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Analysis of the Current Water Environment in Urban Economic Development Zones

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Abstract

Nowadays, urban water environment has become an important influencing factor for urban development and even residents' lives. This paper will analyze and discuss the current situation of water environment in the Economic and technological development zone of a certain city (referred to as "the economic development zone of a certain city"), focusing on the outdated basic pipeline measures in the economic development zone, the severe pressure of sewage discharge, and the non-standard drainage of enterprises and residential areas. The actual problems such as the large number of water areas worse than Class V and the severe damage to the water environment and water ecology in the Yangtze River Basin have proposed measures such as adapting to local conditions, implementing water environment governance and restoration methods such as "overall planning and classified measures", "scientific planning and active protection and remediation", and conducting source-tracing rectification and internal governance. Systematically summarize and study the practical operation methods for restoring the water environment and water ecology of the Xigan Canal, Chihu Canal and the Yangtze River in the Economic Development Zone to create a national garden city, a national demonstration city for the treatment of black and odorous water bodies, and a national water- saving city, and provide experience and methods for other cities to treat water environment.

Keywords

Water Environment Status; Water Environment Management; Rainwater and Sewage Separation; Pipeline Network Survey and Rehabilitation.

1. Introduction

With the acceleration of urban modernization, the water environment is exerting tremendous pressure on development in various places. The water environment in different places is suffering from varying degrees of damage, which not only poses a severe challenge to the future construction planning of cities, but also seriously affects the basic quality of life of urban residents.Specific measures for water environment governance have been carried out in various places based on their own conditions, and academic scholars have also conducted targeted research.[1-3]

In order to effectively address the problems such as the difficulty in renovating old pipelines in the economic development zone of a certain city, the serious pollution caused by enterprise sewage, the non-standard discharge of urban and rural sewage, the insufficient level of equipment operation and maintenance, the difficulty in improving the water system of Class V or worse, and the serious damage to the water ecology of the Yangtze River, the ecological environment of the economic

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development zone was treated on the premise of ensuring the normal life of urban residents and the normal production activities of enterprises. A study on the restoration and governance of the water environment in the economic development zone of a certain city was conducted in accordance with national policies and local regulations. The research results can provide reference opinions for water environment governance and restoration in other similar areas.

2. Overview of the Water System in the Economic Development Zone

2.1 Location and Main Locations

The Economic Development Zone is located in the eastern part of the urban area. It has a superior geographical location, is close to the Yangtze River, and has a rich water system, which is an important part of the Yangtze River Basin. The main water systems are Xigan Canal, Chihu Canal, Siqing Canal, Huagang River, Zhipai SAN Canal and Wangjiagang Canal. Due to the large area of the economic Development Zone, the large number of urban and rural residents, and the fact that most of the high-tech industrial parks are located here, the sources of water pollution are complex, resulting in varying degrees of water pollution in the water bodies of various canals. The more serious water systems include Xigan Canal, Chihu Canal, Siqing Canal and Huagang River.

2.2 Existing Problems in the Water Environment

In recent years, extreme weather changes and increased rainfall have led to frequent water ecological environment problems due to the special geographical location of the economic development zone. The reasons for solving the problems are summarized as follows:

(1) The urban rainwater and sewage diversion system is lagging behind

According to the survey results of the pipe network, in the economic development zone, there are many old residential areas and self-built houses in towns and townships. Urban domestic sewage is directly discharged into water bodies. There are common misconnections and mixed connections in the main and secondary road pipe networks and sewage collection pipe networks of enterprises and institutions in the area. Rainwater and sewage diversion is not thorough. Along the West Main Canal, moat, Chihu Canal and other rivers, there are cases of sewage being discharged directly into rivers and lakes on rainy days at the sluices and pumping stations of the three direct drainage channels.

(2) Disorderly discharge of wastewater by enterprises

The economic development Zone contains a large number of industrial parks, which are the main source of sewage production. The pipe networks in the industrial parks are not well developed, and problems such as old, damaged, mixed and wrong connections are prominent. Many enterprises transport the sewage into the sewage treatment plant in the park by tank trucks and discharge it directly without treatment.

(3) The stability of urban drainage facilities is low

At present, the drainage facilities in the economic development zone are seriously aging and damaged. The operation efficiency of the drainage pumping stations is not high. The opening and closing of the drainage culverts and sluices, the operation of the pumping stations and the detection of water quality mainly rely on manual labor. The facilities have not been updated in time and cannot achieve precise control. Despite the consumption of a large amount of manpower and material resources, the efficiency is still low.

(4) There are significant irregularities in the discharge of sewage in the "five small" industries

The problem of non-compliance with sewage discharge in the "five small" industries (including catering, hotels, car washing, etc.) remains significant, especially in the catering industry. In urban areas with a high concentration of restaurants, it is common to see wastewater from washing vegetables and dishes being discharged at will.

(5) Agriculture and animal husbandry cause serious pollution

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The water environment in the economic development zone covers a large area, including a large number of agricultural production bases and aquaculture sites. However, agricultural production waste is not properly treated and is piled up in large quantities around the water bodies, and many agricultural production wastes are directly dumped into the water bodies, causing river blockages. The collection and treatment facilities for manure and sewage in aquaculture sites are incomplete. Livestock and poultry breeding wastewater and aquaculture tail water are directed to ditches through privately set hoses. Aquaculture waste is piled up randomly beside ditches and ponds for a long time, affecting the surrounding water bodies.

(6) There are too many water bodies of Class V or worse

Through the establishment of monitoring sections, it was found that the water quality in places such as west of Chihu Road Bridge, east of Bridge, Huanggang Village, south bank of Sanban Bridge on Chihu Canal, and Direct Discharge Sanqu Pumping Station reached worse than Class V (pollution level exceeding Class V).

3. Strategies and Measures for Water Environment Treatment in the Economic Development Zone

The management of water systems is a complex and comprehensive task, especially in economic development zones where the treatment of water environment is particularly crucial. The primary strategy should be to focus on the governance and restoration of the water environment, while formulating flexible measures based on local conditions. Below, we will elaborate on the specific strategies and measures that the economic Development Zone has adopted in water environment governance and restoration, and analyze them one by one.

3.1 Water Environment Governance

For water environment governance, a strategy of "overall planning and classified measures" has been adopted, with a focus on two major measures: one is to eradicate black and odorous water bodies, and the other is to improve the efficiency and quality of sewage treatment. Specifically, the key tasks include intercepting sewage along rivers, clearing river silt, inspecting and repairing drainage networks, diverting rainwater and sewage pipes and correcting incorrect connections, tracing and rectifying discharge outlets, treating urban and rural domestic waste and agricultural non-point source pollution, as well as expanding sewage treatment plants and renovating pumping stations. On the basis of effectively controlling and cutting off pollution sources and treating internal pollution, enhance the collection and treatment capacity of sewage in the economic development zone.

(1) Conduct a comprehensive survey of pipe networks, restore and rebuild pipe networks with problems or defects. The underground pipe network system in the economic development zone is complex, with many old residential areas and self-built houses, and many sweet water pipes are mixed with drainage pipes, resulting in serious misconnection. This misconnection is a key factor causing domestic sewage to be wrongly discharged into natural water bodies through stormwater pipes. To improve this situation, a comprehensive inspection of the planned built-up area is needed. In addition to the previous census of municipal and district pipe networks, a comprehensive inspection will be carried out on the blank areas of the municipal main pipe network and the internal branch pipe networks of enterprises and residential areas beyond the completed 1,470 km of drainage pipeline detection and 973KM of internal inspection, including all supporting rain and sewage pipe networks in main and secondary roads, back streets and alleys, old communities and residential areas. This means a comprehensive and detailed "physical examination" of the underground pipe network in these areas to ensure that rainwater and sewage can be properly separated and to avoid further pollution to the environment.[1]

(2) Conduct a thorough investigation and rectification of the illegal drainage outlets one by one, and start a comprehensive investigation and rectification of the drainage outlets along the black and odorous water bodies. Based on the data obtained from the pipe network inspection, a series of

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measures will be taken to classify and manage the pipe network. These measures include, but are not limited to, the diversion of rainwater and sewage, the strict investigation and punishment of illegally connected drainage outlets, the implementation of gate control and renovation projects, and the rectification of incorrect connection and mixed discharge points. Through these combined measures, the stormwater and sewage outlets are comprehensively optimized to effectively prevent domestic sewage from being directly discharged into water bodies, thereby reducing the pollution of the water environment.

(3)Implement river dredging projects to remove sediment and pollutants from the riverbed, restore the natural purification capacity of the river, update and statistically analyze the inspection results uniformly, and enhance awareness of standard management of the river ; Build pumping stations, and through the regulating effect of pumping stations, optimize the flow and circulation of water bodies to prevent eutrophication and dead water; Build or expand sewage treatment plants to enhance the centralized treatment capacity of sewage, ensure that the discharged water quality meets environmental protection standards, and reduce pollution to natural water bodies.[2]

(4) Rectify urban and rural domestic waste, build garbage transfer stations, implement harmless garbage treatment projects, further enhance the collection, transportation and treatment capacity of urban domestic waste, improve the rural garbage collection, transportation and treatment system, and fully achieve incineration treatment of domestic waste; To control agricultural non-point source pollution, implement the project to reduce the use of chemical fertilizers and pesticides, promote new soil testing and formula fertilization technology, replace chemical fertilizers with organic fertilizers, popularize green pest control technology, achieve zero growth in the use of chemical fertilizers and pesticides, use transplanting and mechanical transplanting techniques, and gradually reduce direct seeding of rice; We will implement comprehensive control of livestock and poultry manure, strengthen the management of no-farming zones, ensure no new large-scale farms are added in no-farming zones, close farms have no rebreeding behavior, strengthen the supervision of the operation of livestock and poultry manure treatment and utilization facilities, eliminate illegal discharge, continue to carry out resource utilization of livestock and poultry manure, promote the treatment of aquaculture tail water, and promote the management model of artificial composite wetlands. Prohibit the direct discharge of aquaculture tail water into rivers and lakes.[1,3]

(5) Improve the urban ecosystem, reduce sewage discharge from the source, restore the water environment ecology, increase the area of green Spaces in the economic development zone, such as parks and green belts, to enhance the natural purification capacity of the city, and apply the core concept of "sponge city", that is, effectively manage stormwater runoff and reduce non-point source pollution by building green infrastructure, Carry out the sponge transformation and upgrading of old residential areas in urban areas and the strengthening and modernization of infrastructure in urban renewal projects.

(6) Carry out special law enforcement on water environment, improve relevant laws and regulations, implement the management of domestic sewage drainage permits in combination with water quality monitoring,strengthen drainage supervision, eliminate illegal and disorderly connections and discharges from the source, and continuously investigate, spot-check,manage and rectify drainage in various industries.[3]

3.2 Water Ecological restoration

After water environment governance, we also need to restore it, based on "scientific planning, active protection, treatment and compensation",and promote ecological restoration through measures such as active water, water protection, pollution control and compensation.

(1) Scientifically carry out ecological water diversion and replenishment in the Yangtze River Basin, build artificial wetlands, accelerate the construction of mountain, water, forest, field, lake, grass and sand projects, carry out water system dredging and improvement in Qizhi Canal, Qingshui Canal, Wuchang Canal, Beigang River, Nangang River, Baixing Canal, Wangjiagang Canal, Beigang area, etc., restore and build new box culverts and control gates and other water system connection projects

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Increase ecological water replenishment channels, build an ecological conservation system in the park, strengthen the management of water in building foundation pits to prevent external water and natural water bodies from entering the sewage network.[1,2]

(2) In order to establish an efficient water system protection management system, a thorough investigation and organization of water resources in the economic development zone will be carried out. In this process, closely combined with the urban land development and utilization planning and the actual needs of flood control and drainage and water system interconnection, accurately identify the water system resources that should be retained and utilized, as well as the water system network to be newly built, thereby optimizing and improving the urban water system layout. Based on this, the functional positioning of various water bodies is scientifically defined, and detailed planning and layout of water areas, water quality conditions, water ecological environment and waterfront landscapes are carried out. This includes defining the water level benchmarks for river basins and inland waterways, designing the interconnection paths between water bodies, and planning the corresponding control facilities. Within the framework of the master plan, clearly define the areas and set clear protection standards and control indicators for the areas in subsequent detailed control plans. Strictly enforce these control requirements during the implementation of the plan and project approval to ensure the effective implementation of the plan. For water resources, a detailed classification and graded protection strategy is implemented, and untreated sewage and garbage are strictly prohibited from entering water bodies. In the controlled areas, actively promote green planting to build a green ecological protection barrier.[3] Through these measures, a scientific, reasonable, efficient and orderly water system protection management system will be established to provide a solid water resource guarantee for the sustainable development of the city and the high- quality life of the residents.

(3) Strengthen industrial pollution control, fully implement the industrial enterprise inspection project, comprehensively inspect the current status of pipe networks, rectify and repair misconnections, and regularly strengthen supervision to ensure that wastewater from water-related industrial enterprises is discharged up to standard. Carry out the inspection and rectification project of rain and sewage pipe networks in industrial parks, accelerate the transformation of mixed and wrongly connected domestic sewage pipe networks, pipe network renewal and damage repair, and promote the transformation of rain and sewage diversion; Further improve the supervision mechanism for the collection and treatment of industrial wastewater, work in conjunction with sewage treatment plants, regularly compare water usage and drainage, build facilities for the collection and treatment of initial rainwater and emergency sewage, start submersible sewage pumps half an hour before rain or during emergency plans, and pump the collected initial rainwater or abnormal water bodies to sewage treatment plants for treatment and discharge after meeting standards.

(4) Implement pilot projects for ecological compensation and establish and enforce the principle of "compensation by beneficiaries, compensation by damages, and rewards for protection actions". This system aims to clearly define the rights and responsibilities of the implementers of ecological protection actions and the beneficiaries of environmental protection results, and to fairly define the means of compensation and the areas it covers. At the same time, efforts are made to build and improve the institutional framework and communication and collaboration platform for ecological protection compensation to promote the formation of a mechanism where the beneficiaries of environmental protection bear the costs, the executors of protection actions receive appropriate rewards, and all parties work together to maintain the ecological environment.[3]

4. Effectiveness of Governance

Through a series of measures, water pollution in the Economic Development Zone has been greatly improved, and the water ecology is gradually recovering. Under the water quality monitoring of 29 surface water sections in the Economic Development Zone, black and odorous

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water bodies have been basically eliminated. Water bodies such as the Xigan Canal and the Chi Lake Canal have been upgraded from Class V to Class IV. The Economic Development Zone has carried out source tracing and rectification of discharge outlets in different areas. A total of 51 discharge outlets have been rectified in the Economic Development Zone. Through the approach of leading by example and advancing step by step, All six outlets are now "open" and operating normally, covering an area of 89 hectares. 75% of the outlets have been rectified. The problem of enterprise pipe network diseases has been significantly reduced, and the enterprise wastewater treatment rate has reached 100%. The water ecological environment of the Yangtze River has been gradually restored, vegetation coverage has increased, and rainwater and sewage separation transformation projects have been implemented. The defects in the pipe network have been repaired to ensure the smooth operation and safety performance of the drainage system, effectively prevent improper infiltration of external water sources such as groundwater, thereby increasing the volume of water entering the sewage treatment plant and its pollutant concentration, and significantly improving the urban sewage collection efficiency. While making all-out efforts to treat black and odorous water bodies, the economic development zone steadily advances the comprehensive improvement of the water environment, Continuously upgrade and strengthen the urban drainage network system. By building a smart drainage supervision system, intelligent and refined drainage management has been achieved, taking the pulse of urban water environment health.[2] In order to regulate drainage behavior, a drainage permit issuance scheme was designed, and the supervision process and daily management of the drainage permit were improved to ensure that every drop of water discharged was legal and compliant, effectively guaranteeing water quality safety. In addition, a long-term mechanism for water body inspection and maintenance has been established, as if a professional "guardian" has been provided for urban water bodies, ensuring that water body problems can be detected and resolved promptly. This series of measures together build a solid barrier for the ecological base flow of urban water bodies, laying a solid foundation for the sustainable development of the urban water environment[1,3]. From the upgrading of infrastructure to the overall improvement of management capabilities, the economic development Zone has achieved remarkable results in water environment governance, and the urban water environment has taken on a completely new look, truly achieving a beautiful transformation from "black and odorous" to "clear and bright".

5. Conclusion

Through the two years of water environment governance from 2023 to 2024, the water system governance in the economic development Zone and the Yangtze River Basin has achieved initial results. Various water problems have been effectively alleviated, significantly reducing their impact on residents' daily lives and urban operations. But the effort does not stop at ecological restoration and environmental improvement, but rather focuses on water resource management, water security and comprehensive planning of water-related infrastructure, aiming to create a natural water system environment with self- regulation and storage capacity. The plan not only focuses on the present but also looks to the future, starting from the small details and gradually expanding to the entire river basin. It requires starting from small things, such as building ecological embankments, optimizing rainwater collection systems, and strengthening water quality monitoring networks, each measure aimed at enhancing the resilience and self-recovery of the city's water environment. Through this local- to-whole strategy, the economic development Zone is steadily moving towards a local area with abundant water resources, stable water security and complete water-related facilities. In the future, we will continue to explore new ways to deal with various water pollution problems, adhere to the principle of "overall planning and classified measures" to promote water environment governance, and at the same time apply the comprehensive basin management strategy of "scientific planning, active protection, treatment and compensation" to provide valuable practical examples and guiding ideas for the protection and restoration of water systems in other regions.

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References

[1] Jing Yuanyuan, Ma Nian, Chen Jie. A Brief Discussion on Water System Environmental Governance and Ecological Restoration in an Ancient City [J]. Urban Road, Bridge and Flood Control, 2014(11):122-125.

[2] Li Sen, Wang Tao, Zhang Qunhua, et al. Design and Practice of Comprehensive Water Environment Management Project in the eastern part of Songzi City [J]. Environmental Ecology, 2023,5(11):107-114.

[3] Pan Hui. Research on the Construction of Water Ecological Compensation Mechanism in the Yangtze River Basin [J]. Water Resources and Hydropower Express, 2023,44(12):82-87.