

# Study on Flood Control Evaluation of a Water Conservancy Project in the Yellow River Basin

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## Abstract

**Flood control evaluation is an important guarantee for the safety construction of water conservancy projects. Based on the analysis of the basic situation of the Longmen section of the Yellow River Basin, this article analyzes the flood control design flood flow, backwater, and scouring capacity of a certain water conservancy project in the Longmen section of the Yellow River Basin. The results show that the characteristics of the river channel will not be changed, so the project will not have an impact on the implementation of the siltation plan for the Xiaobei Main Stream of the Yellow River, Provide case validation for flood control evaluation work.**

## Keywords

**The Yellow River Basin; Engineering Construction; Water Conservancy Engineering; Flood Control Evaluation.**

## 1. Introduction

Due to historical and natural conditions, the economic and social development of the Yellow River Basin is relatively lagging behind, especially in the upper and middle reaches and downstream tidal flats, which are relatively concentrated areas of poverty in China. Actively supporting provinces and regions in the basin to win the battle against poverty and solve the flood control safety, drinking water safety, ecological safety and other issues of concern to the people of the basin, especially ethnic minorities, is of great significance for maintaining social stability and promoting ethnic unity Yi.

The current situation of wharfs along the Yellow River in Hejin City is basically manifested as: lack of necessary infrastructure, some equipment is aging, and the transport capacity is poor, which cannot meet the requirements for safe parking, only some simple steps or roads to the river are built, and the width and longitudinal slope and other parameters do not meet the specification requirements, and there is no slope protection structure; The personnel on board the ship and the place where the ship docks are on natural bank slopes, with steep slopes and slippery roads, posing great safety hazards. However, convenient transportation terminals have long played an important role in rural transportation, with strong demand for ferry and short distance passenger transportation. As a component of rural transportation, they will still exist for a considerable period of time. Facing the current situation of backward docks, especially under the overall goal of building a moderately prosperous society in all respects, completing the construction of the Longmen Convenient Transportation Green Dock project as soon as possible is an important guarantee for leveraging the advantages of water transportation, improving people's water travel conditions, and ensuring people's travel safety. At the same time, it is also a concrete manifestation of the implementation of the Shanxi Province Transportation Power Construction Plan. Therefore, it is necessary to standardize the construction of Longmen Convenient Transportation Terminal and promote the integration of water transportation and tourism in the Yellow River. This article evaluates and analyzes the flood control design of a water conservancy project in the Longmen section of the Yellow River

Basin through relevant water conservancy calculations, in order to provide practical verification for flood control evaluation work.

## 2. Overview of the Project Area

The project area is located in the west of Longmen Scenic Area, Hejin City, Shanxi Province, about 272 m away from the upstream Houma–Xi'an railway Bridge, and about 230 m away from the downstream Yumenkou Yellow River Highway Bridge (G108). The location coordinates are  $110^{\circ} 36'11''$  E and  $35^{\circ} 39'31''$  N. The Yellow River Chuanwo to Longmen waterway is currently classified as a Class VI waterway and is planned as a Class IV waterway. The riverbed of this section can be divided into sandy and rocky beaches. With the launch of the waterway regulation project from Hukou to Yumenkou, the navigation conditions will be effectively improved. This section of water can meet the requirements for berthing and turning operations of ships. The proposed Longmen Wharf has a straight shoreline, stable bank slopes, no adverse engineering geological phenomena, and good natural conditions. The proposed Longmen Convenient Passenger Terminal is located immediately behind the Yellow River Highway, with convenient transportation and superior geographical location. Water, electricity, and communication for port construction can be connected from adjacent villages and towns, with convenient construction conditions. Due to the abundant construction materials in the local area, the use of earth-rock materials for port construction can be obtained locally. There are multiple shipping engineering construction teams in Shanxi Province, which can meet the needs of the port construction. The layout plan of "overhead stairway+overhead trestle" is proposed to be adopted for the Longmen Wharf, and Pile foundation is adopted. The total length and width of the single berth overhead staircase are 12.7 meters and 6 meters, respectively. The rear side of the elevated staircase is connected to the shore by an elevated trestle bridge, with a total length of 17.3 meters and a width of 6 meters. Based on the principle of focusing on the near and combining the far and near, it is planned to construct 2 passenger berths and reserve 1 working ship berth. The structure adopts a floating+sloping structure, with a designed throughput capacity of 960000 people/year and an occupied shoreline length of 106 meters.

## 3. Basic Information of the River Channel

The river course where the project is located belongs to Hejin, and the Yellow River basin involved includes Xiahua, Fancun, Qingjian three townships (towns) and a part of the Yellow River beach, with a drainage area of 307.7 km<sup>2</sup>, a flood volume of 7.304 million m<sup>3</sup> in normal year and 3.222 million m<sup>3</sup> in dry year. The total flood volume in the city is 13.769 million cubic meters in normal years and 5.853 million cubic meters in dry years. Longmen Wharf is located on the main stream of the Yellow River between Yumenkou and Huangyu 68 section, which belongs to the upper section of the Xiaobei main stream of the Yellow River (Yumenkou to Tongguan). Qingjianwan Bend Diversion Project is located in the west of Longmen Village, Qingjian Subdistricts of China, Hejin City, between the sections of Huangyu 67~68. It is adjacent to the No. 6 dam of Yumenkou Project on the top and the high cliffs of Shizui and Xiaoshizui on the bottom. The project is a pilot project with a total length of 2472 m. There are 20 spur dikes and 14 buttress dams. The dam crest elevation of the 0+000~2+765 section is 386.08~382.81 m, and the engineering design defense standard is 12700 m<sup>3</sup>/s flood at Longmen Station.

The section from Yumenkou to Tongguan is 132.5 km long, with a wide and shallow river channel and scattered water flow, belonging to a strongly accumulated wandering river channel. From a longitudinal perspective, the river channel has a steep gradient from top to bottom, ranging from 0.3 to 0.6 ‰, with an average of 0.4 ‰. The height difference of the beach channel is generally 0.5-1.5 meters. From a plane perspective, the river channel is alternating in width

and overall in a dumbbell shape, with a narrower middle and wider ends. The bending coefficient of the river channel is 1.12.

The Yellow River is the largest river in the city, flowing through a length of 35 kilometers. According to the long-term observation data of Longmen Hydrological Station (1988-1995), the average annual flow of the Yellow River is 731.81 m<sup>3</sup>/s. The flood season mostly occurs from July to September. According to previous data, the maximum peak flow during the flood season is 21000 m<sup>3</sup>/s, and the average annual flow is 4710-16400 m<sup>3</sup>/s, while the average flow during the dry season is 53.2 m<sup>3</sup>/s. According to observation data from 1970 to 1992, the sand content of rivers is greater than 100 kg/m<sup>3</sup> for 5-12 days of the year, mostly occurring in June, July, and August, with a multi-year average of 25.9 kg/m<sup>3</sup>.

According to the drilling data, the burial depth of groundwater in the site is 5.13-5.99 meters below the natural ground level, and the stable water level is expressed in elevation as 375.82-377.0 meters. Based on the lithology of the water-bearing medium, the groundwater type is loose rock pore water, and is classified as phreatic water according to the burial conditions of the groundwater. The groundwater in the site is mainly supplied by atmospheric precipitation infiltration and lateral runoff of the Yellow River water, and the groundwater discharge mode is mainly lateral runoff and atmospheric evaporation, The groundwater flows westward to eastward, and the annual variation of water level is 3-5 meters.

#### 4. Flood Control Works

Flood control projects mainly exist downstream of Longmen Hydrological Station, among which the flood control projects on the left bank (Shanxi) of the Yellow River main stream from Yumenkou to Fenhe River estuary section include Yumenkou project, Qingjianwan diversion project, Qingjianwan project, Dashizui project, Xiaoshizui project, Fenhekou project, Xifan project, Xifan control and diversion downstream extension project, Miaoqian project, and Chengnan project. Engineering can be divided into control and navigation engineering and bank and beach protection engineering. The defense standard is: the control and guidance engineering generally follows a local flow rate of 4000 meters<sup>3</sup> / Designed with a flow rate of s-5000 m<sup>3</sup>/s, some control and guidance projects with key protective effects are designed with a 5-year return period (equivalent to a flow rate of 12700 m<sup>3</sup>/s at Longmen Station); The revetment project is designed for a 20-year return period (equivalent to a flow rate of 20000 m<sup>3</sup>/s at Longmen Station), and the revetment project is level with the beach surface.

#### 5. Flood Control Impact Assessment

The Guxian Water Conservancy Hub planned and constructed by the ladder is approximately 93.4 km upstream of the Longmen Project. Due to the long distance, the construction of this project does not conflict with the planning and implementation of the Guxian Water Conservancy Hub, and will not have any adverse impact on the planning and implementation of the Guxian Water Conservancy Hub. The Ganzepo Water Conservancy Hub project under planning and construction is located in the lower section of the Dabei Main Stream of the Yellow River, 2.5 kilometers away from Longmen Hydrological Station, and then moved up to the vicinity of Tonggeling Wharf, approximately 26.8 kilometers away from Longmen Project. The construction material preparation site for the Yumenkou Water Conservancy Project is located about 21.8 km upstream of the Longmen Project, and is not included in the project construction. Therefore, there is no contradiction between the project and the planning and implementation of the Yumenkou Water Conservancy Project, and it will not have adverse effects on the planning and implementation of the Yumenkou Water Conservancy Project. The Longmen Wharf project is located on the left bank beach at the beginning of the Xiaobei Main Stream of the Yellow River, mainly serving the navigation of the Yellow River and facilitating the

implementation of shipping planning. The construction of the project will generate relatively small backwater and will not change the characteristics of the river channel. Therefore, the project will not have an impact on the implementation of the siltation plan for the Xiaobei Main Stream of the Yellow River.

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