Sand and Gravel Resources of Iowa

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Sand and gravel are sorted into different sizes for various uses at this Worth County operation along the Shell Rock Valley. This major Iowa resource is used primarily for road construction and maintenance.

Sand and gravel are resources commonly taken for granted, yet they represent one of Iowa's largest mineral industries. Over 16.8 million short tons of sand and gravel, valued at over 58.4 million dollars, were marketed by Iowa producers in 1992 according to the U.S. Bureau of Mines. These resources were used primarily for maintenance of the state's gravel road system, for aggregate to be mixed into concrete, and for subgrade material in highway construction. Some of these uses have specific requirements related to aggregate size, sorting, and quality. The Iowa Department of Transportation publishes aggregate specifications for its various projects.

Since nearly all of Iowa's sand and gravel resources originated as sediment deposited by streams, most sand and gravel operations are located in stream valleys. The volume and velocity of flowing water as well as the availability and size of sediment for transport vary considerably in stream systems. Typically, cobble- and pebble-sized gravels move only short distances before deposition, and these deposits contain poorly sorted, coarse material. Finer-grained pebbly sands are deposited farther downstream from their source

areas (bedrock outcrops or glacier margins). Still smaller particles (sand, silt and clay) may travel long distances before deposition, and these deposits are often better sorted.

Iowa's river system is a complex hierarchy of streams ranging from small rills on hillslopes to the broad expanses of the Mississippi and Missouri rivers on the state's eastern and western borders. These streams connect to form a drainage network across the state's landscape. The stream valleys consist of two basic components: floodplain and terraces. The floodplain is the lowest part of the valley, and consists of the modern stream channel and that part of the valley floor covered with water when the river is at flood stage. Terraces are relatively flat remnants of former floodplains now elevated along the valley because the river downcut (eroded) to lower levels.

The characteristics of Iowa's stream valleys and their sand and gravel resources change significantly within the different physiographic regions of the state. For example, western and southern Iowa valleys are part of the well-connected drainage system cut into older glacial materials deposited several hundred-thousand years ago. These valleys contain extensive, high, sandy and gravelly terraces. Many of these terraces are mantled with windblown silt (loess) originating from the Missouri Valley during late-glacial time. Valleys of the Iowan Erosion Surface of northeastern Iowa are also part of an integrated drainage system, but most of the valleys are wide and shallow, and the loess cover is generally thin or absent. Extensive sand and gravel deposits in these valleys were derived from older glacial materials and bedrock during the erosional development of this region. In north-central Iowa a youthful, poorly developed stream network was established following the glacial advance which occurred 14 to 12 thousand years ago. These valleys were affected by meltwater floods from stagnating glaciers. River valleys of extreme northeastern Iowa are much different from other valleys in the state. They are deeply carved into bedrock and form spectacular bluffs along such rivers as the Upper Iowa, Yellow, and Turkey. Thick deposits of sand and gravel occur in high terraces within these valleys. These differences in location, age, and source of sand and gravel have made a systematic, state-wide study of this resource difficult.

Patterns of sediment deposition in this Emmet County gravel pit indicate shifts in stream-flow direction, volume, and velocity associated with the melting of north-central Iowa glaciers.

The variability in Iowa's stream deposits also reflects past changes in river conditions along different reaches of the valleys and past shifts in climate. For example, valley landscapes, as well as sand and gravel deposits, were affected by increased discharge from incoming tributaries, the proximity to former glacial meltwater sources, and local variations in shallow bedrock uncovered along the valley. In addition, river environments and associated deposits changed significantly as glacial climates during Wisconsinan time (last glacial) shifted to non-glacial conditions during the Holocene (which includes the present). During the Wisconsinan, valleys were flooded by high discharges of sediment and water, while during the Holocene, peak sediment and water discharges have been significantly less, with reduced fluctuations and a predominance of overbank sedimentation of fine-grained deposits.

Sand and gravel deposits from former stream valleys also occur buried within the sequence of upland glacial deposits across the state. Where not too deeply buried, these deposits are used as sand and gravel sources, and they show the same types of variability as described for modern stream valleys. The occurrence of these deposits is difficult to predict, however, because of their burial and limited distribution.

Other important upland sources of sand and gravel include distinctive glacial landforms on the Des Moines Lobe, features known as "kames" and "eskers." Kames, such as Ocheyedan Mound State Preserve, are round or elliptical hills composed predominantly of sand and gravel, while eskers, such as Caylor Prairie State Preserve, are linear or slightly sinuous ridges of sand and gravel. Both of these landforms were deposited in direct contact with melting ice, probably in glacial tunnels or crevasses. Kames and eskers can be good sources of sand and gravel, but they typically show abrupt, unpredictable changes in grain size, and may have appreciable quantities of unwanted, fine-grained stream, lake, or mudflow deposits.

For sand and gravel producers, concerned with obtaining the resources economically, these changes in the character of sand and gravel along a valley necessitate using different methods of extraction. End-loaders and draglines are used to excavate shallow deposits, less than 20 feet below the surface and usually above the water table. Most of these deposits are located either on the higher terrace levels of stream systems or in the isolated, upland kames and eskers. Sand and gravel from these locations is usually coarse, poorly sorted, weathered, and may contain organic material (coal, wood, peat, fossil bones and teeth). Such deposits are used primarily for asphalt aggregate as well as road base and surfacing material because of their unsuitability for concrete aggregate. These operations are not as cost effective as the larger, more permanent dredge operations because of increased hauling and loading costs. However, shallow deposits are excellent sources for seasonal excavation or when aggregate is needed for nearby gravel roads and highway projects.

Dredge and dragline operations, on the other hand, are used to excavate thicker (20 to 60+ feet) stream-valley deposits of sand and gravel which often occur below the water table and are buried by finer-grained material. Dredge operations are the most cost-effective method to remove these extensive, buried, water-saturated sand and gravels. Material excavated from such operations is finer grained, less weathered, and contains nearly uniform particle sizes, thus making it quite suitable for concrete aggregate. Once a sand and gravel operation is finished, the excavation site may be acquired by a county park system to provide swimming and fishing for local residents, or may be converted into a housing development with waterfront lots. Unfortunately, numerous abandoned sand and gravel pits have been used for trash dumps. Such pits can present serious environmental hazards since most of them are connected to strata which provide drinking water to wells. Proper management of abandoned sand and gravel pits is needed to avoid environmental hazards in the future.

In summary, sand and gravel constitute an important resource used extensively in every Iowa county. While complex variations exist among the state's sand and gravel deposits, further geologic investigations will enable better assessments and more economical use of this important resource.

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