

The September 2024 Flood – Hydrological Analysis, Infrastructure Performance, and Consequences

Marta BARSZCZEWSKA and Mateusz BALCEROWICZ

The State Water Holding Polish Waters, Warsaw, Poland

✉ marta.barszczewska@wody.gov.pl; mateusz.balcerowicz@wody.gov.pl

Abstract

In September 2024, southwestern Poland was struck by one of the most intense floods in recent years. The main causes of the disaster were prolonged, torrential rains that occurred between 13 and 15 September, with daily totals locally exceeding 300 mm—several times above multi-month precipitation norms. The flood primarily affected the Odra River basin, and the resulting flood wave caused alarm levels to be exceeded on numerous water-courses. Retention reservoirs and dry polders played a key role in flood mitigation, including the Racibórz Dolny reservoir, the Buków polder, and the cascade of reservoirs on the Nysa Kłodzka River, which collectively retained significant volumes of flood-water, helping to prevent more severe damage in cities such as Wrocław.

Despite these efforts, the flood had serious consequences: 9 fatalities, more than 238,000 people affected, estimated damages exceeding PLN 13 billion, and widespread destruction of infrastructure. The flood had fluvial and pluvial characteristics and was accompanied by failures of hydrotechnical infrastructure. In most cases, the extent of flooded areas corresponded to zones outlined on flood hazard maps; however, in some locations (e.g., Głucholazy, Stronie Śląskie), events occurred beyond previously anticipated scenarios. The findings from this analysis will inform the update of the flood risk assessment as part of the third planning cycle.

1. INTRODUCTION

In September 2024, southwestern Poland was affected by one of the most extensive and intense flood events in recent years. The phenomenon included fluvial, pluvial, and partly technogenic flooding due to failures of hydrotechnical structures. This event constitutes an important reference point for future flood risk assessments in Poland and demonstrates both the capabilities and limitations of the current flood protection infrastructure under extreme conditions.

2. METEOROLOGICAL AND HYDROLOGICAL CONDITIONS

The flood was caused by torrential rainfall associated with Mediterranean low-pressure systems that brought extreme daily precipitation totals between 13 and 15 September, locally exceeding 200 mm. Monthly precipitation norms were exceeded several times in many locations – e.g., by over 450% in Jelenia Góra. As a result, water levels on rivers rose rapidly, triggering multiple instances of alarm level exceedances and fast-moving flood waves across the Odra and Vistula basins.

2.1 Flood dynamics

The peak of the flood activity occurred between 14 and 18 September. On 16 September, a record number of alarm level exceedances was recorded (81 locations in the Odra basin). The flood wave then propagated downstream, reaching successive towns and causing local inundations and damage. Notably, the peak flow of the Odra River did not coincide with the peaks of its tributaries, which helped reduce the flood risk in the Wrocław area.

3. ROLE OF FLOOD PROTECTION INFRASTRUCTURE

Flood protection reservoirs played a key role in mitigating the impact. The Racibórz Dolny reservoir retained 147 million m³ of water (197 million m³ of water including the Buków reservoir), while the cascade of reservoirs on the Nysa Kłodzka (Topola, Kozielno, Otmuchów, Nysa) collectively stored about 155 million m³. Additional support came from dry reservoirs (e.g., Buków, Stronie Śląskie) and six polder systems (e.g., Blizanowice-Trestno, Oławka). The coordinated operation of this infrastructure significantly limited the impact of the flood wave and reduced the threat to downstream urban areas.

4. IMPACTS AND DAMAGE

According to government estimates, total losses exceeded PLN 13 billion. The flood claimed 9 lives, affected more than 238,000 people, and led to the evacuation of nearly 4,500 residents. A total of 10,522 residential buildings and 814 socially significant facilities were inundated. Over 3,600 km of roads, 229 bridges and 1,823 culverts were damaged. Failures were also reported in the hydrotechnical infrastructure, particularly in the Stronie Śląskie and Topola reservoirs.

5. THE 2024 FLOOD AND FLOOD HAZARD MAPS

A comparative analysis of the actual flood extent versus existing flood hazard maps showed high predictive accuracy – in most cases, the inundated areas corresponded to 1% (1-in-100-year) or 0.2% (1-in-500-year) probability scenarios. Deviations were observed mainly in areas affected by infrastructure failures (e.g., Morawka, Biała Łądecka) or exceptional rainfall (e.g., Głuchołazy, Jelenia Góra).

6. CONCLUSIONS

The September 2024 flood revealed both the effectiveness and the limitations of current flood protection systems in Poland. The data and observations from this event are crucial for updating the Preliminary Flood Risk Assessment (PFRA), flood hazard and risk maps (FHRM), and for developing improved emergency management scenarios. The flood confirmed the urgent need for further modernization of hydrotechnical infrastructure, enhancement of early warning systems, and strengthening of community flood resilience.