Legislative Aggregate Resources Task Force

Aggregate Primer

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Introduction to Aggregates

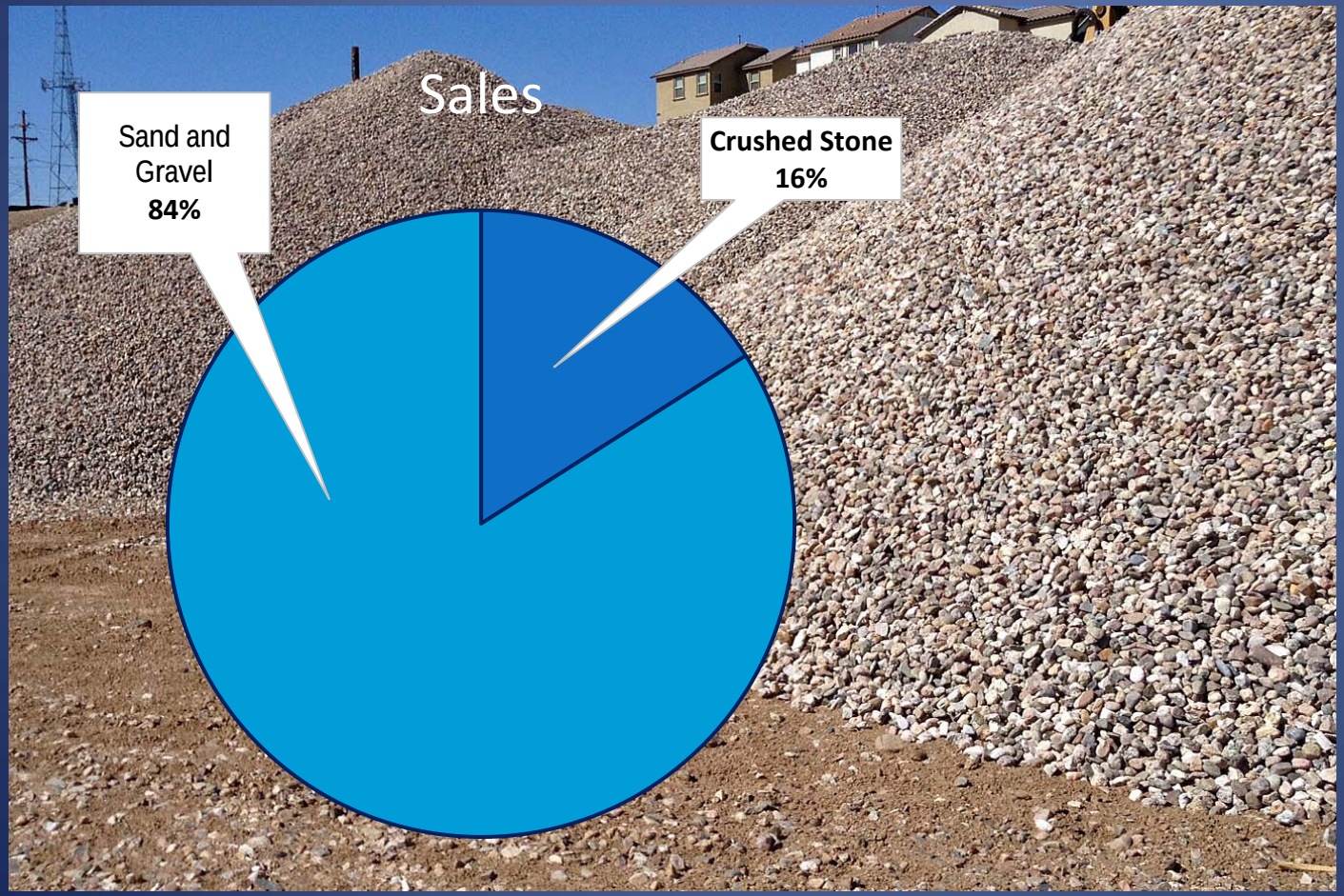
- Definitions
- Aggregates Use
- Specifications
- Mine Development
- Environmental Review and Permitting
- Mining and Processing

Definition - Natural Aggregates

Natural aggregates are materials composed of many rock fragments.

They can be used in their natural state or after primary processing operations such as crushing, washing, and sizing.

Sources of Aggregates in MN



- Crushed Stone
- Sand and Gravel

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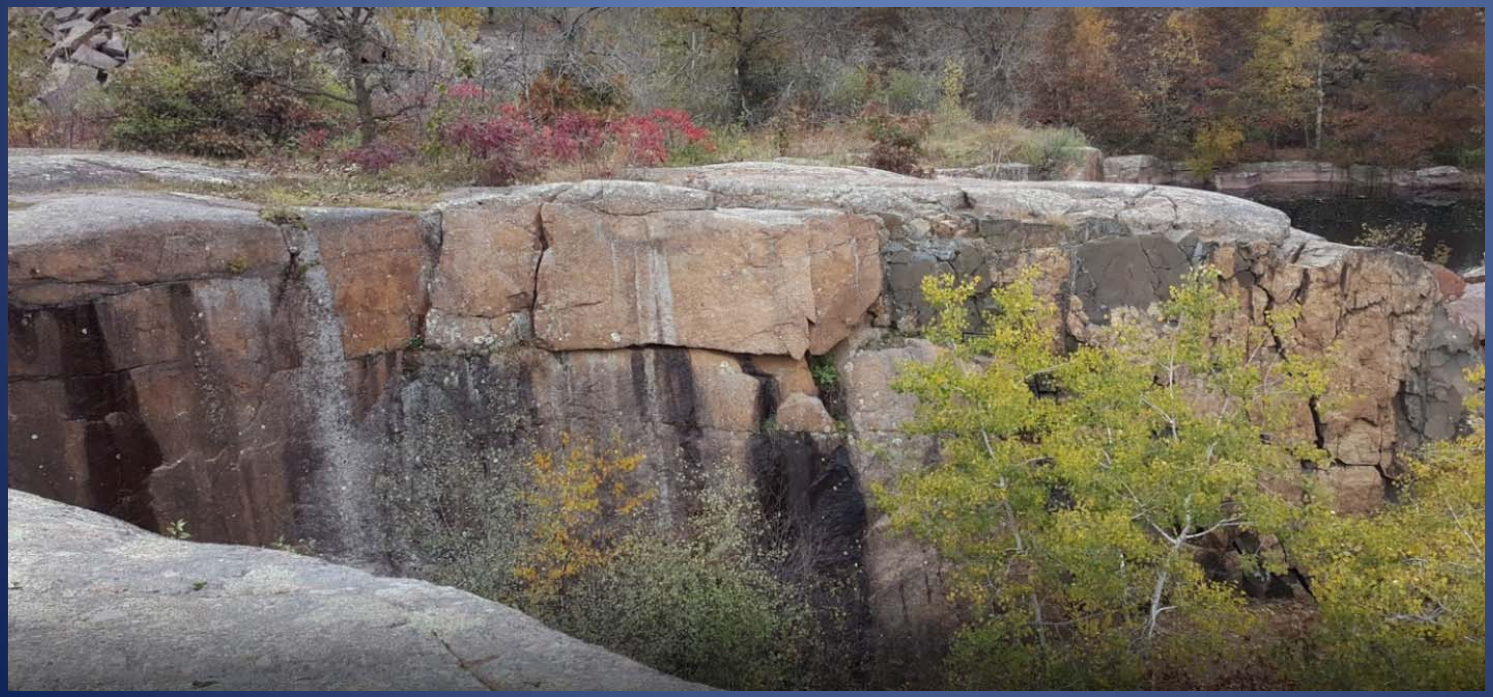
Crushed Stone Sources

Limestone/Dolomite – Calcium Carbonate

Crushed Stone Sources

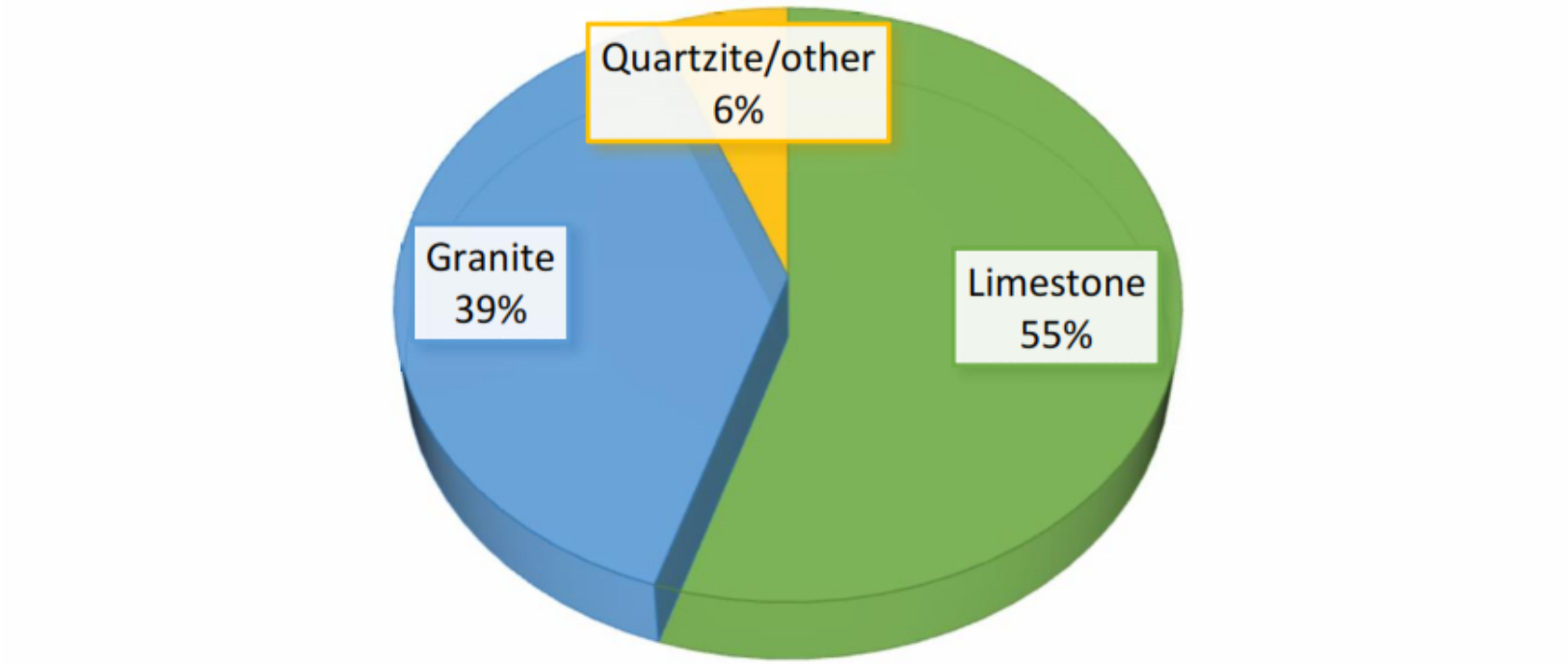
Granite



Crushed Stone Sources

Quartzite

CRUSHED STONE - MINNESOTA



2013 USGS Minerals Report for MN

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Sand and Gravel

- Sand and gravel is a mixture of various sizes of rocks and rock fragments. The distinction between sand and gravel is based on size.

Sand

Sedimentary material consisting of small, often rounded grains or particles of disintegrated rock.

Sand often consists of quartz, but it can contain other minerals or rock fragments as well.

Gravel

- Larger size fraction than sand
- Higher value
- Many different mineral assemblages and rock types
- Different rock types impact the quality of the aggregate

Use of Construction Aggregates

Aggregates are a VITAL component of our state's infrastructure

Concrete and Asphalt Mixes
Foundations for Highways
Foundations for Structures
Railroad Ballast
Road Shoulder Stabilization
Gravel Roads
Driveways
RipRap/Erosion Control
Shoreland Stabilization

Agricultural Lime
Snow and Ice Control
Drainfields
Golf Course Sand
Infield Mix
Recreational Trails
Landscape Rock
Engineered Backfill
Retaining Wall Blocks
Beaches

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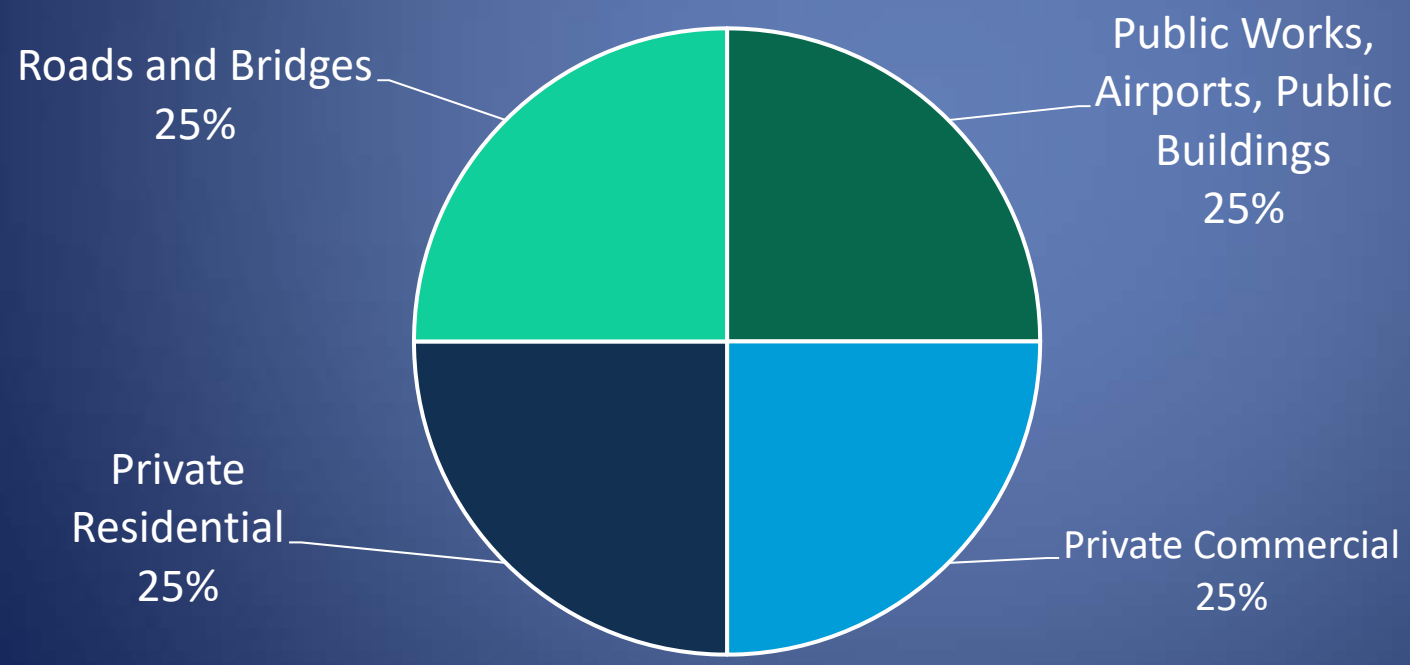
Estimated annual consumption of aggregates is 9-10 tons per person to build and maintain roads, bridges, develop infrastructure, and support construction projects.

2017 Minerals Education Coalition Society for mining, Metallurgy & Exploration Foundation



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Use of Construction Aggregates

REPORTED USE (2013)	CRUSHED STONE	SAND AND GRAVEL
Road Base	41	42
Asphalt/Bituminous Mixtures	19	22
Concrete Aggregates	19	21
Fill Material	0	14
Ag Lime	9	0
Riprap	3	0
Other	9	2

USGS 2013 Minerals Commodities report for Minnesota

Road Construction

The majority of aggregates produced in Minnesota are used in road construction

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Road Construction

It is estimated that 85,000 tons of aggregates are necessary to construct one mile of a four-lane interstate highway

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Asphalt and Bituminous Mixes

Asphalt: Over 90% Aggregates

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Asphalt and Bituminous Mixes

Asphalt: Over 90% Aggregates

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Concrete/Ready-Mix

Concrete: 60-75% Aggregates

Concrete/Ready-Mix

Concrete: 60-75% Aggregates

The construction of a new home uses an average of 120 tons of aggregates. Sidewalks, driveways, roofs, foundations, floors, fences, and walls all contain aggregates in one form or another.

Specifications

Not all rocks make good aggregate!

Gradation Grain-size distribution

Particle Shape: Surface characteristics

“Contaminants”: shale, silt, clay, mica, and organic materials

Physical soundness

Hardness and strength

Chemical properties: Inert – not chemically reactive

Volume changes

Specific gravity

Standard Specifications

DIVISION III

MATERIALS

Cementing Materials

Aggregates

Table 3137-1
Coarse Aggregate for General Use

	Quality Test	Maximum Percent by Weight
(a)	Shale:	
	Fraction retained on the ½ in [12.5 mm] sieve	0.4
	Fraction retained on the No. 4 [4.75 mm] sieve, as a percentage of the total material	0.7
(b)	Soft iron oxide particles (paint rock and ochre)	0.3
(c)	Total spall materials*:	
	Fraction retained on the ½ in [12.5 mm] sieve	1.0
	Fraction retained on the No. 4 [4.75 mm] sieve, as a percentage of the total material	1.5
(d)	Soft particles‖	2.5
(e)	Clay balls and lumps	0.3
(f)	Sum of (c) total spall materials, (d) soft particles, and (e) clay balls and lumps†	3.5
(g)	Slate	3.0
(h)	Flat or elongated pieces‡	15.0
(i)	Quantity of material passing No. 200 [75 µm] sieve:	
	Class A and Class B aggregates#	1.5
	Class C and Class D aggregates§	1.0
(j)	Los Angeles Rattler, loss on total sample	40.0
(k)	Soundness of magnesium sulfate**	15.0

* Includes the percentages retained by shale and soft iron oxide particles, plus other iron oxide particles, unsound cherts, pyrite, and other materials with similar characteristics.
‖ Exclusive of shale, soft iron oxide particles, and total spall materials.
† For total spall materials, use the percent in the total sample retained on the No. 4 [4.75 mm] sieve.
‡ Thickness less than 25 percent of the maximum width. Length greater than 3 times the maximum width.
# Each individual fraction at the point of placement consists of dust from the fracture and free of clay or shale.
§ For each individual fraction at the point of placement.
** Loss at 5 cycles for any fraction of the coarse aggregate. Do not blend materials from multiple sources to obtain a fraction meeting the sulfate soundness requirement.

MnDOT - Standard Construction Specifications

Aggregate Mine Development

1. Identify Potential Sources of Aggregate

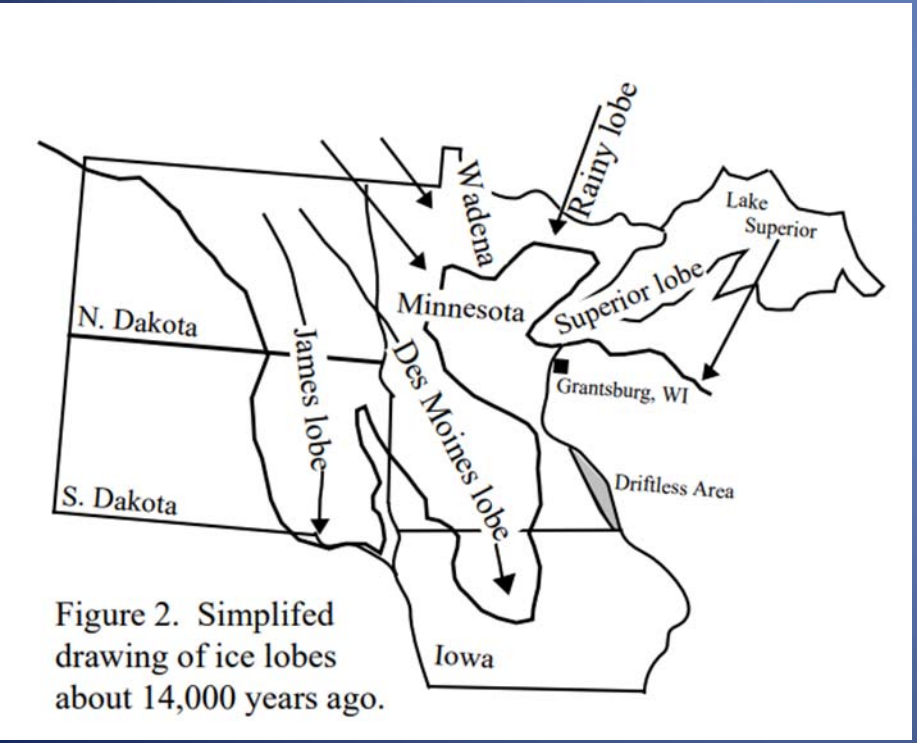

Figure 2. Simplifed drawing of ice lobes about 14,000 years ago.

Need to understand the geology of the State

Sand and gravel deposited from glaciers and water

MN – Glacial History

ICE AGE - Pleistocene Epoch 2 million years ago to 10,000 years ago

Wisconsin Age 75,000 years ago majority of glacial sediments in Mn

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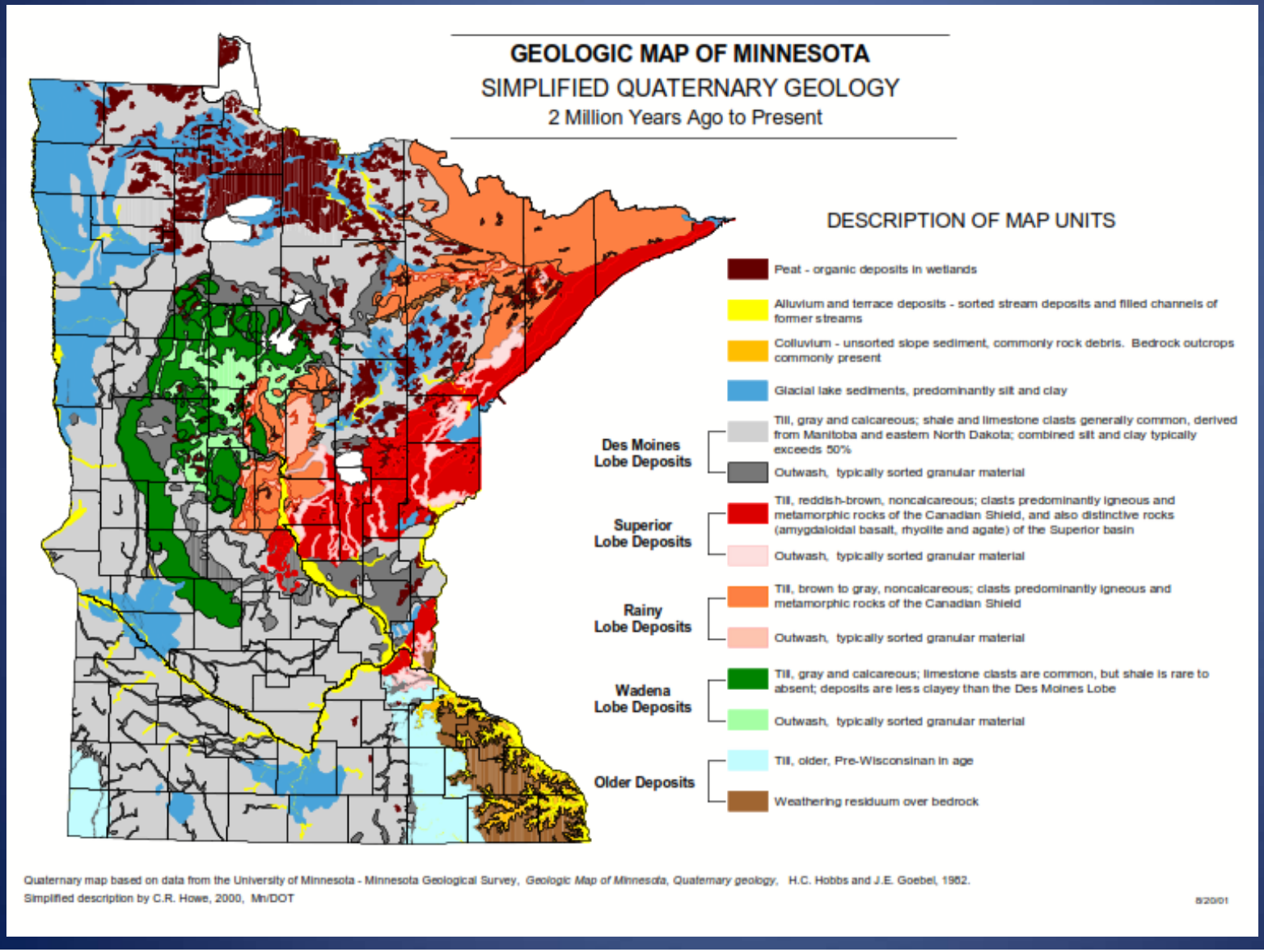
Aggregate Mine Development



Glacial Deposits
Outwash/Till

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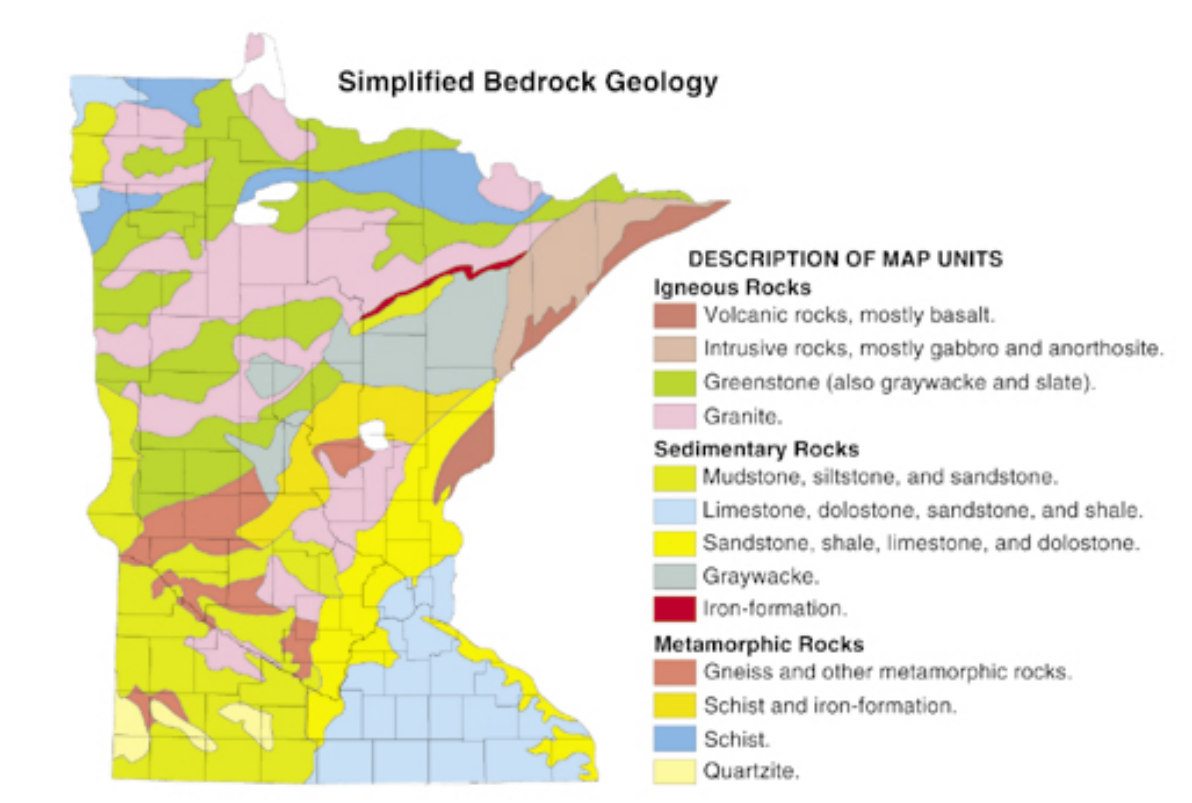
Aggregate Mine Development



Understand the bedrock geology of the state to identify crushed stone sources

Identify suitable types of bedrock

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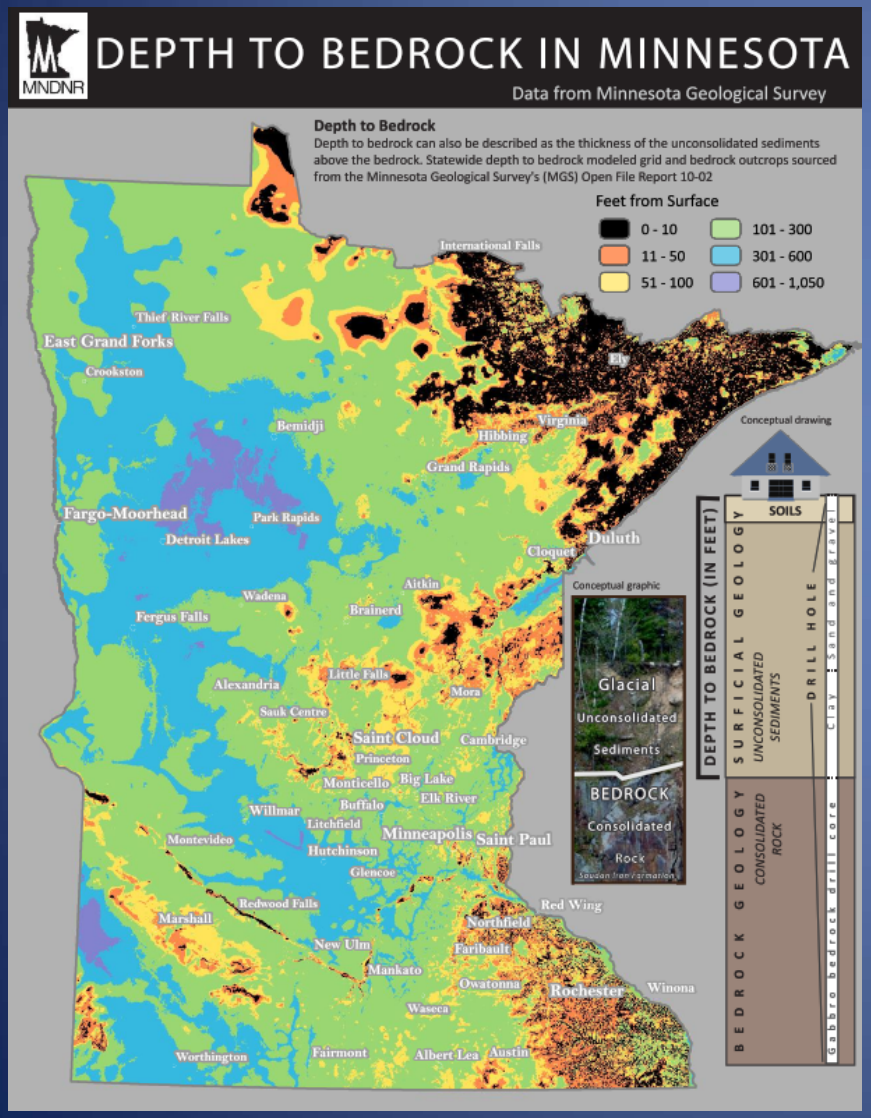
Aggregate Mine Development



Understand the bedrock geology of the state to identify crushed stone sources

Identify suitable types of bedrock

Identify areas without excessive overburden

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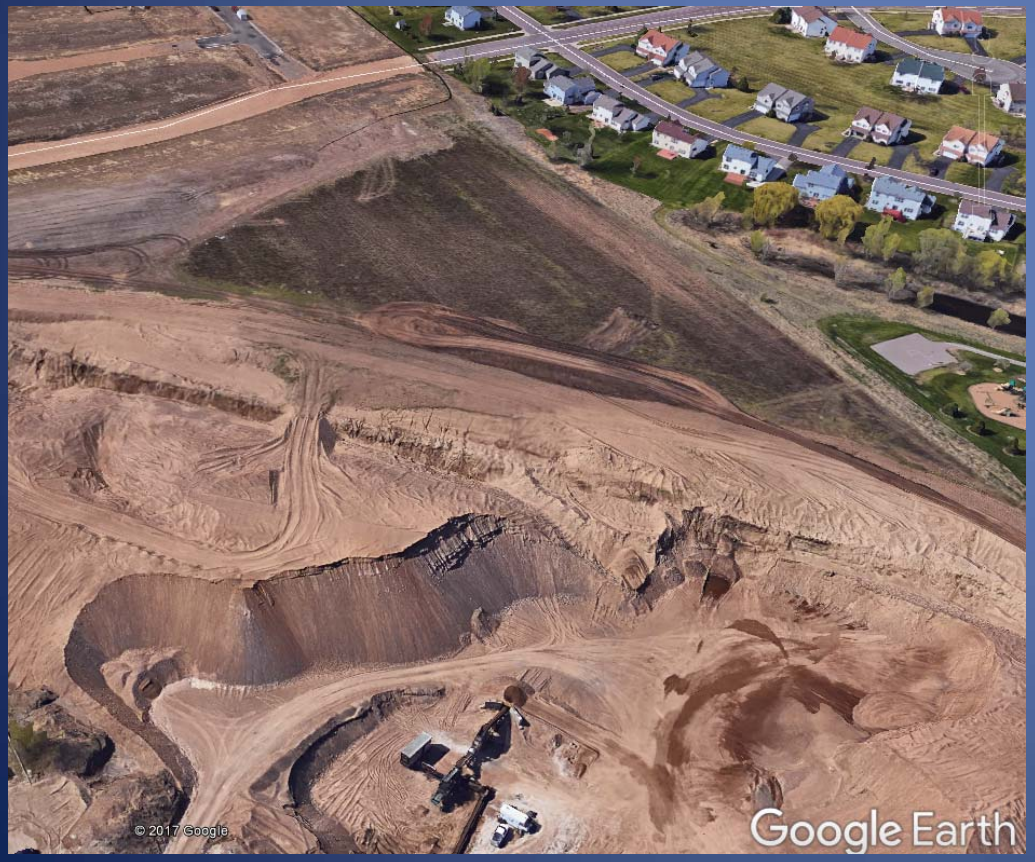
Aggregate Mine Development

Location considerations



Near to end use of the aggregate

Developing Areas

Perceived land use conflicts can create challenges for mine permitting

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Aggregate Mine Development

Permits:

MINE PERMITTING

LOCAL GOVERNMENT
Land Use Permit: CUP/IUP

MPCA:
- Air Emissions Permit
- NPDES Stormwater Permits

DNR:
- Work in Public Waters
- Water Appropriations
- Threatened or Endangered Species Takings permit

BWSR
- Wetlands

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Mining and Processing

Clear and Grub
Strip Overburden

BLASTING: (Crushed Stone Sources)
and removal

Mining and Processing

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and removal

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Mining and Processing

Sand and Gravel

Extraction above and below the water table

Mining and Processing

Crushing: Larger sized pieces of rock, either blasted bedrock or boulders and cobbles in sand and gravel deposits are crushed to break them into smaller sizes.

Mining and Processing

Washing: Removes fine particles, like silt from the larger pieces of rock.

Mining and Processing

Screening

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Mining and Processing

Conveyors and material transfers

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Multiple Aggregate Products

- 3” with fines
- 1 ½ inch with fines
- ¾ inch screened
- 3/8 inch with fines
- 3/8 inch washed
- Class 5 gravel
- Landscape Boulders

Ready-Mix Plant

Hot-Mix Asphalt Plant

Summary

1. Aggregates are an important natural resource in Minnesota
2. Both the public sector and the private sector use aggregates to maintain and build our states infrastructure including roads, bridges, public works projects, schools, and homes
3. Aggregates must meet certain quality standards
4. The location of an aggregate mine depends upon the local geology, we can't choose.
5. Local supplies of quality aggregates are economically beneficial, reducing tax payer dollars spent on construction projects
6. Aggregate mining and processing is regulated on the local, state, and federal level