

# Research on the Integration Method of Water Function Zones and Control Units

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**Abstract:** Through studying the technical method system of integrating water function areas and control units, it is used to guide the pilot areas to carry out the pilot work of integrating water function areas and watershed control units. Through the pilot areas, the differences and problems between water function areas and the current water ecological environment management system are further clarified, and the problem of the inconsistency between the two management systems of water function areas and control units for surface water environmental quality is explored. This lays the foundation for optimizing and constructing a unified national water ecological environment management zoning system.

**Keywords:** Water Function Zone; Control Unit; Assessment System; Management System Integration

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## 1. Introduction

### 1.1 Research Progress at Home and Abroad

#### 1.1.1 Research Progress on Water Function Zones

As early as 1965-1967, the United States conducted functional division of most domestic waters. That is, firstly, the water body is divided into functional zones, including industrial water use zone, recreational water use zone, urban water use zone, fish and wildlife water use zone, rural water use zone, and mixed zone, and then the water quality standards for corresponding functional zones are formulated. When dividing water (environmental) functional zones, the United Kingdom considers both direct receiving water bodies and final receiving water bodies of sewage. When the water body has multiple functions and uses, the principle of high-function protection is followed, and the water quality requirement with the highest standard is taken as the protection target. In the mid-1980s, various river basin agencies and relevant local water conservancy and environmental protection departments cooperated to carry out the water resource protection planning of the seven major river systems, and identified water function and division as an important content of the planning. In the National Technical Outline for Water Function Division formulated by the Water Resources and Hydropower Planning and Design Institute of the Ministry of Water Resources in 2000, a two-level system water function division method was proposed. In terms of classification system, it focuses more on the integrity characteristics of water resources as a basin unit, which solves the contradiction problem of single-level system division results and is more in line with the needs of China's current water resource protection and water environment management.

#### 1.1.2 Research Progress on Control Units

The main purpose of dividing control units is to decompose complex water environment problems into individual control units. There are three main methods for dividing control units based on hydrological units, water ecological zones, and administrative districts. The control unit division based on hydrological units was first applied to the largest daily load total plan in the United States. It is based on the hydrological unit map drawn by the United States Geological Survey (USGS) and is divided according to the catchment characteristics of the basin. The purpose is to use the divided control units to solve

complex water pollution problems. The control unit division based on water ecological zones was proposed by Meng Wei et al. The main idea is to divide the watershed and its water bodies into different spatial units based on the water ecological zones of the basin, according to the differences and similarities of environmental factors, water ecosystem characteristics, and ecological service functions in different regions. The control unit division based on administrative districts refers to the division based on the theory of watershed management and administrative district management, taking full account of the characteristics of water bodies, water systems, water environment, and other factors, combined with administrative divisions. By solving the water environment problems within each unit and handling the relationship between units, the purpose of watershed water environment management can be achieved.

## **1.2 Research Purpose and Significance**

It is of great significance to study and solve the coordination and integration of water function areas and land control units, implement the optimization of water function areas in the overall planning of water and land areas, construct a unified water ecological environment management zoning system, monitoring system, and assessment system, carry out research on the integration of water function areas and water environment control units, and pay attention to the coordination of land pollution control and water function management in the adjustment of water function areas, which can provide support for strengthening the comprehensive and coordinated management of the ecological environment in water function areas.

## **2. Integrate Technology Method System Construction**

### **2.1 Association between Water Function Zones and Control Units**

Application ArcGIS The software imports and calibrates the vectorized layers of water function zones and control units. Taking the water function zones as the benchmark, it sequentially searches for related control units in space. arcgis—arctoolbox. The spatial connection tool in ArcGIS Pro connects the attributes of control units to the attributes of water function zones based on spatial relationships. Define the target feature as the water function zone, the connected feature as the control unit, and transfer the attributes (name) of the connected feature to the output feature class. If multiple connected features with the same spatial relationship to the same target feature are found, the field mapping merge rule will be used to aggregate the attributes in multiple connected features.

### **2.2 Optimization and Adjustment of Water Function Zones**

Functional areas that straddle county-level administrative districts should first be split across counties to meet the management requirements of functional areas based on county-level units. Due to administrative division adjustments, functional areas can be split, merged, and so on based on the current administrative boundary. After adjusting the scope of river-based water functional areas based on the administrative boundary of the county, the spatial correlation attributes of the water functional areas and control units are compared based on spatial correlation methods to analyze the degree of matching and identify problems.

## **3. Typical Regional Applications**

Selecting Xuzhou City, Jiangsu Province as a typical area, and combining the water ecological characteristics, natural conditions, and socioeconomic status of the typical area, carry out demonstration of the integration of water function zones and control units. Based on the relationship between water and land response, combined with administrative divisions, refine the division of control units and adjustment of control sections on the basis of national control units.

### **3.1 Basic Information of Typical Areas**

Xuzhou City is located in the northwest of Jiangsu Province, at the junction of four provinces of Jiangsu, Shandong, Henan and Anhui. It is adjacent to Lianyungang and Suqian in the east, Suzhou City in Anhui Province in the south, Shangqiu City in Henan Province in the west, and Jining, Zaozhuang and Linyi in Shandong Province in the north. It has jurisdiction over 5 counties (cities) and 5 districts, namely Fengxian County, Peixian County, Suining County, Pizhou City, Xinyi City, Tongshan District, Jiawang District, Gulou District, Yunlong District, and Quanshan District, with a land area of 11,258 square

kilometers.



Figure 1 Location Map of Xuzhou City

### 3.2 Typical Regional Division Results

The total proportion of the optimization and integration treatment plan for the Xuzhou raw water functional zone system is 52.4%, with 22.2% of the functional zones merged, 20.6% of the water functional zones having their names optimized, 6.3% of the functional zones deleted, and 1.6% of the water functional zones split.

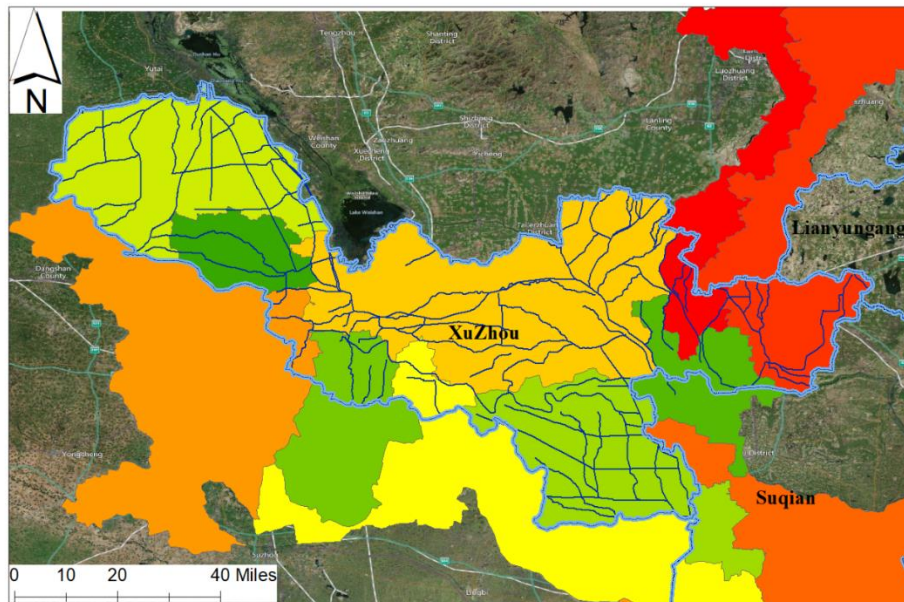


Figure 2 Integration results of water function zones and control units in Xuzhou City

## 4. Discussion and Suggestions

### 4.1 Unified Management of Functional Areas

The existing water function zones cover unevenly distributed waters, and there is an urgent need to unify the understanding and adapt it to the actual management needs. The first water function zoning was carried out under the

organization and guidance of various river basin agencies. At that time, there was no experience in the administrative management of water function zoning, and each local area also carried out zoning according to the different requirements and standards of various river basin agencies and local areas, resulting in some areas with dense water systems and some areas with sparse water systems. After nearly 20 years of management practice, the understanding of water function zoning in various regions has gradually deepened. This zoning plan aims to unify the standard for waters included in the provincial water function zoning, and supplement and improve it in combination with the actual management situation of the local area, in order to solve the contradiction between zoning and the actual management situation.

## 4.2 Unify with the Water Quality Assessment System

Due to the fact that the original water function zones and water environment quality assessment are under the jurisdiction of two administrative departments, namely the Ministry of Water Resources and the Ministry of Environmental Protection, there are inconsistencies in the assessment of the two systems, including unit boundaries, assessment indicators, assessment sections, and goals. It is necessary to focus on the integration of the two systems and optimize the unified water ecological environment management zoning system.

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