the environmental impact of water quality therein. The laboratory samples recorded spatial and temporal variations for the monitoring sites mentioned below, where the sample from site (Site 3) Real Estate Registration recorded concentrations of (18) I/Mg, and the sample from site (Site 4) Integrity Complex 1/ Ur District recorded concentrations of (48) I/Mg on 7/10/2025, and the sample from site (Site 5) Integrity Complex 2/ Al-Ikhlal District recorded concentrations of (52) I/Mg on 9/10/2025, which do not exceed the local and international standards, which amount to (60Mg/l) while the samples from the site (Site 2) Professors Complex (Tina) concentrations reached (108) I/Mg and the sample from Site 1 Judges Complex (Mansouriya) concentrations reached (106) I/Mg on 5/10/2025 and the sample from Site 6 Lebanese Complex (Sharif) concentrations reached (102) I/Mg on 9/10/2025, which exceeds the local and international standards and specifications mentioned above. The reason for the difference in the concentrations of suspended solids in the laboratory samples between the residential complexes is due to various factors, including the age of the water transmission pipes and the violations they are exposed to along the transmission distance, the lack of financial allocations in most water pumping projects, and the lack of installation and replacement of filters.

Weiner, E.R. 2000. Application of environmental chemistry. Boca Raton. London. UK

(1) Ahmed Mays Sadkhan, Pollution of the Euphrates River in Dhi Qar Governorate, Master's Thesis, College of Education, University of Basra, 2007, p. 153.

**Table (1) Spatial variation of suspended solids concentrations (TSS) for the study samples in modern residential complexes in Nasiriyah city and comparing them with local and global environmental determinants.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
Exceeding the limits	Exceeding the limits	106	5/10/2025	1. Mansouriyah Judges Complex	Site 1
Exceeding the limits	Exceeding the limits	108	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	18	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	48	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	52	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
Exceeding the limits	Exceeding the limits	102	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 60Mg/l, Local standard 60Mg/l					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

**2. Environmental**

**assessment of drinking water quality (turbidity).**

Turbidity is defined as the presence of non-self-containing substances in water that impede the transmission of light, causing it to scatter and be absorbed instead of traveling in a straight line. The primary cause of turbidity is the presence of suspended particles, often washed from the soil by the rapid flow of water in rivers. Additionally, the presence of microorganisms and plankton in the water contributes to turbidity. While naturally clear water with low turbidity allows for excellent depth perception, it is also beneficial for aquatic plants.

High turbidity levels can protect microbes from the effects of sterilization and stimulate bacterial growth; therefore, in cases where water is not sterilized, the turbidity level must remain low in order for sterilization to be ineffective. It is evident from the field study Analysis of laboratory samples to assess the concentrations of suspended solids in drinking water at monitoring points (6) in modern residential complexes and to determine the environmental impact of water quality therein. The laboratory samples recorded spatial and temporal variations for the monitoring sites mentioned below, where the sample from site (Site 3) Real Estate Registration recorded concentrations of (18) I/Mg, and the sample from site (Site 4) Integrity Complex 1/Ur District recorded concentrations of (48) I/Mg on 7/10/2025, and the sample from site (Site 5) Integrity Complex 2/Al-Ikhlās District recorded concentrations of (52) I/Mg on 9/10/2025, which do not exceed the local and international standards, which amount to (60Mg/l) while the samples from the site (Site 2) Professors Complex (Tina) concentrations reached (108) I/Mg and the sample from Site 1 Judges Complex (Mansouriyah) concentrations reached (106) I/Mg on 5/10/2025 and the sample from Site 6 Lebanese Complex (Sharif) concentrations reached (102) I/Mg on 9/10/2025, which exceeds the local and international standards and specifications mentioned above. The reason for the difference in the concentrations of suspended solids in the laboratory samples between the residential complexes is due to various factors, including the age of the water transmission pipes and the violations they are exposed to along the transmission distance, the lack of financial allocations in most water pumping projects, and the lack of installation and replacement of filters.

**Table 2 Spatial variation of drinking water turbidity concentrations (Turp) for the study samples in modern residential complexes in Nasiriyah city and comparing them with local and global environmental determinants.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
Exceeding the limits	Exceeding the limits	9.81	5/10/2025	1. Mansouriyah Judges Complex	Site 1
Exceeding the limits	Exceeding the limits	72.2	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
Exceeding the limits	Exceeding the limits	23.2	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
Exceeding the limits	Exceeding the limits	56.1	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
Exceeding the limits	Exceeding the limits	26.3	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
Exceeding the limits	Exceeding the limits	45.4	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Local Standard 5/ NTU, Global Standard 5/ NTU					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

**3. Environmental assessment of**

**physical elements and total dissolved salts (TDS in drinking water)**

It is a term that refers to all water-soluble solids, whether ionized or non-ionized, excluding suspended and colloidal substances. These substances exist in varying quantities in water and are considered major water pollutants. Natural processes, such as rock weathering, as well as human factors, such as household waste and industrial byproducts, contribute to water pollution with dissolved solids. This, in turn, negatively affects human and animal health. This becomes significant when the salt concentration in water reaches permissible levels, causing algae growth and depletion of dissolved oxygen. Furthermore, there is a relationship between total dissolved solids (TDS) and electrical conductivity; electrical conductivity values increase with rising TDS levels. This affects water properties, rendering it unsuitable for many applications, particularly agricultural ones.

Table (30), Map (17) and Figure (0) clearly show the high levels of total dissolved solids (TDS) in all research sites, with temporal and spatial variation, where site (Site 3) Real Estate Registration Complex recorded the highest concentration of dissolved salts at (898) I/Mg on 7/10/2025, while the sample from site (Site 1) Judges Complex recorded concentrations of (894) I/Mg on 5/10/2025, and neither exceeded the local and international standards of (1000, 1500)Mg/l respectively, while the samples from the site (Site 6) The Lebanese complex had a concentration of (884) I/Mg, and the sample from Site 5, Al-Nazaha 2 Complex (Al-Ikhlās Street), had a concentration of (878) I/Mg on 9/10/2025, and the sample from Site 4, Al-Nazaha 1 Complex (Ur District), had a concentration of (868) I/Mg on 7/10/2025. Finally, the sample from Site 2, Al-Asatidha Complex (Tina), had a concentration of (864) I/Mg on 5/10/2025. These do not exceed the local and international standards and specifications mentioned above in all monitoring points (6) and the samples collected from within the residential complexes. This indicates that the quantity of water supplied in all service projects is subject to purification and filtration processes for the water supplied to the general population in the city, even if the scientific methods used are limited.

Table 30, Map (17) and Figure (0) clearly show the high levels of total dissolved solids (TDS) in all research sites, with temporal and spatial variation, where site (Site 3) Real Estate Registration Complex recorded the highest concentration of dissolved salts at (898) I/Mg on 7/10/2025, while the sample from site (Site 1) Judges Complex recorded concentrations of (894) I/Mg on 5/10/2025, and neither exceeded the local and international standards of (1000, 1500)Mg/l respectively, while the samples from the site (Site 6) The Lebanese complex had a concentration of (884) I/Mg, and the sample from Site 5, Al-Nazaha 2 Complex (Al-Ikhlās Street), had a concentration of (878) I/Mg on 9/10/2025, and the sample from Site 4, Al-Nazaha 1 Complex (Ur District), had a concentration of (868) I/Mg on 7/10/2025. Finally, the sample from Site 2, Al-Asatidha Complex (Tina), had a concentration of (864) I/Mg on 5/10/2025. These do not exceed the local and international standards and specifications mentioned above in all monitoring points (6) and the samples collected from within the residential complexes. This indicates that the quantity of water supplied in all service projects is subject to purification and filtration processes for the water supplied to the general population in the city, even if the scientific methods used are limited.

**Table 3 Spatial variation of suspended solids concentrations (TSS) for the study samples in modern residential complexes in Nasiriyah city and comparing them with local and global environmental determinants.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	894	5/10/2025	1. Mansouriyah Judges Complex	Site 1
unsuspected	unsuspected	864	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	898	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	868	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	878	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	884	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 1500Mg/l Local standard 1000Mg/l					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

(1) Frank R. Slepman and Nancy E. Whiting, Environmental Technology Science, translated by Al-Siddiq Omar Al-Siddiq, First Edition, Center for Arab Unity Studies, Arab Organization for Translation, 2012, p. 191

(1) Safaa Abdul Amir Rashm Al-Asadi, Geography of Water Resources, 1st ed., Dar Al-Ghadir for Printing and Publishing, Basra 2013, p. 48.

(2) Ayat Saeed Hussein Al-Amiri, Spatial Analysis of Water Pollution in the Euphrates River Streams (Abu Ghraib - Al-Radwanayah - Al-Yusufiyah Al-Latifiyah) and its Environmental Effects, PhD Thesis, College of Arts, University of Baghdad, 2018, p. 98.

**Fourth: Environmental assessment of electrical conductivity (EC) in drinking water**

Electrical conductivity refers to water's ability to conduct electricity. This conductivity is determined by the concentration of dissolved ions such as sodium (Na<sup>+</sup>), calcium (Ca<sup>2+</sup>), magnesium (Mg<sup>2+</sup>), chloride (Cl<sup>-</sup>), sulfate (SO<sub>4</sub><sup>2-</sup>), and bicarbonate (HCO<sub>3</sub><sup>-</sup>), as well as the water temperature. Acids, bases, and inorganic salts dissolved in water are good conductors of electricity, while organic salts and acids are poor conductors due to their low ionization rate in water. The electrical conductivity increases proportionally with increasing concentrations of dissolved salts in the water. It is usually measured in microsiemens/cm<sup>2</sup>.µS/cm) at a standard temperature of 25°C. The environmental importance of electrical conductivity is highlighted. EC serves as a rapid indicator of the total salinity level of drinking water, is an active ingredient for the initial detection of inorganic chemical pollution, and provides clear evidence of saltwater intrusion into freshwater, particularly in arid and semi-arid regions. It is also an important factor in the environmental assessment of the efficiency of drinking water treatment plants in the study area. It is clear from the table (0) The map (0) and the figure (0) and the field study on the variation in the height of the electrical conductivity rate in the general research sites, with the difference in the times of its monitoring in time and place, where the site (Site6) Lebanese complex recorded the highest electrical conductivity rate at (1520).MS/CMOn 9/10/2025, the sample from the same location was recorded (Site 3) Real Estate Registration Complex, concentrations reached (1514)MS/CMOn 7/10/2025, and they do not exceed the local and international standards, which amount to (2000)MS/CMMicro Siemens/cm.

**Table 4 Spatial and temporal variation of the electrical conductivity property (EC) for the study samples in modern residential complexes in Nasiriyah city and comparing them with local and global environmental determinants.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	1505	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	1413	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	1514	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	1435	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	1445	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	1520	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 2000MS/CM, Local Standard 2000MS/CM					

**Source:** The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory. While the samples from the same location (Site 1) Judges Complex (Al-Mansouriya) Concentrations reached (1505)MS/CMOn 5/10/2025 and recordedThe sample

from the site (Site5) Integrity Complex 2 (Al-Ikhlās Street) had concentrations of (1445)MS/CMOn the dateOn 9/10/2025, the sample from the same location (Site4) in the Integrity Complex 1 (Ur District) recorded concentrations of (1435).MS/CMOn 7/10/2025, the sample from the same location was finally recorded (Site 2) Professors' Complex (Tina) The lowest concentration rate reached (1413)MS/CMMicro Siemens/cm dated 5/10/2025, noting that all (6) monitoring points do not exceed the local and international standards and specifications mentioned above within the modern residential complexes in the city of Nasiriyah.

**Second. Environmental assessment of drinking water quality based on spatial and temporal analysis (of chemical properties) in modern residential complexes in Nasiriyah city.**

The chemical properties of water are of paramount importance in determining its quality and suitability for human use. Chemical substances that enter water are classified into two main types: organic substances, which deplete oxygen and affect both plants and animals, and inorganic substances, which include naturally occurring dissolved salts. Temperature affects the timing of chemical reactions and metabolic processes in the aquatic environment, as well as the solubility of gases. Heavy metals (elements) such as cadmium and lead are considered hazardous if present in water at levels exceeding permissible limits. (10)

**1. Environmental impact assessment of pH values (pH in drinking water)**

pH is an important indicator of the chemical, physical, and biological systems in water, as it has a clear impact on the nature of the ecosystem. pH refers to the acidity or alkalinity (basicity) of water, where a one-degree change in pH results in a tenfold difference in acidity. (11) The pH range is (0-14), where (7) reflects the neutral state of the solution based on ion concentrations, while a pH greater than (7) indicates alkalinity, and a pH less than (7) indicates acidity. (12) pH affects the aquatic environment through its impact on aquatic organisms, especially fish. It also affects the solubility of organic matter and nutrients in water, which in turn affects aquatic life because a decrease in pH makes water toxic in nature. Moreover, pH is determined by the concentrations of carbon dioxide, bicarbonates, and carbonate minerals in water, and an increase in carbon dioxide leads to a decrease in its value, which occurs throughout the summer as a result of the decomposition of organic matter, which increases with rising temperatures. (13)

It is evident from Table (4), Figure (0), and Map (0) that all pH values taken for the monitoring sites (6) and dated 5/7/9/October 2025 did not exceed the locally permissible environmental limit of (6)-(9.5) for all study samples, although they varied spatially according to the monitoring points, while the highest pH value was recorded at site (Site 6) Note that it did not exceed the global environmental limit of (6.5) - (8.5), and the other sites did not exceed the value of the global limit.

It is clear from During the study samples, it was found that there is depletion in some sewage networks and the mixing of their water with the drinking water networks that have been exposed to subsidence and breaks. This interaction between the two has led to a change in the pH values in the studied locations, and it is perhaps the most influential factor in making the water alkaline or acidic. In addition, the climatic characteristics have an effect on the variation in its high or low values, which is reflected in the activity of aerobic and anaerobic bacteria and the amount of carbon dioxide gas they deplete or release, which affects the decrease or increase in the pH value. Accordingly, all samples in the study area are classified as tending towards alkalinity.

**Table 5 Spatial and temporal analysis of pH values (pH) in water samples from modern residential complexes in Nasiriyah city and their conformity to locally and internationally approved environmental standards.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	7.23	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	7.66	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	7.47	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	7.47	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	7.50	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
Unsuspected	unsuspected	7.69	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global standard 6.5 - 8.5, Local standard 6 - 9.5					

**Source:** The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory. **2. Environmental impact assessment of magnesium (mg) in drinking water**

Magnesium is an alkali metal found in varying amounts in nature. Its periodic number is 12, and its atomic weight is...(24.305) It is found in primary sources such as dolomite, limestone, and silica. However, the significant increase in its concentration in water is due to human and industrial waste and the resulting sewage, leading to water pollution and changes in its color and taste. (14) Magnesium and calcium contribute to the overall hardness of water. Water with a low magnesium

(1) Hind Qais Hussein Al-Dulaimi, The Impact of Industries Established on the Banks of the Tigris River on the City of Baghdad, Master's Thesis, College of Education, University of Baghdad, 2001, p. 83. Sawyer, CN, McCarty, PL, & Parkin, GF, Chemistry for Environmental Engineering 2 and Science, McGraw-Hill, 2003, p. 45

(2) Iraqi Ministry of Water Resources, Water Quality and Management, Baghdad, 2018, p. 45.

(3) Abbas Zghair Muhaysin Al-Maryani, previous source, p. 126.

(4) Adel Mishaan Rabee, Contemporary Environmental Problems, First Edition, Arab Community Library for Publishing and Distribution, Amman, 2008, p. 129.

(5) Iyad Barakat Enezeh, Earth Sciences, First Edition, Dar Safaa for Printing, Publishing and Distribution, 2008, p. 61.

(6) Mohammed Bader Jassim Al-Ghazi, Environmental Assessment of Pollution Resulting from Dhi Qar Oil Refinery, Previous Source, 2024, p. 204.

(7) Fathia Muhammad Al-Hassan, Environmental Problems, First Edition, Arab Community Library, Amman, Jordan, 2010, p. 56

concentration is considered sweet, while water with a high hardness is considered high magnesium. Accordingly, the average high magnesium concentration in river water is 5.6 mg/L.15).

It is clear from the table (0) Figure (0), Map (0), and laboratory analysis of all study samples revealed that magnesium (mg) values varied temporally and spatially at all (6) monitoring points collected from modern residential complexes in Nasiriyah. These complexes included treated water samples from drinking water projects supplying the city, which are almost equally distributed across its central neighborhoods. The monitoring points included the following locations: (Al-Qudat Complex (Al-Mansouriya), Al-Asateeth Complex (Tina), Real Estate Registration Complex (Al-Iskan), Al-Nazaha 1 Complex (Hayy Ur), Al-Nazaha 2 Complex (Al-Ikhlās), and Al-Lubnani Complex (Al-Sharif). Concentration levels of (52, 55, 53, 50, 51, and 54) mg/L were recorded, respectively, and collected on (5, 7, and 9) of October 2025. These values did not exceed the Iraqi and international environmental standards for water quality suitable for human use. It is worth noting that Most of the projects in the study area conform to local and international environmental standards for the treatment and processing of drinking water in the city center in general and the complexes in particular.

**Table 6 Spatial and temporal analysis of the element magnesium (mg) in water samples from modern residential complexes in Nasiriyah city and their conformity to locally and internationally approved environmental standards.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	52	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	55	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	53	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	50	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	51	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	54	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 150Mg/l, Local standard 100Mg/l					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

### 3. Environmental impact assessment of calcium (ca) in drinking water

Water is a natural product of the weathering of sedimentary rocks and minerals that have undergone chemical weathering processes at the riverbed, resulting in the release of high levels of calcium into the aquatic environment. Human activity and the waste generated by it have also contributed to increased calcium levels in nature.16) Calcium ranks fifth in terms of abundance in natural waters, and the concentration of calcium in rivers flowing in arid or dry regions is higher than in humid regions, as this element is one of the main causes of overall water hardness.17).

The field study samples taken to determine the concentration of calcium in the drinking (treated) water of modern residential complexes in downtown Nasiriyah revealed the following levels: (132, 116, 120, 112, 118, 136) mg/L of calcium, as shown in the table, on October 5, 7, and 9, 2025. These levels were recorded for the following residential complexes: Judges Complex, Professors Complex, Real Estate Registration Complex, Integrity Complex 1, Integrity Complex 2, and the Lebanese Complex, respectively. While these levels varied spatially and temporally across the study locations, they did not exceed the permissible local and international standards at all six monitoring points mentioned above. The actual findings of the study can be visually assessed and scientifically interpreted using Table (0), Figure (0), and Map (0) in a visual analysis of all monitoring points within the residential complexes.

**Table 7 Spatial and temporal analysis of the element calcium (ca) In water samples from modern residential complexes in Nasiriyah city and their conformity to locally and internationally approved environmental standards.**

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

### 4. Environmental impact assessment of chloride (Cl) in drinking water

Chlorides are classified as one of the most important chemical pollutants if they exceed permissible limits. They are found in higher concentrations in water compared to other salts due to their ease of solubility. They are also characterized by high concentrations in industrial waters. The degree of chloride ion concentration in water

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	132	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	116	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	120	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	112	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	118	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	136	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 200Mg/l, Local standard 150Mg/l					

depends on the amount of salts present. Therefore, when it reacts with sodium ions, it produces sodium chloride (table salt). Deposits can also form on water pipes in industrial facilities and power plants, and high concentrations cause damage and deterioration.18The concentration of chloride ions was measured using the scientific methods

described in the analysis of the study samples in the Hood apparatus.19) .

It is clear from the table (Figure (0), and Map (0) show that the concentrations of chloride (Cl) in samples from the study area reached (133, 129, 138, 132, 127, 130) mg/L, distributed across (6) monitoring points in modern residential complexes, which include (the Judges Complex, the Professors Complex, the Real Estate Registration Complex, the Integrity Complex 1, the Integrity Complex 2, and the Lebanese Complex), respectively. It should be noted that all monitoring points collected from the study area underwent laboratory testing at the Dhi Qar Water Directorate laboratory on October 5, 7, and 9, 2025, and the laboratory analysis results showed that they conformed to the Iraqi standard parameters.350Mg/lThe World Health Organization (WHO) and adult200-300 l/Mg.

<sup>(1)</sup> Safaa Abdul-Amir Al-Asadi, River Load of the Shatt al-Arab and its Environmental Effects, PhD Dissertation, University of Basra, College of Education, 2012, p. 10699.

<sup>(2)</sup> Bashar Fuad Abbas Maarouf, The Impact of Human Activity on the Temporal and Spatial Variation of Water Pollution in the Shatt al-Hillah, Master's Thesis (Unpublished), College of Education, University of Babylon, 2008, p. 225.

<sup>(3)</sup> Nazim Farman's hydrochemistry of the Tigris River in Baghdad, Master's thesis, College of Science, University of Baghdad, 1992, p. 65.

<sup>(4)</sup> Ayat Saeed Hussein Al-Amiri, Spatial Analysis of Water Pollution in the Euphrates River Streams (Abu Ghraib - Al-Radwanayah - Al-Yusufiyah - Al-Latifiyah) and its Environmental Effects, PhD Thesis, College of Arts, University of Baghdad, 2018, p. 119.

<sup>(5)</sup> Personal interview with Hamdiya Badr Katea, Head of Physical and Chemical Laboratory Testing at the Dhi Qar Water Directorate Laboratory, 6/10/2025.

**Table (8) Spatial and temporal analysis of the chloride element (cl) In water samples from modern residential complexes in Nasiriyah city and their conformity to locally and internationally approved environmental standards.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	133	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	129	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	138	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	132	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	127	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	130	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 200-300 1/Mg, Local standard 350Mg/l					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory.

**5. Evaluate the percentage of sulfate concentrations (SO<sub>4</sub>) in drinking water**

Solutions of sulfate minerals found in sedimentary rocks such as anhydrite and gypsum are the main source of sulfate ions in water. Sulfates are considered one of the important components of water hardness after calcium and magnesium, and their high concentrations above 500 mg/L cause a bitter taste in the water. 20 Sewage and industrial waste discharged into rivers also contribute to raising sulfate concentrations in water. Another source that increases sulfate concentrations in water is the reaction of fuel combustion from industrial facilities and thermal power plants with rainfall, which subsequently turns into sediment on the ground and mixes with river water, leading to increased sulfate concentrations in the water and causing serious environmental pollution. 21. Table (0), Map (0) and Figure (0) clearly show the high levels of sulfate concentrations (SO<sub>4</sub>) was found in all research sites, with temporal and spatial variations. Site (Site 3), the Real Estate Registration Complex, recorded the highest sulfate concentration at (348) I/Mg as of 7/10/2025, while the sample from Site (Site 6), the Lebanese (Sharif) Complex, recorded a concentration of (345) I/Mg as of 9/10/2025. The samples were recorded at the same location (Site 1) Judges Complex (Al-Mansouriya) recorded a concentration of (344) I/Mg on 9/10/2025. The sample from Site 5, Integrity Complex 2 (Al-Ikhlās Street), recorded a concentration of (336) I/Mg on 9/10/2025. The sample from Site 4, Integrity Complex 1 (Ur District), recorded a concentration of (323) I/Mg on 7/10/2025. Finally, the sample from Site 2, Professors Complex (Tina), recorded a concentration of (329) I/Mg on 5/10/2025. Note that all site samples do not exceed the Iraqi standards and specifications, which amount to (400Mg/l) While it exceeded the World Health Organization's guidelines, which amounted to (200Mg/l) The above mentioned in all monitoring points (6) and the treated samples collected from within residential complexes. This calls for a serious pause to work on improving water quality and making it conform to international standards, especially since all readings collected from monitoring sites have given results of high concentration and close to the upper limits allowed locally.

**Table (9) Spatial and temporal analysis to show the percentages of sulfate concentrations CO<sub>4</sub> in water samples from modern residential complexes in Nasiriyah city and their conformity to local and international standards.**

Comparison with the World Health Organization	Comparing it with the Iraqi standard	spatial rate	Sample date	Completed residential complexes	Sample number
unsuspected	unsuspected	344	5/10/2025	1. Mansouriya Judges Complex	Site 1
unsuspected	unsuspected	329	5/10/2025	2. A complex for professors Al-Shumoukh neighborhood	Site2
unsuspected	unsuspected	348	7/10/2025	3. Real Estate Registration Complex (Housing)	Site3
unsuspected	unsuspected	332	7/10/2025	4. Integrity Complex 1 - Ur District	Site 4
unsuspected	unsuspected	336	9/10/2025	5. Integrity Complex 2, Al-Ikhlās Street	Site 5
unsuspected	unsuspected	345	9/10/2025	6. Lebanese Complex Al Sharif area	Site 6
Global Standard 200Mg/l Local standard 400Mg/l					

Source: The researcher's work is based on the field study and the results of the laboratory analysis of the Dhi Qar Water Directorate laboratory on 5, 7, and 9/10/2025.

<sup>(1)</sup>Ayed Radhi Khanfar. Environmental Pollution: Air, Water, Food, Dar Al-Yazouri for Publishing and Distribution, Amman, Jordan, 2010, p. 60.

<sup>(2)</sup>Mohammed Khalil Obaid Al-Ajrash, Environmental Impact Assessment of the Nasiriyah Thermal Power Plant, Master's Thesis (Unpublished), University of Dhi Qar, College of Arts, 2020, p. 107.