

Evaluation of Water Quality for Water Bathing Conditions on Querer Beach in the Municipality of Santa Rosa, Tocantins

Rubens Oliveira Lustosa¹, Angelo Ricardo Balduino², Diogo Pedreira Lima³, Polyana Lopes da Silva⁴.

¹ Academic from the Civil Engineering Course – President Antônio Carlos Tocantinense Institute
Email: rubensoliveira95@hotmail.com

² Researching Teacher, Master in Environmental Sciences – President Antônio Carlos Tocantinense Institute (Academic Advisor)
Email: angelo@ifto.edu.com

³ Researching Teacher, Master in Environmental Engineering – President Antônio Carlos Tocantinense Institute
Email: diopli@gmail.com

⁴ Graduated in Chemistry, Leader of the Public Water Treatment System – BRK Environmental
Email: polylopesilva@gmail.com

Abstract— The water is an indispensable natural resource for life, economic development, and the conservation and maintenance of ecosystem services. It is known that the quantity and quality of water available for consumption is decreasing considerably and the increasing scarcity of this resource may be associated with factors such as the irregular distribution of water, waste and irrational use of it, socioeconomic and environmental problems, pollution of resources inadequate disposal of sewage, lack of basic sanitation and treatment of sewage, among others. In this way, the environmental problems have gained relevant space in the current discussions due to their importance, making the debates of these questions in the society necessary. Because of the anthropic activities that have been developed in a disorderly way and without planning, it reflects drastically in the environmental degradation, especially in this case, in the quality of the waters, which compromises this natural resource, whatever the purpose of its use. Thus, the objective of this work is to evaluate the water quality of Querer Beach in Santa Rosa-TO, promoting a water bathing condition study. Therefore, to investigate the effects of anthropogenic interferences on water quality, the water quality was evaluated by means of monitoring. The analyzes of the bathing conditions, show the percentages obtained for the situations in which the beach is classified as suitable for bathing, the investigations followed the criteria established by the CONAMA resolution nº 274/00. The water quality at a specific point of the beach was evaluated and monitored for a determined period of six weeks, and the microbiological indicator of water quality according to the

Collilert technique according to the methodology described by Standard Methods was used as a parameter. In this way, it was possible to verify the tolerances of the Brazilian parameters for the water bathing conditions indicators of Querer Beach.

Keywords— *Water Bathing Conditions Quality. Water quality. Natural resources.*

I. INTRODUCTION

Nowadays, discussions about environmental problems in society are increasingly gaining space. This happens due to the importance of the issue and its consequences. Thus, addressing water quality issues continually encompasses interaction with other environmental compartments. The variation in the quality of the water linked to the pollution processes implies the need for greater monitoring, in view of the quality standards peculiar to its use.

It is well known that water is a natural resource indispensable to life, economic development and conservation and for the maintenance of ecosystem services, being essential for the origin and preservation of life. In a historical way, water has always presented multiple uses such as: maintaining the vital functions of the organism, food production, cooking, energy generation, urban development, means of transportation of goods and people, agricultural activities and people's leisure alternatives.

In this sense, it is pertinent to say that Brazil is considered privileged in terms of its natural resources, with a vast and rich biodiversity. The fresh water available in the country is in great quantity and a considerable part of the coasts are

bathed by warm waters. In summary, Brazil is surrounded by beautiful scenery, which ends up inviting seaside and watering activities and attracts tourists from all over the world.

For Sperling (2005), the total volume of water on the planet is 1,386 million km³, of which 3% refers to freshwater and 97% is distributed to the oceans and seas. Of these data, 0.8% refer to groundwater and surface waters, and glaciers and shells form 2.2%. However, of all this volume only 3% represents greater accessibility to humans.

Brazil has 12% of the total volume of fresh water of the planet, which is a privileged situation; however, all this abundance does not represent the unequal distribution of the territory in the country, supported by aspects such as the significant increase in degradation of quality thus reflecting serious problems of scarcity in certain areas (HIRATA, 2001).

In this sense, according to Becker (2001), in Brazil, there is a great quantity of freshwater, even with poor distribution and with a rich biodiversity, besides about 3 thousand km of coast bathed mainly by predominantly warm waters, beautiful and quite inviting to water bathing conditions, attracting domestic and foreign tourists. Thus, it is important to create measures that subsidize the rational use of water resources and their conservation, as with this the volume of available water of the planet will be enough to supply the population demand.

However, the conservation of this natural resource (water) implies adequate and specific sanitary conditions, because during the water bathing conditions there is direct contact of people with water, making involuntary ingestion common. It occurs that water quality is not always adequate for this purpose. Generally, the problem of poor water quality is due to the disposal of sewage into it, with this happening directly and indirectly in the river basins. The degradation of water resources, contaminated mainly by sanitary sewage, increases the risk of transmitting diseases by the primary contact of the population when using these places for bathing and leisure activities.

In this context, the study regarding this theme is very relevant, since discussing water bathing conditions is not much evidenced and seen in the media when compared to other subjects involving public health. This reflects in increasing the attention and deepening the studies on the subject, putting it in evidence and being better publicized and worked.

Water bathing conditions is understood as the quality of water whose purpose is primary contact leisure, ie direct and long contact with water, such as water skiing, swimming, diving, among others, and with these activities the probability of considerable and appreciable water ingestion is high. In this way, the understanding of water bathing conditions is implied if the water is proper for

recreational bathing purposes, which is the definition of water bathing conditions. (CETESB, 2011).

In this sense, Quintela (2004) emphasizes the expression water bathing spas, relating to places with the same purpose, such as thermal and hydromineral spas. However, according to the place, whether in the country or historical moment, places suitable for bathing (leisure) have different designations.

The World Health Organization (WHO) characterizes in its safe water recreation guide places intended for water recreation, with fresh or salt water, such as freshwater, estuarine or coastal waters, where any form of recreational use of the same is performed by a significant number of people, also shows that even if its use is varied, the greatest concern is the contact through the ingestion of this water, which is a relevant risk (WHO, 2003).

The water bathing conditions index analysis the microbiological quality of the water bodies designated to recreation activities with long and direct contact with water (bathing and sport activities). The parameter qualifying water bathing conditions is the quantity of fecal coliforms present in the water. The analysis of water bathing conditions is regulated by the CONAMA Resolution n° 274/2000 which establishes the legal parameters and all the criteria related to water quality. With this scenario, the evaluation and the monitoring of water quality for water bathing purposes is an important tool in the reduction of impacts in the local economy, in the evaluation of environmental quality of the rivers and in the increase of sanitary security of the population.

With this perspective, this study intends to address issues pertinent to the environment, through the theme of water use as leisure and recreation, the sustainable use of this resource, as well as being a public health aspect. Thus, the present study evaluated the water quality for bathing purposes in Querer Beach in the municipality of Santa Rosa, state of Tocantins, which is a socioenvironmental concern.

Tourism, among other anthropogenic activities, accelerates the process of degradation of natural resources, such as water pollution, which can cause several health problems to the population, making it necessary to evaluate the conditions of water use. Thus, we analyzed in this study the conditions of the water sanitation level for bathing at Querer Beach in Santa Rosa -TO, and the alternatives that are necessary for the preservation/environmental maintenance of this natural resource of the region.

The development of anthropic activities, without proper planning, has led to a great degradation of water quality, compromising the varied uses of this natural resource. The conditions of use of Querer Beach in the Tocantins River basin in Santa Rosa - TO were evaluated and classified by means of objective criteria based on the monitoring of the fecal coliform group indicators and the results obtained

were compared to the defined parameters by CONAMA Resolution No. 274/00, to determine if the water destined for bathing purposes are considered proper or improper for recreational activities.

Water bathing condition is an instrument for checking the parameters that indicate if the water has quality for primary contact recreation. It is relevant to raise questions about the theme, considering that the process of environmental degradation triggers high levels of pollution and contamination of water resources, which directly affects people's life quality.

Hirata (2001) argues that in relation to water resources, there are recurrent problems of overexploitation of water bodies and consequently their contamination. The use of water bodies improperly, such as waste receptacles, domestic sewage, agricultural and industrial waste, compromise its use.

Therefore, the development of studies regarding water quality enables evaluations of the real conditions of the water resources in relation to the proper supplying of water bathing demand, besides serving as subsidy for the advance of effective measures of environmental conservation and preservation that allow to the municipality of Santa Rosa the expansion of its economical activities in a sustainable way.

II. MATERIAL AND METHODS

This work has analyzed the water quality in Querer Beach. It was performed a descriptive analysis with an experimental approach. This kind of research was significant for raising data of the variables of water quality and the evaluation of water bathing conditions in the beach of the municipality of Santa Rosa.

Study Area

The chosen area of this study was Querer Beach, located in the Tocantins River basin in the municipality of Santa Rosa - TO.

The municipality of Santa Rosa has the following geographical features: 1796.3km² of area; 4568 inhabitants; population density of 2.5 inhabitants per km². It is located 88 km south-east of Porto Nacional, the largest city in the vicinity. It is located at 288 meters of altitude, from Santa Rosa do Tocantins the geographical coordinates of the municipality: Latitude 11 ° 26 '31' 'South, Longitude: 48 ° 7' 2 " West.

The municipality is located at the Manuel Alves River Basin and is part of the Tocantins River Hydrographic System (right bank), corresponding to the T5 unit, with a drainage area of 14,894.7 km².



Fig. 1: Map Location from the Municipality of Santa Rosa from Tocantins.

Source: Google Maps (2017)

Sample collecting

The present study evaluated the water bathing conditions of Querer Beach, located in the municipality of Santa Rosa-TO. The CONAMA Resolution No. 274/00 recommends that the sampling collecting should be performed in a place that presents the isobath of one meter and where there is a greater concentration of bathers. However, it is known that the time of greatest concentration of bathers is in the period of beach season, from June to September. Therefore, it was not possible to perform the research in this period, thus defining the collecting between the months (March and April), which represents rainy season in the region.

The raining season represents one of the main causes of contamination of the river body through the transportation of materials over the soil. With this scenario, a collecting point was selected with the assistance of a GPS device according to the legal standards established by Resolution 274, as demonstrated in figure 2.



Fig. 2: Sample collection location in Querer Beach.

Source: From the author (2018).

The geographical coordinate of the chosen collecting points described in Table 1. It was performed collections in this specific place, in virtue to the beach access in the rainy season.

Table.1 - Geographical Coordinate of the marked point

POINTS	COORDINATES	
	Latitude (ϕ)	Longitude (λ)
P1	12°40,801'S	46°20,802'W

In each week a sample of water was collected at the selected spot in a suitably sterilized 100 ml glass vessel, approximately 1 meter deep. Sampling was carried out during 6 consecutive weeks, from March to April 2018: (03/08, 03/15, 03/22, 03/29, 04/05, 04/12), in the morning period as shown in the table 2.

Table.2 - Relation of the water collection dates of Querer beach.

DATES OF WATER COLLECTION				
WE EKS	MON THS	DAY OF THE WEEK	DAY OF THE MONTH	SCHE DULE
1 ^a week	Marc h	Thursday	08	07:00 to 09:00
2 ^a week	Marc h	Thursday	15	
3 ^a week	Marc h	Thursday	22	
4 ^a week	Marc h	Thursday	29	
5 ^a week	April	Thursday	05	
6 ^a week	April	Thursday	12	

For sample collection, disposable gloves and sterile vials were used. After the collection, the samples were stored in an icebox and transported immediately to the IFTO chemistry laboratory. The analyzes were performed following the methodology described by the APHA (*Standard Methods for the Examination of Water and Wastewater*), to determinate the concentration of fecal coliforms (thermotolerant) and *E. coli*.

Microbiological analysis

Among the methods used for the analysis of coliforms, we have the technique of fermentation in multiple tubes (FTM), which is very laborious and depends on a large number of materials, having up to 96 hours to disseminate the results and the quick Colilert (IDEXX) and Colitag (HEXIS) methods, which are more practical techniques with time to deliver the results in 24 hours (GREGHI, 2005).

The analysis methodology adopted was the Colilert technique for simultaneous detections, specific and confirmatory identifications of total coliforms and *E. coli*. It is a technique based on the principle of identification of

the microorganisms, and the estimated time of 24 hours for determination of the Most Likely Number (NMP / 100ml) of bacteria of the total coliform group and *Escherichia coli* (IDEXX, 2016).

The procedures for collection, transportation and analysis followed the criteria recommended by the *Standard Methods for the Examination of Water and Wastewater* - APHA, 2007 / American Public Health Association. In total, six microbiological tests were performed using the methodologies recommended by APHA (2007). The density is expressed as *The Most Likely Number of E. coli* per 100 ml of water sample, where a positive dome is equivalent to one bacterium in 100 ml of water (IDEXX, 2016).

In this context, the laboratory results were analyzed and compared with the criteria established by CONAMA Resolution No. 274/00, which define the bathing conditions classified in the following categories: proper (excellent, very good and satisfactory) or inappropriate for primary contact recreation.

III. RESULTS

The process of evaluating water bathing conditions is essential and a clear set of criteria must be established for it to be performed in an efficient way. These criteria need to be based on supervised indicators and their values compared to predetermined standards to enable the identification of the appropriate dispositions in a given place (SEMA, 2010).

Therefore, it is sought to relate the existence of fecal pollution indicators in the aquatic environment and the potential threat of acquiring serious diseases when using water for recreation. These criteria must essentially be linked to the well-being, safety and health of society (CETESB, 2004).

Thus, the data obtained in the present study were tabulated and analyzed, indicating the classification of Querer beach's water, when compared to the water bathing parameters required by CONAMA Resolution 274/00.

The resolution No. 274 of November 29, 2000 defines the criteria for bathing in Brazilian waters to guarantee the conditions for recreation of primary contact and to analyze the development of water quality compared to established levels (CONAMA, 2000).

The monitoring of the microbiological quality of the water under study occurred between March and April 2018, a rainy season in the region of Santa Rosa do Tocantins. It was observed that in the rainy season the water had a dark coloration from the solids transported to the riverbed. However, it is emphasized that the dark coloration of the water is not a characteristic indicator of contamination since it may have a transparent color and be contaminated as well.

During the monitoring, it was observed that the beach was in bad conditions, with high woods, besides the absence of cleaning and maintenance, to the detriment of the rainy period. Thus, this can be considered a negative factor, since the tourist potential of the beach can be explored all year round, since the water level of the river usually remains constant.

According to CONAMA (2000), it is important to mention the second article of Resolution 274 that defines the conditions of evaluation in the proper and improper categories:

§ 1° Water considered proper can be subdivided into the following categories:

Excellent: when in 80% or more of the samples obtained in each of the previous five weeks, taken at the same place, there are at most 250 fecal coliforms (thermotolerant) or 200 *Escherichia coli* or 25 enterococci per 100 milliliters;

Very Good: when in 80% or more of the samples obtained at each one of the previous five weeks, taken at the same place, there are at most 500 fecal coliforms (thermotolerant) or 400 *Escherichia coli* or 50 enterococci per 100 milliliters;

Satisfactory: when in 80% or more of the samples obtained in each of the previous five weeks, collected at the same site, there are at most 1,000 fecal coliforms (thermotolerant) or 800 *Escherichia coli* or 100 enterococci per 100 milliliters.

§ 40 The water will be considered IMPROPER when one of the following occurrences is verified in the evaluated section:

- Failure to meet the criteria established for the waters;
- Value obtained in the last sampling is greater than 2,500 fecal coliforms (thermotolerant) or 2,000 *Escherichia coli* or 400 enterococci per 100 milliliters;
- High or abnormal incidence in the collection region of waterborne diseases indicated by the sanitary authorities;
- Presence of solid or liquid waste, including sanitary sewage, oils, greases and other substances capable of presenting health risks or making recreation unpleasant;
- pH <6.0 or pH > 9.0 (fresh water), except in natural conditions;
- flowering of algae or other organisms until proven not to pose a risk to human health;
- Other factors that contraindicate, temporarily or permanently, the exercise of primary contact recreation;

Table 3 presents the classification of the water in relation to its water bathing conditions, according to Resolution 274/2000.

Table 3 - Classification of water in relation to its water bathing conditions, according to Resolution 274

Category	Fecal coliforms (NMP / 100ml) *	<i>Escherichia coli</i> (NMP/100ml)*
Excelent	< 250	< 200
Very Good	< 500	< 400
Satisfactory	< 1000	< 800
Improper	Above 2500	Above 2000

*NMP: The most probable number per 100ml, in 80% or more of a set of samples obtained in each of the previous five weeks.

Source: CONAMA RESOLUTION No. 274/2000.

The resolution 274/2000 states in its third article on the prohibition of stretches of beaches and resorts if the environmental control agency determines that the poor quality of primary contact recreation waters justifies such a measure. Excavations should also be banned if there are accidents such as: oil spillage and sewage leakage, toxicity or cream formation due to flowering of algae or other organisms and, in the case of fresh water, the presence of potential transmitting mollusks of schistosomiasis and other waterborne diseases.

Thus, the environmental control agencies are responsible for the disclosure of the bathing conditions of the beaches and resorts and for inspecting the application and compliance of this resolution (CONAMA, 2000).

In this sense, the results obtained in the research were presented and discussed through the indicators of total coliforms and *E. coli*, considering the classification criteria of the CONAMA Resolution No. 274/00, for waters with the proper or improper classification for bathing purposes, based on the average of six consecutive samples.

During the monitoring period a high percentage of total coliform concentration was evidenced. The results obtained at the collection point remained above the values recommended by CONAMA Resolution 274/00.

The concentration of *E. coli* present in the water it is believed to happen due to elements pertinent to the physical characteristics present at the point of collection selected for the study, such as the presence of fuel oil from vessels, animals in their environment and bathrooms with septic tanks, as well as waste brought by rain. It is important to consider that the access of these effluents to the water body causes changes in water quality for recreation of primary contact as well as for other activities in this sense

Soon after the samples being submitted to the presence of ultraviolet light at 365 nm, the fluorescence characteristics were observed, so the result was positive for the presence of fecal coliforms. The Resolution of CONAMA 274/00

(2000), states that when 80% or more of a set of samples obtained in each of the six weeks, a maximum of 200 *Escherichia coli* is found, the waters are considered proper and fit the category of "excellent" for bathing purposes. The table 4 presents the results of the analyzes obtained.

Table.4 - Overall result of the analyzes obtained.

PARAMETERS	03/08 /2018	03/15 /2018	03/22 /2018	03/29 /2018	04/05 /2018	04/12 /2018
	PI	PI	PI	PI	PI	PI
pH	6,98	6,93	7,07	6,97	7,02	7,05
Temperature (in locu)	27,5	27,3	27,1	27,7	26,5	27,2
Electric Conductivity (µmbo/cm)	51,87	53,82	56,34	51,29	55,42	54,61
Turbidity (NTU)	28,3	28,1	30,3	29,7	27,8	31,1
Total of Thermotolerant Coliforms (NMP/100 mL)	>241 9,6	>241 9,6	>241 9,6	>241 9,6	>241 9,6	>241 9,6
<i>Escherichia coli</i> (NMP/100 mL)	17,7	27,5	19,9	23,4	30,9	25,7

In the analyzed data collection period, the Querer beach of natural waters presented little or no concentration of visitors or bathers due to the analyzes having been performed in the middle of the week and outside the beach season. To carry out the classification of the samples analyzed in the respective categories established by the CONAMA resolution n° 274/2000, the results obtained for *Escherichia coli* at the location during the period of six weeks were compared with the limits established by said resolution, as presented in table 3. In the research in all samples analyzed from the place of the collection, after the incubation period of 24 hours, the presence of the total coliforms was observed throughout the study period.

From this perspective, for WHO (2003), there are exposures to both chemical and physical risks, as well as the possibility of accidents, such as the presence of venomous animals, drownings, etc. Among the exposed risk groups, children are more susceptible, as they often do not have adequate hygiene and health knowledge, as well as remaining more time in the water and drinking it,

sometimes in great quantities. Another high risk group is the elderly, exposed to great health damage due to the existence of microbiological deterioration of the water properties, because of the exposure to pathogenic organisms in these environments.

The risks in which individuals are exposed in relation to their contact with water, primary or secondary, can vary according to Quintela (2004), as shown in table 5.

Table.5 - Eminent risks to users

Cold, heat and sunlight	Chemical and physical agents
Contamination of beach sand	Water quality (especially when contaminated by sewage, as well as exposed to pathogenic microorganisms that inhabit the water in recreations)
Dangerous aquatic organisms	Physical hazards (such as injury or drowning)
Algae and their toxins	

Source: Quintela (2004)

IV. DISCUSSIONS

When analyzing the water samples, values of *E. coli* with great variation during the monitoring period were found from 17.7 to 30.9 per 100 ml of water. The values of the analyzes are lower than 200 *E.coli*; therefore, in this period, the waters are considered suitable for recreational use. The highest presence of *E. coli* was observed on the fifth (05/04) and sixth (04/12) week, during which there was a big incidence of rainfalls. The rain may have interfered with the result, considerably increasing the contamination rate by approximately 189%.

Coliforms are bacteria used as a microbiological indicator of water quality control - monitoring of pathogenic microorganisms. The survival of these microorganisms depends on the quality of the water in relation to the temperature, amount of oxygen, turbidity and nutrients present in the water. The pathogens may be adhered to the sand particles and sediments, increasing the concentration of these organisms in rivers and lakes (HERMES and SILVA, 2004).

The *Escherichia coli* bacteria were found in all samples analyzed during the study period. The place of the collection presented the lowest value of *E. coli*, 17.7 NMP/100ml in the first week of analysis (08/03) and in the fifth week (05/04) the highest value of 30.9 NMP/100ml. The place of collection during the six following weeks showed, during the rainy season (March - summer) and the transition period from summer to autumn (04/05/2016), an increase in the amount of fecal coliforms (*E. coli*) possibly due to the superficial drainage of rainwater on the soil

contaminated by waste and feces of warm-blooded animals or by the presence of private septic tanks and the absence of a sewage network in the surrounding establishments, thus compromising the quality of the waters for recreation. This is explained by the increase of rainfall flow in the summer and the consequent transport of microorganisms present in the surroundings of the springs (MORAIS and SILVA, 2012).

The CONAMA resolution 274/00 determines that at least 80% of the analyzed samples present an *Escherichia coli* count below 800 NMP/100 ml per sample for the water bathing conditions of the beach to be considered in the proper category and satisfactory subcategory.

According to Resolution No. 274 (CONAMA, 2000), in relation to the presence of *E. Coli*, in the given sample period, the Querer Beach was rated for bathing in the proper category and excellent subcategory, since more than 80% of the samples obtained in each of the six weeks presented lower values than those established by the Resolution, which means less than 200 NMP / 100ml.

In the analyzed period, all the water samples from the collection place of Querer Beach presented satisfactory conditions to receive their visitors and bathers, thus proving the excellent water bathing conditions in 100% of the samples, making the beach suitable for primary recreation activities.

According to Berg *et al.* (2013), streams of water contaminated by domestic sewage, when they encounter beach water, for example, can let the bathers exposed to bacteria, viruses and protozoa. It is important to consider that spa waters outside health standards increase the possibility of acquiring various diseases, leading in some cases to death. These microorganisms are the authors of waterborne transmission to bathers (Table 6).

Table.6: Water borne diseases

DISEASE	TRANSMISSION	SYMPTOMS
Cholera	Contaminated water, raw food and flies.	Diarrhea, feces similar to rice water, thirst, pain and coma.
Typhoid Fever	Contaminated water, milk, dairy, oysters, food and flies.	General infection, characterized by continuous fevers, pink spots, diarrhea.
Leptospirosis	Food, water or contaminated soil or excreta and urine of infected animals.	Fever, headache, nausea, muscle pain, vomiting, thirst and prostration.

Amoebiasis	Contaminated water, raw food, flies and cockroaches.	Abdominal discomfort, diarrhea, stool bleeding.
Ascariidiasis-Helminths	Food, contaminated water and sewage.	Feces in the stool, abdominal pain, skin rashes and nausea.
Schistosomiasis	Contaminated water	Diarrhea, dermatosis, cirrhosis of the liver, spleen disorders.
Ancylostomiasis	Water and raw food.	Intestinal disorders, abdominal pain, vomiting, sleep disturbance.
Infectious Hepatitis (A e)	Water, food, milk, direct contact.	Fever, nausea, headache, loss of appetite, possibly vomiting and fatigue.
Polio	Direct contact and through the sewage network.	Fever, headaches, malaise, and paralysis.

Source: CESA (2008).

The good water bathing conditions of Querer beach during the study period may have as justification the decrease of bathers, visitors and boats at the analyzed places. However, even though the *Escherichia coli* values are lower in the samples, their presence indicates fecal contamination, which represents a risk to the bathers' health, since contaminated water increases along with the growth of pathogenic microorganisms throughout the year in its several climatic seasons conditions and should be regularly monitored.

V. CONCLUSION

This research was performed in order to evaluate the quality conditions of the beach water for recreation of primary contact, through indicators of fecal pollution, such as bacteria of the total coliform group and *E. coli*.

The results obtained from the microbiological analyzes of the water samples collected at Querer beach in Santa Rosa do Tocantins confirmed that the total coliform bacteria were present at the monitoring point during the study period.

The levels of *E. coli* bacteria show low concentrations that allow to classify the waters regarding their water bathing conditions as proper, subdivided into the category of "excellent", according to Resolution No. 274/00 of CONAMA. Therefore, Querer Beach waters, during the analysis period, based on the bacterial indicator of the *E. coli* group, met the recommended standards for water bathing conditions (primary contact recreation).

Although the conditions for water bathing conditions meet the criteria established for proper waters, it is considered pertinent to recommend some practices, because the concentration of *E. coli* was detected during the period of analysis. The recommendations focus on establishing a water monitoring program as an appropriate practice to provide greater sanitary security for bathers and encourage the use of the beach in an yearly basis as an attractive place for recreation and leisure.

In addition to the application of legislation instruments to contain the advance of contamination, such as the criteria determined by Resolution No. 274/00 of CONAMA and Environmental Legislation. Another preponderant aspect to be observed is the periodic work of cleaning the banks of the river and waste, to avoid being transported to the water body during the rainy season; as well as the supervision of local commercial establishments, ie bars and restaurants, requiring the proper treatment of domestic sanitary effluents

It is also necessary to implement information devices (boards) by the public authority with indications of the water condition, thus offering better guidance and sanitary safety to bathers.

Finally, maintaining the monitoring of water quality should be a constant concern of the State and Municipal Secretariats of the Environment, seeking partnerships with Academic Institutions, in order to develop preventive actions through scientific research to provide a clean environment free of contamination for the tourists and local users, and also to foment the tourist development and economic of the municipalit.

ACKNOWLEDGEMENTS

We would like to thank the Federal Institute of Education, Science and Technology of Tocantins for assigning the laboratory, space and structure for the analysis of the data for research, as well as the supervisor for the valuable contributions to the accomplishment of this work.

REFERENCES

[1] BERG, C. H., GUERCIO, M. J., & ULBRICHT, V. R. (2013). *Water Bathing Conditions Indicators: The Brazilian situation and the recommendations of the World Health Organization*. Florianópolis: International Journal of Knowledge Engineering and Management.

- [2] CETESB, C. O. (2011). *Quality report of coastal beaches in the state of São Paulo*. São Paulo: São Paulo.
- [3] Colilert-18, I. V. (2011). *Quanti-Tray method for counting E. coli and coliform bacteria in water. YEAR 2011*.
- [4] CONAMA. (2000). *Resolution CONAMA No. 274, of November 29, 2000*. Brasília-DF (Brazil): ational Environment Council, Ministry of the Environment.
- [5] Environment., S. -S. (2010). *Report on the evaluation of water bathing conditions of the fluvial beaches 2008 to 2010*. Mato Grosso: SEMA.
- [6] GREGHI, S. d. (2005). *Evaluation of the efficiency of rapid methods used to detect total coliforms and fecal coliforms in water samples compared to the multi-tube fermentation technique*. Araraquara: Faculty of Pharmaceutical Sciences, State University Paulista Julio de Mesquita Filho.
- [7] HERMES, L. C., & SILVA, A. (2004). *Water quality assessment. 1*. Brasília: Embrapa Information Technology.
- [8] MAPS, G. E. (2018). *MAPS. User's Guide*. tps://earth.google.
- [9] MORAIS, R. C., & SILVA, C. E. (2012). *Environmental diagnosis of the spa Curva São Paulo on the Poti river in Teresina, Piauí*. Teresina, Piauí.: Environmental Sanitary Engineering.
- [10] ORGANIZATION, W. H. (2003). *Guidelines for safe recreational water environments: coastal and fresh waters*. Geneva, Switzerland.
- [11] QUINTELA, M. M. (2004). *Saberes and thermal practices: a comparative perspective in Portugal (Termas de S. Pedro do Sul) and in Brazil (Caldas da Imperatriz)*. Portugal S. Pedro do Sul: Manguinhos.
- [12] Resolution, N. C. (2005). *Ministry of the Environment. National Council for the Environment*. Brasília: www.mma.gov.br/port/conama/res/res05/res35705.pdf.
- [13] SPERLING, M. (2005). *Introduction to water quality and treatment of sewage*. Belo Horizonte: Department of Sanitary Engineering - UFMG.