The construction of large hydro developments on flatland rivers introduces large changes in their natural hydrologic regime. The river runoff downstream of hydro developments as a result of the regulating effect of the reservoir becomes more uniform during the year and its regime becomes unsteady over a considerable length.

The change in the hydrologic regime downstream of hydro developments leads to a decrease of the height and increase of the duration of the flood, to a noticeable increase of the levels of the summer and, especially, winter low flow, to a change in the ice regime and, what is especially necessary to emphasize, to a pronounced reduction of the volume of the sediment discharge in connection with retention of sediments in the reservoir.

The accumulation of a considerable part of the sediments in the reservoir causes clarification of the flow in the lower pools of hydro developments. The entry of a clarified flow creates erosion of the river bed. Deep erosion in the near-dam stretch extends downstream. In comparison with natural conditions, erosion of the river channel and banks considerably intensifies in the lower pools. This process involves a decrease, a "slump" of the water levels. So-called natural self-paving of the river channel occurs. It reaches a maximum near the dam and gradually decreases downstream.

As is known, deep erosion is limited by the thickness of the loose stratum of sediments composing the river bed. The nonuniformity of the particle-size distribution of this stratum is an important factor affecting the course of erosion. Selective erosion rapidly leads to enlargement of the composition of the sediments and to the formation of an "alluvial pavement" stopping further erosion.

However, dredging operations carried out for deepening the fairway and quarrying in the channel and floodplain of rivers to extract the sand-gravel mixture for construction and other economic purposes, have a substantial and in some cases a very large effect on deep erosion, since in this case the "alluvial pavement" is destroyed.

Recently, quarrying in channels and floodplains of rivers in many cases has been carried out on a broad scale and in large volumes in the lower pools of large hydro developments, and therefore they have a considerable effect on fluvial processes of the rivers, disrupting their natural course and promoting a continuation of a decrease of the water levels.

Thus there exists a real relation and mutual effect between fluvial processes of river flows and water use occurring on rivers in an ever increasing scale. On one hand, during water-resources management of rivers it is necessary to take into account the natural course of channel phenomena which in themselves affect the work of the water-management objects. On the other hand, quarrying carried out in the channels of rivers and their floodplains on downstream stretches with the use of high-productivity mining equipment (dredges delivering up to 2500 m³ of soil per hour) disrupt the natural course of fluvial processes, considerably intensify their rate, and additionally increase the volume of the low-water channel, preserving the tendency of a decrease, "slump," of the water levels in rivers.

The negative consequences of the indicated phenomena create serious problems in the economic use of rivers: the conditions of operating the intakes of municipal and industrial water supply, waterways, and ports deteriorate, the depth over crossings (cables, sag pipes, pipelines) placed in channels decrease. The hydropower plants, their equipment, and hydraulic structures operate under conditions considerably differing from the design.

All this ultimately leads to a decrease of the efficiency of using water resources of water-management systems and complexes in the economy. The 30-year period of operation of
the Novosibirsk hydro development on the Ob River clearly confirms the indicated relation between fluvial processes in the river and operation of water-management objects of Novosibirsk city.

As a result of clarifying the stream after creating the reservoir, the balance of the sediment load of the Ob River and its largest right tributary on the downstream stretch, the Inya River, below the mouth of which was located the main intake of Novosibirsk, the No. 1 pumping and filtering station, was disturbed. The decrease of backwater checking the movement of the suspended and bed particles from the Ob stream led to an intense increase of the sediment discharge of the Inya. This process was not noted, although it had an increasing character, and in October 1958 the heads of the intake were completely clogged with sand and mud. As a result, the water supply of the city was interrupted for 3 days. According to the data of the Ob basin waterway administration, which cleaned the river in the region of the intake, the volume of transported soil was more than 0.5 million m³.

In the first decade after damming the Ob in 1956 and the creation of the Novosibirsk hydro development, in the lower pool of the hydroelectric station occurred, as was indicated above, the natural process of self-paving of the channel with a tendency toward gradual weakening and dying away. But, beginning in 1966 the organization of quarries for mining the sand-gravel mixture in the channel and floodplain of the Ob on a 30-km stretch downstream of the dam of the hydro development began to have an increasingly more substantial effect on the natural process of transformation of the channel due to streamflow regulation and retention of the sediments by the reservoir.

Between 1966 and 1984, without any preliminary investigations of the matter, more than 40 million m³ of soil was removed from the river channel within the city limits by the hydraulicicking method, which exceeds by 2.5 times the total volume of earth structures composing the dam of the Novosibirsk hydro development.

As shown by investigations of the character of transformation of the Ob channel downstream of the Novosibirsk hydrostation carried out by the All-Union Scientific-Research Institute of Hydraulic Engineering (VNIIG) and the West Siberian Regional Scientific-Research Hydrometeorological Institute (ZapSibRNIGMI) with the active participation of specialists of the Ob basin waterway administration and hydraulic engineering service of the regional power administration (Novosibirskenergo) in 1978-1982, this led to an increase of the initial storage capacity of the low-flow channel by 80%. Such an intense effect on the river mechanism disrupted the natural course of the fluvial process and led to a decrease, a "slump," of the water levels in the river at the site of the Novosibirsk stream-gauging station during the indicated period by 0.9-1.0 m relative to the normal, natural conditions. In the absence of quarrying the decrease of the levels in the region of Novosibirsk city could have been only 15-20 cm.

As a result of dry years the strain on the water-resources balances of the reservoir increased, a deficit of water resources of the reservoir with a storage capacity of up to 1.5 km³ occurred. In 1981 and 1982 the reservoir in the preflood periods was forced to be drawn down by 1.3 m and 1.9 m below the dead storage level to provide normal water supply of Novosibirsk, its population and industry. The indicated circumstance had a negative effect on the water supply of Berdsk city and other populated areas located in the reservoir zone and worsened the conditions for pisciculture and reproduction of the fish stock of the reservoir in the Upper Ob. According to the data of the Upper Ob pisciculture Administration (Verkhnebrybvod) and the Siberian Scientific-Research Institute of Fisheries (Sibrybniiproekt), the losses inflicted on fisheries in those years exceeded 5 million rubles.

In connection with the decrease of the levels in the lower pool of the hydro development the hydraulic structures and equipment of the hydrostation are presently operating under conditions considerably differing from the design. Thus, for example, the maximum head on the structure of the hydrostation increased by the amount of the "slump" of the water level at the site of the station (1.50-1.60 m) and reaches, as a rule, in September-October 20.5-21.0 m versus the design value of 19.60 m. The stability factor of structures of the hydro development decreased accordingly. According to the results of check calculations performed by the Leningrad branch of the All-Union Planning, Surveying, and Scientific-Research Institute (Lengidroproekt) in 1983, this decrease is insignificant and does not pose serious hazards with respect to the strength and stability of the earth and concrete structures of the Novosibirsk hydrostation and navigation lock. At the same time, also known is the opinion of Lengidroproekt that a further "slump" of the water levels in the lower pool of Novosibirsk hydrostation is impermissible and this process should be stopped.