Articulation on Basic Sanitation in the City of Manaus, Collecting Nets Model for Lagoa Azul Community

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Abstract

This article aims to demonstrate and articulate the situation of basic sanitation in the city of Manaus in the state of Amazonas. Through research, the precarious state of the sector in the region is now proven, the proposal for emergency measures such as the sewage collection system in the community of Lagoa Azul, is intended to demonstrate the absence of old management of the provision services for citizens' right to sanitation.

Keywords: Basic sanitation; Sanitary sewage; Water supply.;

1. Introduction

Basic sanitation is guaranteed to every citizen by law 11,445 of 2007, which establishes national guidelines for basic sanitation and the federal basic sanitation policy. These measures are more than rights, they are synonymous with quality of life. Brazil, a country with a huge amount of water resources, has been careless about them.

In the city of Manaus, the aggravation of the precarious sanitation situation is of various spheres, social, cultural, economic and political. Lack of awareness campaigns for the population, little zeal for the city and the environment, rubbish and irregular solid waste clumps in the open are common, the huge amount of waste in the streams from 2013 until June 2019 the city spending public resources approximately 70 million reais to remove 47,000 tons of rubble from the rivers, according to data from the Municipal Secretariat of Urban Cleaning (Semulsp) [1].

Demographic occupation has evolved, largely due to irregular and improper occupations, which are formed in a disorderly manner, with little or no infrastructure, which makes the process of urbanization of these housing complexes difficult.

Sometimes housing is built in high-risk locations such as slopes, slopes, regions near effluent emitters and / or contaminated streams, which undermines the health and well-being of the population living in these locations.

The lack of interest of the public power in this sector, demonstrates an outdated management more interested in treating and remedying the diseases of the population, to remedy the issuer and proliferator of problems.

This article aims to articulate the situation of basic sanitation in the city of Manaus, in order to describe the supply of drinking water to the population, examine the management of rainwater, evaluate the situation of collection and treatment of sewage, propose a sanitary sewage collection network for the community of Lagoa Azul, to elucidate the picture of vector proliferation and diseases.

2. Theoretical Foundation

Manaus developed on the banks of the Rio Negro, the second largest river in the world's water flow, and is still served by the waters of the Alter do Chão sandstone aquifer system currently considered the largest on the planet [2], and even with this availability there are still residents without access to the water distribution network.

According to the 2017 Diagnosis of Water and Sewage Services, conducted annually by the National Sanitation Information System (SNIS) [3], 89.26% of the capital has access to a drinking water network.

The water supply service is provided by the company Águas de Manaus, which started operating in 2018, supplying it through tubular wells and by capturing the surface drainage of the Negro river.

2.1.1 Surface Pickup

The withdrawal of waters from the Rio Negro is over 630.000.000,00 liters per day, which are sent to the treatment station, in order to undergo the water potabilization process, having its purpose defined by [4], as having for human consumption, the essential function of balancing raw water with physical, chemical, biological and radioactive limits.

Ordinance No. 2,914, of December 12, 2011 [5], applies to water intended for human consumption from an alternative water supply system and solution, defining legal responsibilities and parameters for abstraction, treatment, distribution and consumption.

Water treatment consists of a series of processes aimed at removing microorganisms, organic materials,

sediments and any other elements that may be harmful to health. Treatment technologies aim to reconcile the quality of treated water, the costs of implementation, operation and maintenance, and environmental sustainability.

Art. 13 of Ordinance 2914 (Brazil, 2011) [5] cites the competences of the person responsible for the system or collective alternative solution for water supply for human consumption, the main ones being: to guarantee the operation and maintenance of the installations in accordance with the relevant standards; maintain and control the quality of water produced and distributed through: operational control of the intake, adduction, treatment, confinement and distribution points; among others, the provision of reports and results for the public interest.

The distribution network in Manaus consists of 4 Water Treatment Stations (ETA'S). In the West, are located ETA 1 and ETA 2, responsible for supplying 80% of the city, ETA Mauazinho in the south of the capital, and ETA Ponta das Lajes is responsible for water distribution of the Water Program for Manaus (Proama), located in the East Zone.

According to [4], the water treatment plant must have three characteristics for the production of quality effluents: robustness, reliability and resilience. Robustness is the ability to meet demand, whether in flood or drought, reliability is the ability to meet the population at a given future time, and resilience to the regeneration that the body of water has when it suffers. interference or contamination.

The treatment plants in Manaus perform the water potabilization, performing the processes described in Table 1.

Table 1: Potabilization process of the company Água de Manaus.

PRE-ALKALINIZATION	**COAGULATION**	**Flocculation**	**DECANTATION AND FLOTATION**
Lime application to increase alkalinity and correct water acidity.	Lime application to increase alkalinity and correct water acidity.	Application of water to flocculate impurities, facilitating their removal.	Removal of impurities by physical forces.
FILTRATION	DISINFECTION	FLUORETATION	PF FINAL ADJUSTMENT
Retention of the finest impurities in a sand and anthracite filter.	Addition of chlorine, ensuring no microorganism.	Adding a small amount of fluoride to prevent tooth decay.	Second acidity correction for neutral water distribution.

Source: [3].

2.1.2 Underground abstraction

Manaus also has 41 other Groundwater Production Centers (CPAs) in operation. Secondly, [4] capturing groundwater has advantages, among which a significant reduction in implementation costs and a better quality of wastewater, most of the time neglecting most of the potabilization processes, and also presents greater resilience to pollution.

According to [6], due to the low rates of infiltration water in the lower layers and the biological, physical and chemical processes that occur in the soil of aquifer regions, they are naturally more protected from pollution.

Urban growth in Manaus occurs rapidly and several times irregularly, which makes the practice of opening clandestine artesian wells common.

The drilling of irregular wells, without the necessary procedures and studies, even in places vulnerable to pollution or already contaminated, compromises the entire quality of the aquifer, as stated [7], that wells built without ABNT technical standards compromise the environment. , mainly aquifers.

The Mineral Resources Research Company [8] stated that the Amazonian capital has approximately 15,000 groundwater abstraction points, of which 5,000 were duly registered by the Amazonas Environmental Protection Institute (IPAAM), 3,000 are deactivated due to abandonment, 7,000 are clandestine.

The situation is corroborated by [9], stating that in the capital there are thousands of low-yielding wells that draw water from the aquifer in shallow water tables, providing untreated water without monitoring and enforcement, and without any health protection. .

Commercial activities are virtually all sources of groundwater contamination, chemical leaks, industrial processes without the right measures and procedures, inefficient wastewater treatment, mining activities, solid waste management, indiscriminate use of pesticides. in agriculture, they represent the main sources of contamination.

For [10], improper productive activities can lead to soil pollution occasionally from groundwater and especially surface water, which generates problems that remain even after the end of the activity, also states that the management of these liabilities is fundamental to preserve spring and control possible consequences.

2.2 Health Exhaust

Once the water supply system is in place, there is a need for the collection, removal, treatment and final disposal of the wastewater, since these waters will be sources of pollution for the soil, groundwater and surface water, and still pooling. and constituting foci for the dissemination of diseases and vectors.

Sanitary sewage has several implications for society, showing a significant improvement in the population's quality of life, productivity, and e specially in the environment.

In his work [11] he states that the most important objectives of the sanitary sewage system are: improvement of local hygienic conditions and generating increased productivity; the conservation of natural and mineral resources, especially surface waters; sewage collection and remediation; the sanitary proper final disposal of the effluent; avoid creating outbreaks of pollution and contamination as well as aesthetic aspects of the region, for example, foul odors; the protection of downstream communities and settlements; preservation of areas for leisure and sports.

The system adopted in the city is that of sewage sewage, responsible exclusively for sewage without additional loads of rainwater. The model is defined by NBR 9648 [12] as being the set of conductors, installations and equipment for the purpose of collecting, transporting, storing and or treating sanitary sewage only, giving a convenient final disposal, continuously and hygienically safe. .

The Separator System has lower deployment costs, easier maintenance, and improvement in other systems such as drainage. For [11] the advantages of the system are the smaller plumbing, the segmentation of the implantation that allows the prioritization of emergency sections, the improvement in the removal of rainwater from the sewage.

Consisting of plumbing, being collectors, interceptors, emissaries, siphons and forced passages, accessory organs, such as manholes, inspection and cleaning pipes, cleaning terminals, crossing boxes, it also has lifting stations, treatment stations, and works final release and receiving body.

The diagnosis of water and sewage services in [13] reports that in the capital only 12.25% of the population has the sewage collection service. Approximately over 1,800,000 manauaras treat their own sewage or simply discharge it directly into the wild.

In the same way as water supply, the sewage service is performed by the company Águas de Manaus. The collection network has a length of over 500 kilometers, associated with 60 treatment stations and 51 pumping stations.

2.3 Drainage and Management af Low Water

Federal Law No. 11,445 / 2007, which deals with the National Policy of Basic Sanitation [13], in its article 3, provides that the drainage and management of rainwater, cleaning and preventive supervision of the respective urban networks is characterized as "Set of urban stormwater drainage activities, infrastructures and operating facilities, transportation, detention or retention for flood flow damping, treatment and final disposal of stormwater drained in urban areas".

According to [14], the drainage system must be understood as the set of infrastructure existing in a city to perform the collection, transportation and final release of surface water. It consists of a series of measures aimed at minimizing the risks to which populations are exposed, reducing the damage caused by flooding and flooding.

The drainage system should be considered as two systems: Initial System or (Micro Drainage), and System (Macro Drainage), which should be designed differentiated subcriterion, [15]. Figure 1 shows the scheme of micro and macrodrainage systems.

One of the main problems related to urban drainage in large cities concerns precipitation. Urbanization brings soil sealing, channeling of watercourses and impacts related to rainwater beyond the possibility of erosion, including increased flow, pollutant load and sewage that is often discharged into drainage rain.

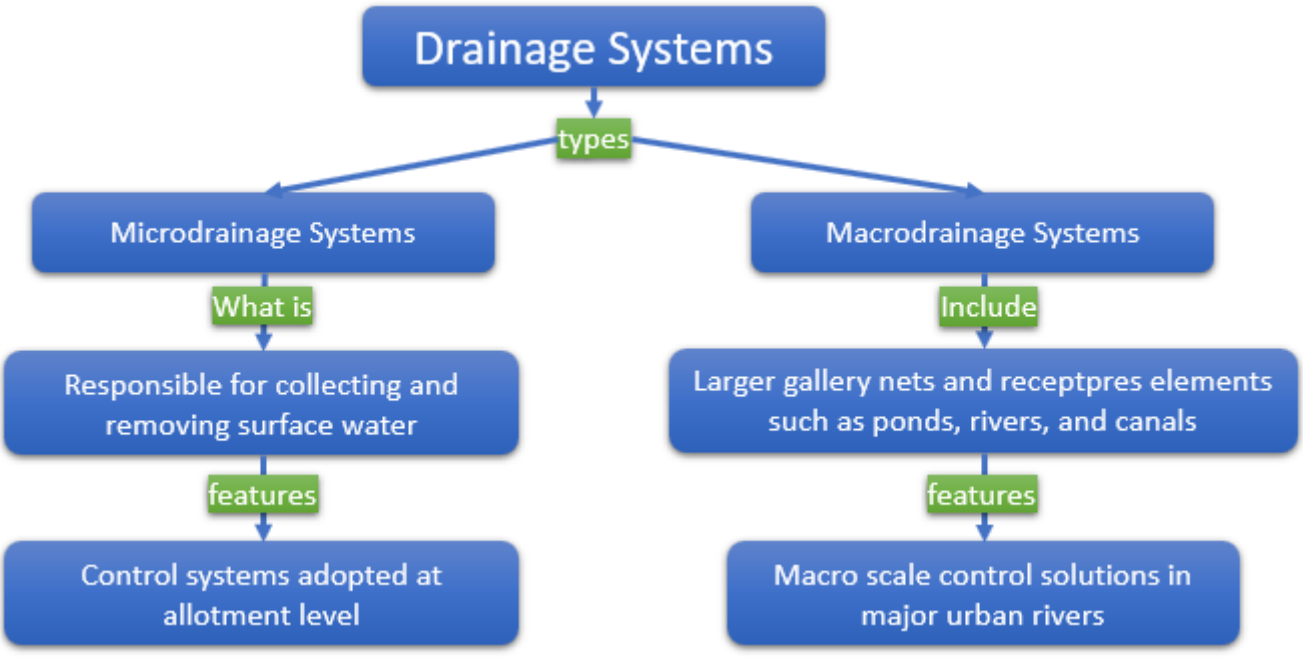

Figure 1: Micro and macrodrainage schemes.
Source: GPACC (2011).

In Brazil, most cities still suffer from flooding, flooding and flooding problems, generating a number of factors, among which two can be highlighted: the disordered occupation of natural stormwater run-off areas and the lack of a urban drainage that can prevent such flooding from occurring. The two factors listed depend directly on government action in the area of housing and sanitation.

According to [16], floods due to urbanization are those that occur in urban drainage due to heavy rainfall and soil sealing or obstruction to runoff, except for other conditions that do not have heavy rain as one of the causes. Problems such as urban flooding are motivated due to poor drainage systems, produced by runoff from stormwater and its excess that does not infiltrate soil already sealed due to misuse.

The existence of a network composed of surface drainage systems combined with underground drainage is a mechanism to control the problems arising from soil sealing in the urban perimeter of cities [17].

Rainwater management is understood as a drainage system that contains street paving, the implementation of surface and underground rainwater collection networks and the final destination of tributaries. It is one of the components of basic sanitation that aims to drain rainwater to prevent harm to human health [17].

The execution of the system services in the City of Manaus is the responsibility of the Municipal Secretariat of Infrastructure - SEMINF [18], which is responsible for developing the strategy for the implementation of infrastructure in the areas of basic sanitation, drainage, establishing priorities and defining implementation mechanisms. monitoring and evaluation.

In their work [19], they consider that the basic drainage system of a city should be structured respecting all legal, technical aspects, economic, social, environmental and institutional dimensions and a minimum physical composition with paving of streets, gutters and curbs, wolves' mouths, drainage galleries and ditches, it is noteworthy that all these elements must be interconnected and functioning properly or the risk of failure in the drainage system is high. In addition to these instruments, the characteristics of watersheds play a major role in the drainage process.

According to the report Geodiversity Commission of the Legislative Assembly of Amazonas [20], highlights that urban drainage in Manaus is precarious. Each time it rains, manauara faces a number of problems related to streams overflowing in virtually all areas of the city, resulting in flooding of streets, houses, manhole clogging and water contamination.

The importance of an adequate urban stormwater drainage and management service becomes significant for the city, where it will provide a series of benefits, such as: appreciation of existing properties in the benefited area, development of the road system; reduction of expenses with maintenance of public roads; rapid runoff of surface waters, ensuring safety and comfort for the population.

2.4 Vectors and Diseases

According to the World Health Organization [21], most of the diseases that spread in developing countries come from poor quality water.

Waterborne Diseases are those in which water acts as a vehicle for infectious agents. Pathogenic microorganisms reach the water through excreta from infected people or animals, causing problems mainly

in the intestinal tract. These diseases can be caused by bacteria, fungi, viruses, protozoa and helminths.

Parasites generally have two life stages: one within the host and one in the environment. While in the host's body, they have ideal conditions for their development, such as adequate temperature and humidity, and plenty of food.

When in the environment, on the contrary, they are threatened and die easily due to excessive light, oxygen, heat, and food shortages. The time that these microorganisms spend outside the host should be sufficient only to reach new organisms and continue their life cycle.

Sanitation and public health are directly linked, as many diseases such as cholera and diarrhea are related to low coverage of treated water supply, lack of a sewage treatment system, other diseases are linked to urban flooding such as dengue and leptospirosis, diseases present in areas with poor infrastructure.

One of the main functions of sanitation is to prevent the spread of these diseases, especially in children, as they are usually the most affected as they enjoy the flood to play forgetting the risk of disease contamination. The riverside families that live near contaminated streams are the ones that suffer the most. According to an IBGE survey [22], between 2016 and 2017, it highlights that 1,935 of the 5,570 municipalities (34.7%) of the municipalities reported epidemics or endemics linked to poor sanitation, with cases of diarrhea, leptospirosis, cholera, malaria and Hepatitis are the most common among the diseases.

Discussed at the 1st Amazonas Environmental Sanitation Seminar, held on October 7 and 8 in the city of Manaus. Deputy Josué Neto, thanked the commitment of the president of the National Health Foundation (FUNASA) [23], Ronaldo Nogueira, to solve the problems of state landfills and to take Amazonas from the precarious levels of sanitation currently existing.

The deputy points out that this is the first time the Federal Government has committed itself to sanitation in Amazonas. Formerly the Federal Government was not interested in Amazonas, with projects focused on sanitation and with this statement of commitment is an opportunity to improve the lives of the interior population.

Insufficient services identified in the sanitation sector are often linked to the most common health problems among the population, such as diarrhea and worms. According to Ronaldo Nogueira, studies show that for every $ 1 invested in sanitation, you save $ 4 in health.

Rita Castro, head of the Nucleus for the Control of Sexually Transmitted Infections and Viral Hepatitis of the Municipal Health Secretariat (Semsa) [24], explains that in Brazil the most common types of the disease are hepatitis A, which has oral-fecal transmission, one infected person to another healthy or through contaminated food or water. Semsa provides hepatitis A vaccine to children under two years of age, who are the most vulnerable to hepatitis A.

A survey by Instituto brasil [25], based on IBGE data, estimates that hospitalization expenses for gastrointestinal infections in SUS amount to R $ 95 million, and with the implementation of an adequate drainage system, these pantries tend to fall to R $ 72 million by 2035.

The most appropriate way to prevent most of these diseases is to take care of hygiene, cleanliness of the environment and food and one way to do so is through sanitation. Therefore, sanitation is fundamental in disease prevention. In addition, preventing solid waste in inappropriate places, for example, also prevents the proliferation of disease vectors such as mice and insects that are responsible for the spread of some diseases.

3. Methodology

The methodology of this paper was divided into 3 steps with different methods of investigation and research. Initially, through bibliographical research, among academic articles, authors, and legislations, the themes encompassed in the objectives can be defined, which clarified the definitions and scope of sanitation complaints.

Through qualitative and quantitative investigative research, among scientific articles, books, magazines, and the media, including news and documentaries, about the sanitation theme in the city of Manaus, we obtained insight into the present situation, notion of services provided, as well as future forecasts of the basic sanitation framework in the city of Manaus.

Using in loco investigations, digital tools, bibliographic research in books, scientific journals and rules governing the subject, and also through interviews with professionals from the sanitation professional community and residents of the Lagoa Azul community, it was possible to measure and discriminate the needs of the local population, noting the urgent sanitation conditions and the growing demand for such services.

The main descriptors sought in data collection were: basic sanitation; water supply; sanitary sewage; Rainwater Drainage and Management; Vectors and Diseases. Being divided into 3 steps, according to table 2.

Table 2: Work steps.

Step 1:	**Definition of sanitation services and infrastructure.**
Step 2:	Estimation of sanitation conditions
Step 3:	Demand from the Lagoa Azul community, sanitary sewerage project.

Source: Own authorship (2019).

4. Results and Discussions

In the city of Manaus there is a change in mentality towards sanitation, citizens are looking for their infrastructure rights, promoting a better quality of life, the competent bodies are gradually improving sanitation management, the solution adopted is the privatization of the sector. .

The company Águas de Manaus, is interested in providing quality services and make major investments in sanitation infrastructure, prioritizing the neediest segments such as sewage, declared publicly its goal to invest 800 million reais in infrastructure.

The completion of lagging ventures such as ETE TIMBIRAS demonstrates the interest in organizing the sector and improving the population's quality of life. The company says it is just the first step in declaring that it will expand the sewage collection network from 12.25% to 80% by 2030 [26].

Important awareness-raising projects have begun, including a culture of environment and resource preservation in the population, as well as the preservation of improvements and the adaptation of norms and procedures, which improves and brings the service provider body closer to the user population. .

Adapting the urban drainage system will provide a number of benefits to the city, such as the development of the road system, the reduction of expenses with maintenance of public roads, reduction in disease

expenses, rapid runoff of surface waters, providing a sense of security and safety. comfort for the population. Pungently, there is a huge water supply in the lightly and thoughtlessly exploited capital, and the intensification of enforcement and punishment must be intensified in order to protect not only the public interest, but the mineral wealth and health of the population. , training and retraining in supervisory bodies should be a priority for management.

With the increasing improvement of basic sanitation services, it will be latent the improvement in the population's health, the decrease of the cases of waterborne diseases, will make the health investments less expensive, being able to be directed to other deprived sectors of the capital like education and infrastructure. The efficient management of the organs, together with the population's awareness, will make the capital's economy grow exponentially, followed by the population's quality of life, increasing several other sectors, such as tourism, ecotourism, industry, commerce, education, among others. others, making Manaus a major attraction for new investors.

4.1 Collection Network, Model for the Lagoa Azul Community

Quick and practical solutions, such as setting up a collecting network, make a big difference in the quality of life in a community.

The elaboration of a collection network project for the Lagoa Azul community aims to demonstrate that with a small initial investment it can improve the daily life of the population.

Figure 2 shows the study area for the implementation of the collection network, the community currently has 1800 houses, approximately 8000 people, because it is an irregular occupation, comprises an area of high demographic density without any wastewater collection, being a shaky source of environmental pollution.

Figure 2: Blue Lagoon Community.
Source: [27].

The criteria and parameters used for the sizing of collecting networks were defined based on the standards of ABNT, NBR 9.649 [28].

To run economically, the network was divided into 3 collector bays each with its own treatment plant, taking advantage of all the differences in terrain quotas, thus excluding the need for pumping stations, since according to NETTO (1998) [11], the use of lifting stations is harmful to the system due to the solids present in the sewage.

The main dimensions are contained in table 3, the executive plan of the coleto network. shown in figure 3.

q (L / inhab day)	200	C	0,8	K1	1,2
Net length (m)		2281	specific mass H2O (N / m3)		9800
Project flow rates		Linear Contribution Rate			
Q start (L / s)	24,50	initial		0,0107	
Final Q (L / s)	47,61	final		0,0209	

stretch	Length (m)	Q PROJECT Inicial / Final	Terrain quota Montante / Jusante	D (mm)	Cota do coletor Amount / Downstream
BAÍA 1					
0	55	1,50	55	100	54,0
		1,50	54	100	53,0
1.1	55	1,50	54	100	53,0
		2,30	52	100	51,0
3	62	1,50	53	100	52,0
		1,50	52	100	51,0
1.2	80	2,71	52	100	51,0
1.1+3		5,26	47	100	46,0
1.3	80	3,57	47	100	46,0
		6,93	44	100	43,0
1.4	20	4,64	44	150	43,0
1.3+4		9,02	44	200	42,9

Initial Pop (Hab)	8000	Final Pop (Hab)	13600
K2	1,5	TI (L/s.m)	0,001

stretch	Length (m)	Q PROJECT Inicial / Final	Terrain quota Montante / Jusante	D (mm)	Terrain quota Montante / Jusante
BAÍA 2					
5.1	80	1,50	54	100	53,0
		1,67	54	100	52,6
5.2	82	1,74	54	100	53,0
		3,38	51	100	50,0
6	60	1,50	51	100	50,0
		1,50	51	100	49,7
5.3	60	3,03	51	100	50,0
5.2+6		5,89	47	100	46,0
7	60	1,50	49	100	48,0
		1,50	47	100	46,0
5.4	47	4,18	47	100	46,0
5.3+7		8,12	45	100	44,0
8	62	1,50	46	100	45,0
		1,50	45	100	44,0

Figure 3: Scales

Source: Own authorship (2019).

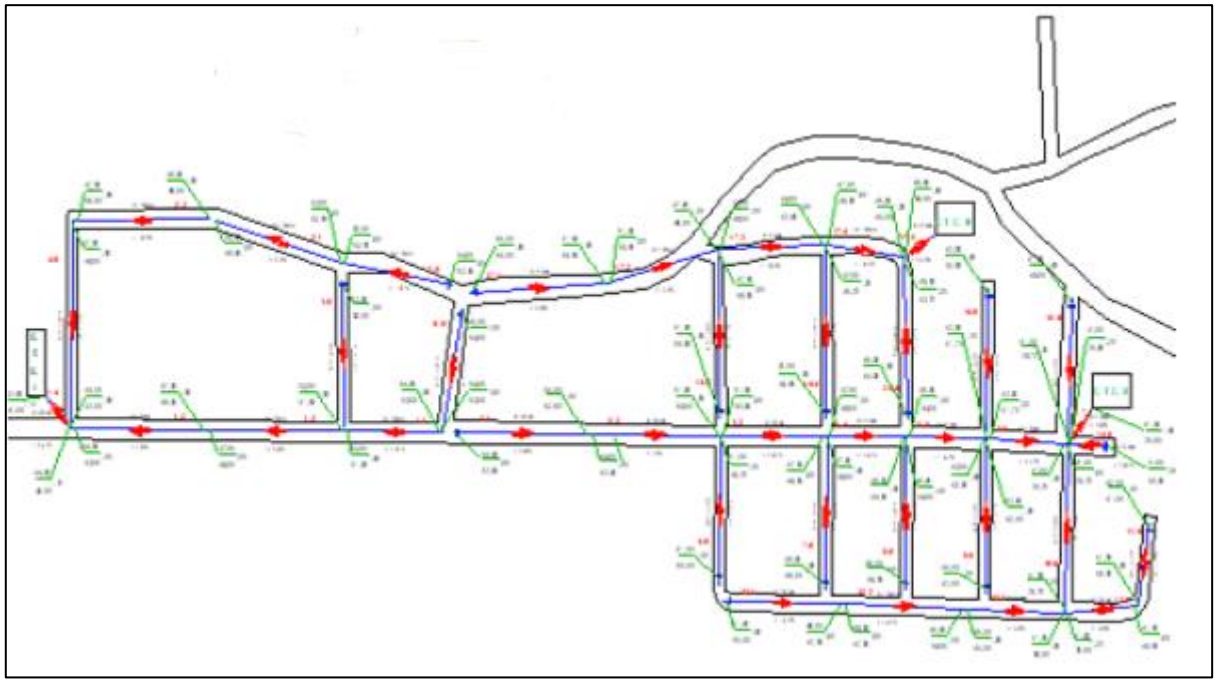

Figure 3 Community Lagoa Azul collecting network

Source: [3]

5. Final Considerations

Thus, in order to provide a continuous supply of safe water to the population in Manaus, existing standards for the production, treatment or distribution of drinking water must be respected. These standards

complement the general environmental protection measures. Therefore, the adoption of protective measures is part of these obligations.

The treatment of domestic sewage is also very important for the preservation of the environment. Sewage contaminates rivers, lakes, dams and seas with an excess of sediment and microorganisms that can cause various diseases.

It is urgent that the contamination of these watercourses by sanitary waste be reduced. Together with these sanitation measures, it will be necessary to intensify the environmental education, hygiene and sanitation programs, make the population aware in order to prevent them from diseases and to protect the environment. Given the information, it was concluded the importance of adapting the basic sanitation systems of the city of Manaus, in order to structure the implementation of new public policies, aimed at improving the quality of life of the local population, and the development of the region.

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