

**Key Issue:**

**6-Reservoir Impoundment**

1-Biological diversity

**Climate Zone:**

Cf: Temperate Humid Climate

**Subject:**

- Marshland Conservation Measures

**Effect:**

- Conservation of the Marshland



Numappara Upper Pond and  
Miyama Lower Reservoir

**Project Name:** Numappara Pumped Storage Power Plant

**Country:** Tochigi Pref., Japan (Asia)

**Implementing Party & Period**

- **Project:** Electric Power Development Co. Ltd. (J-POWER)  
1970 (Commencement of construction) -

- **Good Practice:** Electric Power Development Co. Ltd. (J-POWER)  
1970 -

**Keywords:**

Marshland Conservation, Scientific Investigation, Specialist, Balancing Reservoir

**Abstract:**

Since the scheduled site for upper balancing reservoir construction for the Numappara Power Plant included a marshland, there was a concern that the construction of a dam may lead to the disappearance of the marshland. However, the measures taken based on the result of a scientific investigation by specialists, including the reduction of the size of the balancing reservoir and proper maintenance of the water level in the marshland, contributed to the success in marshland conservation.

**1. Outline of the Project**

The Numappara pumped storage power project used the Miyama Dam (constructed by the Ministry of Agriculture, Forestry and Fisheries) located upstream of the Nakagawa River as the lower balancing reservoir and the Numappara Balancing Reservoir located on a plateau to the east of the Miyama Dam as the upper balancing reservoir to make use of the 500 m head between the two reservoirs for power generation. The project was planned and carried out by Electric Power Development Co. Ltd. and the operation of the power plant started in 1973. The upper balancing reservoir, which is about 500 m on all four sides, was constructed by excavating the plateau. Since the plateau has ground of permeable volcanic sediment, asphalt facing was used on the entire surface.

The project site for the Numappara Power Plant was located within the Nikko National Park and the plateau on which the upper balancing reservoir was constructed was partially located in an area designated as the first class special zone. Since an elevated marshland called the Numappara Marshland was located next to the scheduled site for upper reservoir construction, full attention was needed for the conservation of the marshland. Moreover, the entire area of the project site was covered by national forests and the regional forest office had already formed a plan to use the forests. Project planning and construction, therefore, included consideration of these issues.

Table 1 Specifications of the Numappara Balancing Reservoir

Item		Specifications
River system		Naka River
Catchment area		---
Power Plant	Name	Numappara Power Plant
	Maximum output	675 MW
	Maximum discharge	172.5 m <sup>3</sup> /s
	Normal effective head	478.0 m
	Maximum lift head	528.0 m
Upper Balancing Reservoir	Type	Excavated, asphalt facing
	Maximum embankment height	38.0 m
	Crown circumference	1597.0 m
	Total reservoir capacity	4.34×10 <sup>6</sup> m <sup>3</sup>
	Effective storage	4.22×10 <sup>6</sup> m <sup>3</sup>
	Available depth	40.0 m

## 2. Features of the Project Area

The Numappara pumped storage power project site that includes the Miyama Dam as well as the entire power plant is located within the Nikko National Park. The area lying to the east of Numappara Balancing Reservoir is the center of the Nasu volcanic zone that includes Mt. Chausudake (1917 m). The area, centering around the active, dome-shaped volcano which is still smoking, is a major tourist spot with mountain paths, a ropeway, a skiing slope and mountain foot hot springs and vacation homes.

The plateau called Numappara, the planned site for upper balancing reservoir construction, has an area of approx. 1 km<sup>2</sup>, with a marshland extending from the center to the north of the plateau.

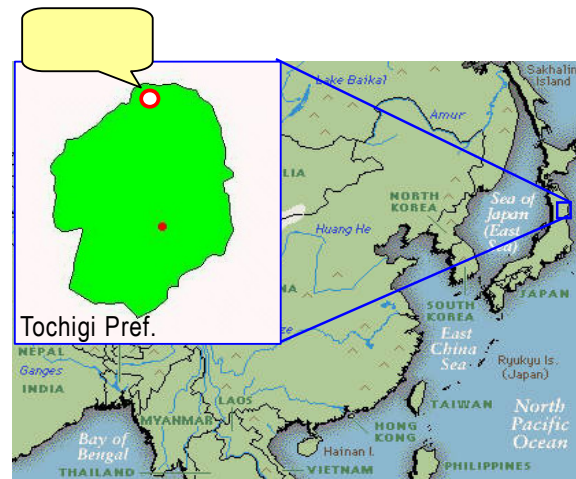


Fig. 1 Location Map

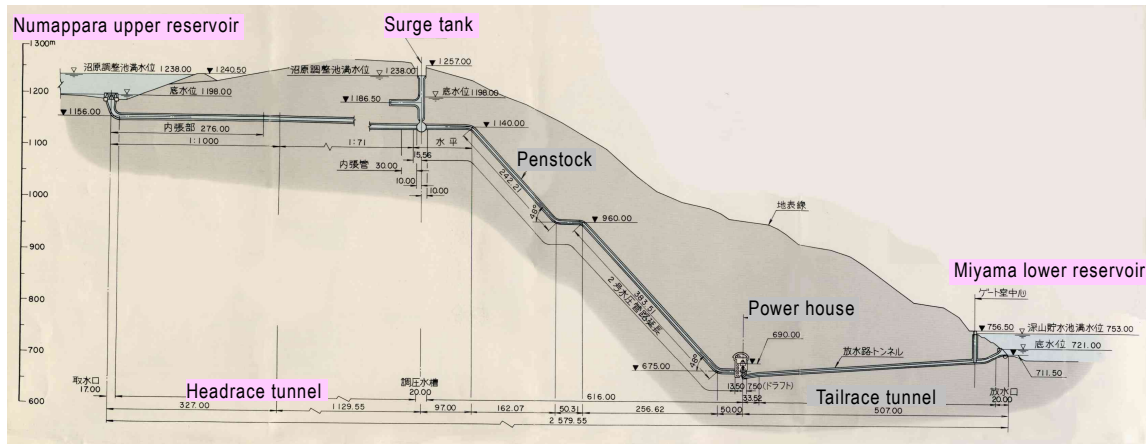


Fig. 2 Profile of the River Channel

This Numappara Marshland is a shallow, mountain slope marshland with a peat layer. The marshland, with a relatively small area surrounded by shrubs, is a home to *Sphagnum papillosum* Lindb., *Sphagnum robustum* (Russ.) Roll, dew grass and other mosses, and a number of gregarious marsh plants including *Filipendula multijuga*, white hellebore, day lily and iris ensata.

An attempt was made during the 1940s to plant Japanese larches on this marshland for the purpose of increasing lumber production, and this included the construction of a drainage channel to dry the marshland.

This caused the disappearance of *Sphagnum* moss from the marshland. The tree planting proved a failure, and dead Japanese larches were left untouched. However, by the time the pumped storage power project was planned, the marshland environment had been on the way to recovery: the water level had returned to normal and the spots covered by *Sphagnum* moss had gradually been expanding.

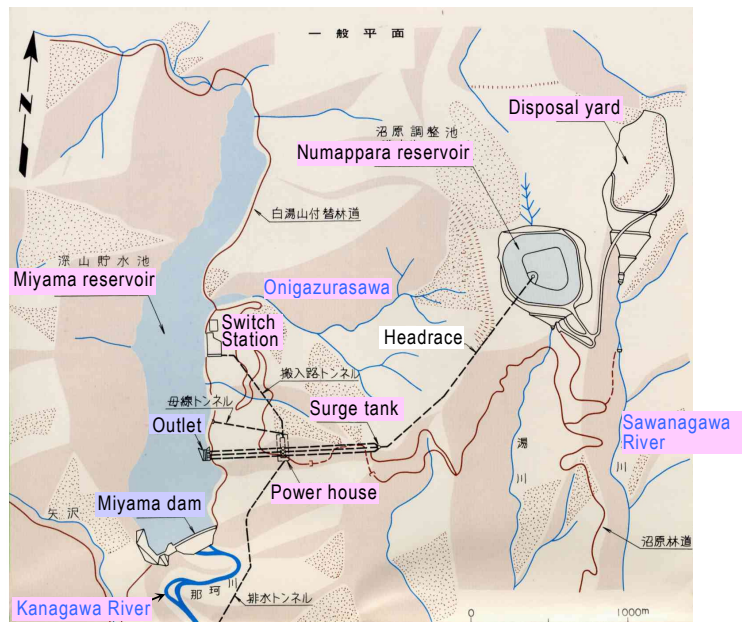


Fig. 3 Plane View of the Area Around the Power Plant

### 3. Major Impacts

To protect and use the national park, the Numappara Marshland and the right upstream bank of the Sawanagawa River next to the marshland are designated as the first class special zone

in the Nikko National Park. The Natural Parks Law requires the approval of the Minister of Health and Welfare for activities including the changes to the topography, collection of soil and stone, cutting of trees and bamboos and installation of structures within the first class special zone. This naturally necessitated prior approval from the Natural Park Council for the implementation of a geological survey

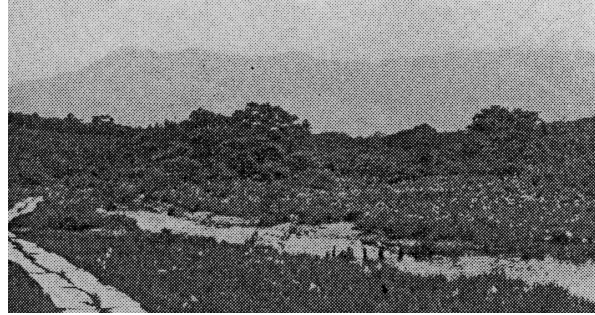


Photo. 1 Numappara Marshland

in the proposed site for balancing reservoir construction as well as for the formulation of a project plan.

Electric Power Development Co. Ltd. applied for approval for the geological survey to the then Ministry of Health and Welfare, and the National Parks Department to which the application was made presented questions regarding the protection and use of national parks to the Natural Park Council in September 1968. The council, while noting no particular problems regarding the drilling for the geological survey, pointed out three problems below, particularly regarding the construction of the upper balancing reservoir, a part of the Numappara Power Plant construction, for which a project application was expected in the near future.

- 1) The Numappara Marshland leading to the direction of Mitogoya is renowned for its natural beauty and it is deeply regrettable that the nature around the area might be destroyed.
- 2) While the amount of soil to be generated from the excavation of the upper balancing reservoir was estimated to be 5.2 million m<sup>3</sup>, the area to be needed for the disposal of excavated soil was estimated to be 370,000 m<sup>2</sup> in the upstream of the Sawanagawa River. This may damage the landscape in the area, and measures must be taken, for example, regarding landscape adjustment, natural restoration, greening and the safety from waste soil.
- 3) Although the shape of the upper balancing reservoir is almost a square, creating a shape that blends with the surrounding natural landscape is preferable.

In consideration of these points above, the Ministry of Health and Welfare granted approval for the geological survey of Numappara to Electric Power Development Co. Ltd. on the condition that a scientific investigation be carried out regarding these problems. Electric Power Development Co. Ltd., with the intention to carry out the scientific investigation according to the conditions presented by the Ministry of Health and Welfare, commissioned the work to the Natural Conservation Society of Japan.

The commissioned Natural Conservation Society of Japan carried out the investigation of Numappara using specialists in the following fields, first during October 24 and 26, second during November 11 and 13 and third during November 23 and 25 in 1968. The investigation team presented an interim report on February 29, 1969.

Table 2 Organization of the Investigation Team

Members	Responsibilities
Team Leader	
Group No. 1 (Group leader and five staff members)	1. Landfill method for the waste soil disposal site 2. Selection of plant species suited for greening 3. Planting method 4. Other
Group No. 2 (Group leader and four staff members)	1. Present state of the marsh ecosystem 2. Investigation of the water level in the marshland 3. Marshland conservation measures 4. Other

#### 4. Mitigation Measures

Based on the result of the investigation mentioned above, Electric Power Development Co. Ltd. partially revised the Numappara pumped storage power project plan and applied for approval for new construction of structures within the first class special zone in the Nikko National Park to the Minister of Health and Welfare on March 10, 1969, and was granted approval on August 19 of the same year. Marshland conservation measures included the following.

##### 1) Reduction of the size of the balancing reservoir

Although it was more advantageous for the pumped storage power project to increase the size of the upper balancing reservoir to a maximum, it was detrimental to the conservation of the marshland and the landscape to excessively increase the height of the landfill at the dam relative to the elevation of the marshland. These circumstances led to the reduction of the capacity of the balancing reservoir and the use of excavation as the construction method.

##### 2) Shape of the balancing reservoir that includes consideration for the landscape

The elevation of the crown of the upper balancing reservoir was limited to a maximum of 1,240 m, in view of the landscape to be seen from the marshland, and the dam body on the marshland side was designed with a gentle incline (1:3), while the dam body on the other sides was designed with a steeper incline (1: 2.5).

##### 3) Prevention of water level reduction during construction

Since the construction of the Numappara Balancing Reservoir included ground excavation up to almost 30 m deep, this raised a concern that the excavation may reduce the water level in the adjacent marshland and affect the marshland vegetation. Sheet pile facing, approx. 350 m long, was therefore installed 10 m deep down to the impermeable layer, in order to prevent a reduction in the water level in the marshland.

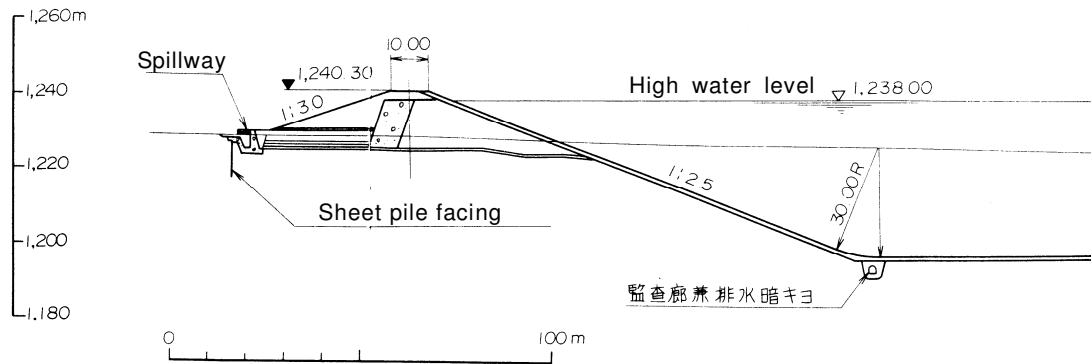


Fig. 4 Cross Section of the Upper Balancing Reservoir

#### 4) Maintenance of water level after construction completion

Since the marshland is located upstream of the upper balancing reservoir, there was a concern that the construction of the balancing reservoir may block the watercourse, causing the submergence of the marshland. A spillway was therefore built on the border between the marshland and the balancing reservoir in order to ensure the flow of the spill water from the marshland down the spillway. An intake was constructed at the foot of the dam body on the marshland side to ensure the flow of spill water through an approx. 400 m long tunnel to Onigazurazawa.

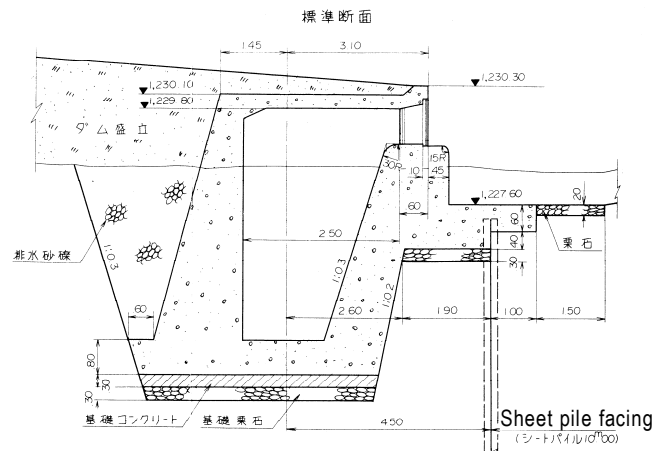
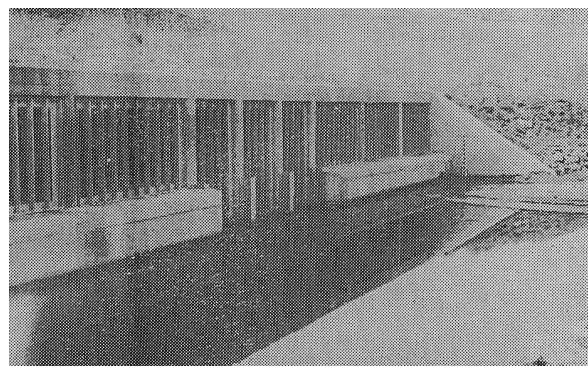


Fig. 5 Spillway Intake

To maintain the water level in the marshland prior to construction start and ensure the safety of spill water flow, the intake of the spillway was designed with three crests of different size.

### 5. Results of the Mitigation Measures

The Numappara Marshland had been drying up due to draining that was needed for the planting of Japanese larches when the construction started. However, measures taken to prevent a reduction in the water level in the marshland during the construction and to prevent an increase in the water level after





construction completion contributed to the success in the conservation of the marshland environment.

## 6. Reasons for Success

Based on the result of discussions between the Ministry of Health and Welfare and the regional forest office, project planning and construction gave priority to the conservation of the marshland.

With regard to the marshland conservation methods as well as landscape adjustment and greening methods after construction completion, an expert committee was formed to carry out a scientific investigation with the collaboration of the Natural Conservation Society of Japan.



Photo. 3 Present marshland

## 7. Outside Comments

<Kuroiso City's Homepage>

(<http://www.city.kuroiso.tochigi.jp/guide/kanko/numapara/numapara.htm>)

The Numappara Marshland, located at an elevation of about 1230 m and renowned as the home of alpine plants, is covered with rare plants including the day lily, iris, white hellebore, Filipendula kamschatica and Japanese azalea. Although the marshland has many attractions throughout the year, the best season is from the early to the middle of July when the area is covered with day lilies.

The marshland is well known as the place favorably and frequently visited by the late Emperor Showa, and recently has been visited by the reigning Emperor and Empress.

## 8. Further Information

### 8.1 References

- 1) "12. Conservation and Greening Measures", Hydroelectric Power Generation, November 1973
- 2) Electric Power Development Co. Ltd.: Construction Records of the Numappara Power Plant
- 3) Electric Power Development Co. Ltd.: The 30 Year History
- 4) Kuroiso City's Homepage,  
<http://www.city.kuroiso.tochigi.jp/guide/kanko/numapara/numapara.htm>

### 8.2 Inquiries

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