

MAP OF PRIMARY AGGREGATE SOURCES

SAND AND GRAVEL SOURCES
Sand and gravel deposits were mapped and named as simple land forms (Table 1) and divided into different classifications (Table 2) using various criteria. Several operators and consultants in the aggregate industry, staff of the Materials Division of the Minnesota Department of Transportation and the Division of Minerals of the Minnesota Department of Natural Resources helped to establish the criteria. Deposits are classified by percentage of material retained on the number 4 sieve (4.76-millimeter pore space), sand and gravel thickness, thickness of overlying deposits, location of the water table, and relative amounts of subsurface information available (Table 2).

Source Evaluation
Primary Sources—For classification as a primary source, the following criteria must be met: (1) more than 20 percent of the material is retained on a number 4 sieve; (2) the deposit is thicker than 10 feet; and (3) overlying sediment is no thicker than 10 feet.
Quality of sources where the water table is more than 20 feet below land surface (classifications 1, 2, 3, and 6):

- Excellent to good (less than 1.5 percent total spill materials)
 - Good to moderate (less than 5 percent total spill materials)
 - Moderate to poor (generally more than 5 percent total spill materials)
- Quality of sources where the water table is less than 20 feet below land surface (classifications 7 and 8):
- Excellent to good (less than 1.5 percent total spill materials)
 - Good to moderate (less than 5 percent total spill materials)
 - Moderate to poor (generally more than 5 percent total spill materials)

Secondary Sources—A secondary source must meet one or more of the following conditions: (1) less than 20 percent of the material is retained on a number 4 sieve; and/or (2) the deposit is less than 20 feet thick; and/or overlying sediment is more than 10 feet.

- Potential secondary source—Classifications 4 and 5
- Gravel pit—Active or inactive pit
- Large gravel pit, or an area of more than one gravel pit or gravel-pit operation

The third letter represents the type of deposit.
The first two letters represent the class of the deposit.
The number represents the aggregate quality classification.
The letters and numbers following the classification code indicate a specific named Minneapolis outwash that has a classification of 4. Refer to Tables 1 and 2 for further information.

BEDROCK AGGREGATE SOURCES

Source Evaluation and Reliability of Data
The only available bedrock aggregate source in the Seven-County Metropolitan Area is Prairie du Chien dolomite where outcrops are thicker than ten feet. Both quality and quantity of data determine how reliably the various units of Prairie du Chien are delineated on the map. Information that was used to map bedrock source units includes bedrock outcrops, water-well and soil-boring records, soil maps, and topographic maps.

Excellent Reliability—Areas shown as having excellent reliability are characterized by:
1. outcrops of Prairie du Chien dolomite;
2. numerous, evenly distributed water-well and soil-boring records that indicate carbonate bedrock at less than ten feet below the land surface;
3. soils characterized by parent material or substratum of carbonate bedrock; and
4. the presence of bluffs, flat plateaus, ridges, or rock terraces—landforms that typically form in areas underlain by carbonate bedrock.

Good Reliability—Areas shown as having good reliability are delineated using criteria 3 and 4 above and criterion 1 or 2. Characteristically, areas mapped as having good reliability have fewer outcrops and water-well and soil-boring records. Where such data are available, they are not as evenly distributed as those in areas mapped as having excellent reliability.

Fair Reliability—Areas shown as having fair reliability are delineated mainly by criteria 3 and 4. The mapping is primarily based on soil maps and topographic expression. There are no outcrops and only a few water-well and soil-boring records to support the distribution of bedrock shown.

Where Prairie du Chien dolomite is thicker than 30 feet.

- Excellent reliability
- Good reliability
- Fair reliability

Where Prairie du Chien dolomite is 10-30 feet thick.

- Excellent reliability
- Good reliability
- Fair reliability

Where Prairie du Chien dolomite is less than 10 feet thick.

- Excellent reliability
- Good reliability
- Fair reliability

- Quarry
- Large quarry, or area of more than one quarry or quarry operation

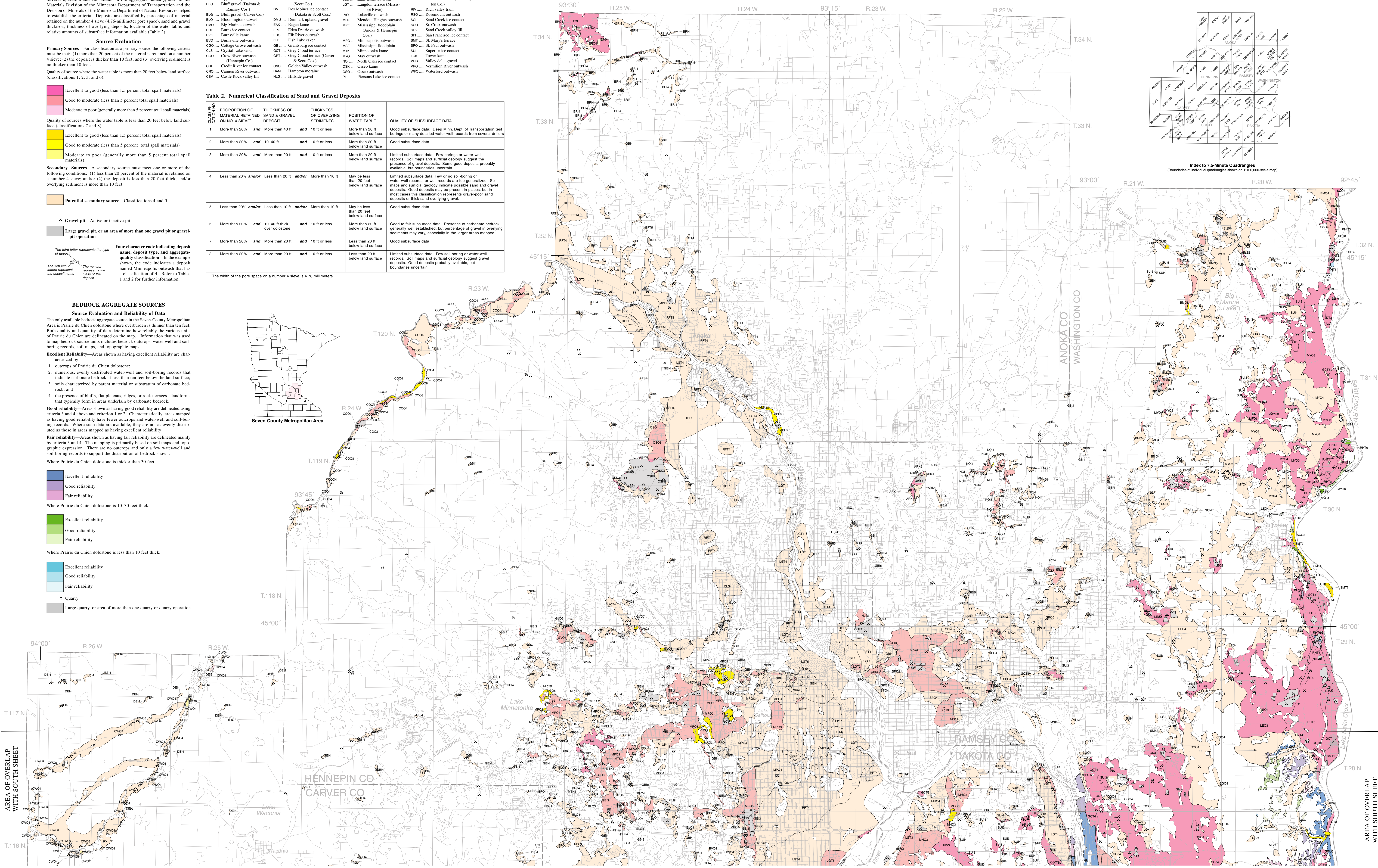
Table 1. Three-Letter Codes for Informally Named Sand and Gravel Deposits

AFV ... Afon valley fill	CWV ... Crow River outwash (Carver Co.)	LD7 ... Langdon terrace (St. Croix River)	PRI ... Prior Lake ice contact
AND ... Apple valley outwash	DEB ... Des Moines ice contact (Scott Co.)	LEO ... Lake Elmo outwash	RFT ... Richfield terrace
BFG ... Bluff gravel (Dakota & Ramsey Cos.)	DM ... Des Moines ice contact (Dakota & Scott Cos.)	LGT ... Langdon terrace (Mississippi River)	RHT ... Richfield terrace (Washington Co.)
BLO ... Bluff gravel (Carver Co.)	LVO ... Lakeville outwash	LVI ... Mendota Heights outwash	RIV ... Rich valley terrace
BMO ... Bloomington outwash	MDU ... Denmark upland gravel	MHO ... Mendota Heights outwash	RKO ... Rosemount outwash
BND ... Big Marne outwash	EPK ... Egan kame	MFP ... Mississippi floodplain (Anoka & Hennepin Cos.)	SCD ... St. Croix outwash
BNS ... Burns ice contact	EPR ... Eden Prairie outwash	SCV ... Sand Creek valley fill	SFI ... St. Francis ice contact
BVW ... Burnsville kame	FLE ... Fish Lake esker	SFR ... St. Francis ice contact	SMT ... St. Mary's terrace
BVS ... Burnsville outwash	GBL ... Grantsburg ice contact	SPO ... St. Paul outwash	SUP ... Superior ice contact
CGD ... Cottage Grove outwash	GCT ... Grey Cloud terrace	SUI ... Superior ice contact	TOK ... Tower kame
CLS ... Crystal Lake sand	GRT ... Grey Cloud terrace (Carver & Hennepin Cos.)	SUN ... Sun Prairie outwash	VLD ... Valley delta gravel
COO ... Crow River outwash (Hennepin Co.)	HAM ... Hampton terrace	SUV ... Superior ice contact	VRI ... Vermilion River outwash
CRH ... Credit River ice contact	GOV ... Golden Valley outwash	OSV ... Osseo outwash	WFO ... Wausted outwash
CRV ... Cannon River outwash	HIL ... Hillside gravel	PIU ... Pioneros Lake ice contact	

Table 2. Numerical Classification of Sand and Gravel Deposits

CLASSIFICATION	PROPORTION OF MATERIAL RETAINED ON NO. 4 SIEVE*	THICKNESS OF SAND & GRAVEL DEPOSIT	THICKNESS OF OVERLYING SEDIMENTS	POSITION OF WATER TABLE	QUALITY OF SUBSURFACE DATA
1	More than 20%	and more than 40 ft	and 10 ft or less	More than 20 ft below land surface	Good subsurface data. Deep Minn. Dept. of Transportation test borings or many detailed water-well records from several districts.
2	More than 20%	and 10-40 ft	and 10 ft or less	More than 20 ft below land surface	Good subsurface data.
3	More than 20%	and more than 20 ft	and 10 ft or less	More than 20 ft below land surface	Limited subsurface data. Few or no soil-boring or water-well records, or well records are too generalized. Soil maps and surficial geology suggest the presence of gravel deposits. Some good deposits probably available, but boundaries uncertain.
4	Less than 20% and/or	Less than 20 ft and/or	More than 10 ft	May be less than 20 ft below land surface	Limited subsurface data. Few or no soil-boring or water-well records, or well records are too generalized. Soil maps and surficial geology indicate possible sand and gravel deposits. Good deposits may be present in places, but in most cases this classification represents gravel-poor sand deposits or thick sand overlying gravel.
5	Less than 20% and/or	Less than 10 ft and/or	More than 10 ft	May be less than 20 ft below land surface	Good subsurface data.
6	More than 20% and	10-40 ft thick over dolomite	and 10 ft or less	More than 20 ft below land surface	Good to fair subsurface data. Presence of carbonate bedrock generally well established, but percentage of gravel in overlying sediments may vary, especially in the larger areas mapped.
7	More than 20%	and more than 20 ft	and 10 ft or less	Less than 20 ft below land surface	Good subsurface data.
8	More than 20%	and more than 20 ft	and 10 ft or less	Less than 20 ft below land surface	Limited subsurface data. Few soil-boring or water-well records. Soil maps and surficial geology suggest gravel deposits. Good deposits probably available, but boundaries uncertain.

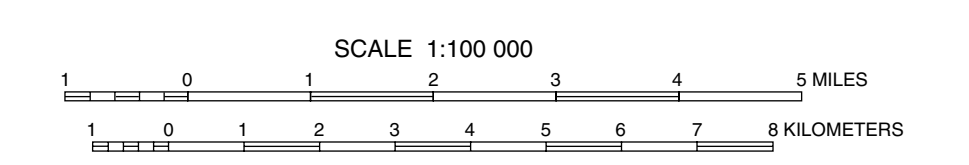
*The width of the pore space on a number 4 sieve is 4.76 millimeters.



Base modified from 1990 Census TIGER/Line Files of U.S. Bureau of the Census; county border lines modified from Minnesota Department of Transportation files; digital base annotation by Minnesota Geological Survey.
Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

Every reasonable effort has been made to ensure the accuracy of the factual data on which this map is based. However, the Minnesota Geological Survey does not warrant or guarantee that there are no errors. Users may wish to verify critical information; sources include both the references listed here and information on file at the office of the Minnesota Geological Survey in St. Paul. In addition, effort has been made to ensure that the information conforms to the current geologic and cartographic practices. No claim is made that the information shown is rigorously correct, however, and it should not be used to guide engineering decisions without site-specific verification.

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Note: This map depicts deposits of sand, gravel, and dolomite within the Seven-County Metropolitan Area that occur geologically and are potentially available as sources of construction aggregate. It is not a depiction of aggregate resources, in that large portions of the mapped deposits do not have "reasonable prospects for eventual economic extraction" because of competing land uses and zoning restrictions, and thus are excluded from the operational definition of a mineral resource.
Resources and Reserves Committee, 1999. A guide for reporting exploration information, mineral resources, and mineral reserves: Littleton, Colo., unpublished report submitted to the Board of Directors, Society for Mining, Metallurgy and Exploration, 17 p.

PRIMARY SOURCES OF CONSTRUCTION AGGREGATE IN THE SEVEN-COUNTY METROPOLITAN AREA, MINNESOTA

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