FIELD TRIP INFORMATION

WIEPRZÓWKA AND STRYSZAWKA STUDY AREA

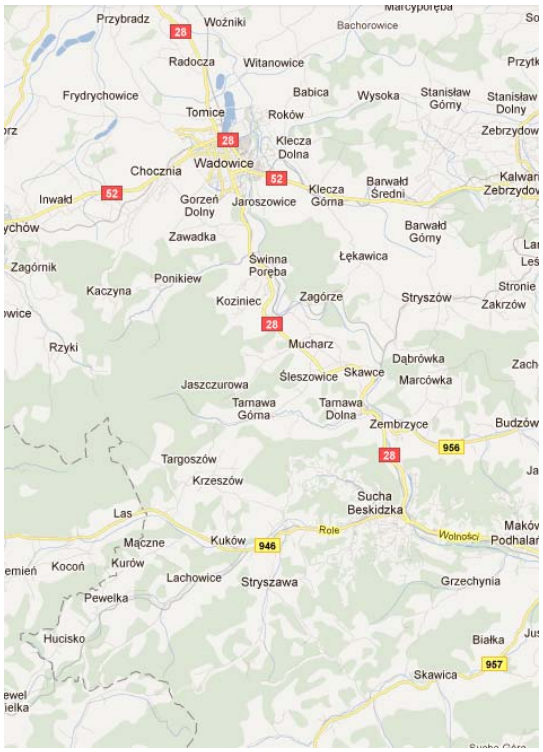
The Polish study area proposed for "CHANGES" research project is situated in southern Poland in Flysch Carpathians. More specifically it covers parts of two mountain groups Beskid Żywiecki and Beskid Mały as well as a part of Carpathian foothills in the north. The area has been named after two rivers: Wieprzówka (northern part) and Stryszawka (southern part).
Basic hydrological characteristics of both rivers are as follows:

Stryszawka:
catchment area – 139.5 km^2
Altitudes from 325 to 1111 m asl
Flow volumes in years 1971-90: NNQ – 0.17 m^3/s; WWQ – 103 m^3/s
Wieprzówka:
Catchment area – 154.4 km^2
Altitudes from 231 to 929 m asl
Flow volumes in years 1961-90: NNQ - 0.017 m^3/s; WWQ – 158 m^3/s

Administratively three municipalities cover almost the whole area i.e.: Stryszawa, Andrychów and Wieprz municipalities. Total number of inhabitants is 66 708.

Polish study area has been selected on different basis than three other study areas in Romania, Italy and France. Namely it was proposed due to the occurrence of floods and landslides, which causes in pair with a relatively high population density significant development problems. There is no research station in the area. Therefore less data is available than in other study areas. However it reflects development planning problems of landslide- and flood-endangered areas. Authors hope that visits to a few places described below will provide participants with instructive illustrations of these issues.

Map 1: Małopolska region and the route of the field trip



STOP 1

LACHOWICE LANDSLIDE

by Teresa Mrozek, Polish Geological Institute – National research Institute, Carpathian Branch, Cracow

Landsliding in Poland occurs mainly in the southern portion of the country in the area of the Polish Flysch Carpathian Mountains. More than 90 percent of all landslides occur within this area, which represents only 6 percent of the Polish territory. The area is part of the larger Carpathian thrust and fold range that stretches in an arc from Central to Eastern Europe. The Carpathian mountains were formed during the Alpine orogeny in the Mesozoic and Tertiary. The subdivisions along the arcuate mountain range of the Outer and Inner Carpathians are attributed mainly to structural, tectonic and lithologic differences resulting from geologic development. The external, generally northern, portion of the orogenic belt is know as a Flysch belt.

Flysch complexes include rigid porous sandstone layers resting on or interbedded with conglomerates, claystones, mudstones and shale strata. The flysch is often mantled with weathered material forming slope covers (clays, loams, silty sands and debris). Geologic setting, combined with physiographic features, hydrology, land use etc. are **determining causes** of landsliding. The **triggering causes** are meteorological and seismic events, yet the former are much more critical in Poland.

Village of **Lachowice** is located in western portion of the Polish Beskids, namely in the Beskid Makowski massif. The latter comprises NE–SW oriented mountain ridges separated by flat-bottom valleys of streams, being left tributaries of the Skawa river. The ridges surrounding the village do not exceed 645 m a.s.l. and only the highest hill – Opuśniak (819 m a.s.l.) – is an exception here. The valley of Lachówka stream descends to ca. 440 m a.s.l. This particular region is in northern part of the Magura nappe, ca. 3.5 km SE from the front of the overthrust. The ridge of Pierchałowa, is located in synclinal patch formed by Magura sandstones (glauconite facies) underlain by Zembrzyce shales (Sub-magura beds) and Variegated shales (Eocene). Unfortunately, the SW-facing slope of Pierchałowa Mt. was not perceived as landslide prone for many years and was settled (Zawodzie hemlet).

It was on 27 July 2001, when long-lasting and heavy precipitation (extreme recorded monthly totals), caused a spectacular slope failure and rejuvenation of an old **landslide**.
The new form developed in the SW portion of the Pierchałowa Mt., while rejuvenation occurred mainly in the NE portion, affecting the total area of ca. 11.7 ha (Photo 1).

Photo 1. Landslide in Lachowice - autumn 2001 (courtesy of W. Rączkowski, PGI)

The new landslide was delimited by an arcuate main scarp (roughly 1.5 m high) and by a steep (up to 7 m high) wall at the western lateral flank. The lateral cracks (1.5 m deep) formed at the north-eastern flanks and set the limits of a 10–20 m wide trough. Depleted rock and earth masses were transferred ca 60–70 m downslope within a dozen of minutes. The tongue dammed the Lachówka stream channel. The colluvial material was removed from the stream to preserve drainage, so a potential flooding was avoided.

The next phase of mass movements in this region was observed in the early spring of 2002, after sudden snowmelt by the end of January. Again, deformations were observed in many spots. The main scarp retreated ca 30 m uphill while the colluvium set in motion formed a 120-m long and 5-6 m high tongue. The still active slope processes stimulated additional examination of the landslide. In the following years (2004-2006) vertical and horizontal displacements were still observed, so the landslide dynamics was examined using various techniques of surface and subsurface monitoring. That helped to define the depth of sliding surface and rate of movement. Prices geodetic monitoring (GPS) showed that rate of horizontal and vertical displacement was decreasing. Inclinometer monitoring is still ongoing with the purpose of observing the landslide dynamics.

Although the mass movements in Lachowice did not result in any casualties, the structural damages were vast. In the first phase of landsliding 12 houses were completely damaged (Fot. 2) while next 38 were endangered. The entire affected region required reclamation – nowadays 2/3 of the area is reforested. The total cost associated with transferring infrastructure out of the landslide area and with mitigation measures exceeded 2.5 million PLN.

Such events like that in Lachowice have far-reaching consequences. Protection against natural disasters, including landsliding, becomes an ever increasing demand in a developed society. It requires identification of susceptible sites as well as reasonable mitigation or prevention measures derived from thorough understanding of hazardous processes and consensus to be reached local society and decision makers.

Photo 2. Landslide in Lachowice (spring 2002) - damaged houses (courtesy of W. Rączkowski, PGI)

STOP 2

ŚWINNA PORĘBA – DAM AND WATER RESERVOIR UNDER CONSTRUCTION

by Edyta Drożdżal and Agnieszka Piwowarczyk, Regional Water Management Body – Cracow Branch

The dam at Świnna Poręba is situated 26 km upstream from the estuary of Skawa River and it encompasses 802 km^2 of its catchment area. The water reservoir is going to extend on territories of three municipalities Mucharz, Stryszów and Zembrzyce In Małopolska region.

Initially it was designed as a drinking water reservoir for Upper Silesia agglomeration and it was intended to work within Little Vistula system together with reservoirs on Little Vistula and Soła rivers. As a result of political and economic transformation the demand for water in Upper Silesia decreased and the function of the reservoir has been shifted to flood protection for valleys of Skawa and Vistula, including the city of Krakow.

Photo 3. View to Świna Poręba dam from the air-side - (courtesy of RZGW Krakow)

Characteristics of the reservoir are as follows:

Total volume – 161 mln m^3

Flood volume – from 24.0 mln m3 to 60.0 mln m^3

Dead volume 15.0 mln m^3

The dam is built of gravel material and made tight with a clay core. It is protected with concrete panels on water-side.

Świnna Poręba is one of the most important ongoing hydro-technical developments in Poland. Due to the progress in the construction achieved so far, one can expect that in spite of the crisis the construction will be completed in the upcoming years and the reservoir will be put to work. The importance of the reservoir is related not only to its flood-protective function but also to the use of water by industry, to the energy production as well as to the recreational use of the artificial lake.

The construction is currently in its final stage. The very dam is practically completed. Accompanying developments are under construction. In its current form the reservoir does not have the flood instruction. It has only water management instruction for the construction period.

During the culmination of spring flood 2010 (16^{th} – 19^{th} Mai) the volume of water in the reservoir has reached 61 mln m^3. The maximal inflow of water into the reservoir was 927 m^3/s whereas the maximal outflow was 358 m3/s. The flood wave was reduced by 62%. Without the reservoir the level of water in Krakow in that time would be 60-110 cm higher. This would mean serious flooding in the old centre of Krakow. while the inflow

STOP 3

PRZYBRADZ – THE MERGING PLACE OF WIEPRZÓWKA AND FRYDYCHÓWKA RIVERS

by Wiktor Głowacki and Janusz Komenda, Institute of Urban Development – Cracow

The stop is located on the crossroad of local roads on flat area where beds of Wieprzówka river and its right tributary Frydrychówka are very close one to another. The only visible trace of the flood is the slightly bent signpost. Due to good transport connections owners of the land applied for housing construction when the local spatial plan had been made in 2003.

In the first draft of the plan applications had been rejected as the area was considered flood-endangered. A bit later water board delivered data according to which, the area seemed to be safe. When the municipal council was close to the approval of the final version of the plan the flash flood occurred in the night 24/25 August 2005. Water from Wieprzówka flew over the road to Frydrychówka stream leaving a bunch of straw on the bent signpost.

Photo 4. Traces of the flash flood 24/25 August 2005. (courtesy of W. Głowacki, IUD)

This way the dispute about the extent of flood-endangered areas was settled down. Development applications were rejected. Next flood in spring 2010 also flew over the same road.

Photo 5. The road from Frydrychowice to Przybradz flooded in spring 2010. (courtesy of Wieprz Municipality)

STOP 4

WIEPRZÓWKA GORGE

by Wiktor Głowacki and Janusz Komenda, Institute of Urban Development – Cracow

Beautiful and natural scenery of this place is a “side effect” of floods. 30 years ago the gorge did not exist. Wieprzówka river used to flow in a shallow wide alluvial riverbed. Meadows and pastures on the floodplain suffered from frequent and violent floods. Therefore people had made many efforts in 70s and early 80s to regulate the river. Embankments and thresholds were built to keep the riverbed in one place.

In mid 80s however the flood destroyed stone-built constructions. Alluvial sediments were removed by subsequent floods. Background rock has been uncovered. It turn out to be a thick layer of dark schist (wierzowskie schist). Fluvial erosion progressed easily in soft rock and the riverbed has been deepened during following years. This way Wieprzówka gorge emerged in its current form. Relics of old embankments hanging 4-5 m above the watertable indicate the level of the river from the beginning of 80s.

Many scientific geological publications dedicated the surrounding area have been written in 70s and 80s but the gorge was first mentioned only in 2002. Now it is legally protected due to its natural value.

Photo 6. The Wieprzówka gorge, spring 2010. (courtesy of W. Głowacki, IUD)