Chapter 1

MINERAL RESOURCES OF NEW YORK

HISTORICAL OVERVIEW

Since the arrival of European colonists in New York, the extraction of mineral wealth has been an important societal goal. Mining, then and now, provides the raw materials for consumer goods. Iron was used for cooking utensils and stoves, among other things. It was the basis for many construction projects. The availability of "hydraulic" cement was as important in the success of the Erie Canal as it is to the maintenance of the New York State Thruway. Mines provided materials to improve the standard of living of the populace. Late-nineteenth-century clay mines in the Hudson River Valley provided clay to make literally billions of bricks used to replace the highly flammable wooden building materials of New York City. The State of New York has, since the 1980s, ranked about fifteenth in the nation in terms of mineral value extracted annually. The Mineral Information Institute reports that each person in New York consumes, on average, 9,871 pounds of stone, 7,811 pounds of sand and gravel, and 714 pounds of cement *every year* (Mineral Information Institute 2009).

Mining in New York began as soon as people entered the region after the retreat of the last glacial period. Native Americans extracted chert for projectile points; clay for pottery; and red, yellow, and black iron and manganese minerals for pigments. Various types of stone were used by these early peoples for jewelry, decoration, and tool making. The modern history of mining in New York began in the southeastern part of the state. As European settlers spread inland, into the Hudson Valley and Adirondacks and westward through the Mohawk Valley to western New York, mining activities accompanied them. Not all portions of the state are equally endowed with mineral wealth. Consequently, many more mines were established in regions such as the Hudson Highlands and Adirondacks than in the Catskills or Southern Tier. Furthermore, since "you can only mine the ore where the ore is," certain commodities were mined only in specific parts of the state. For example, no salt mines ever existed in the Adirondacks and no garnet was ever mined in the Southern Tier.

The Colonial Period

As soon as Europeans arrived in New Netherland, they began to search for mineral wealth, particularly precious metals. Initially, they traded for metal with the Native Americans and later, as homesteads and communities were established, the Europeans began to explore on their own. Gold and silver were never found in economic quantities, but other metals were equally or more important for daily life. Iron was first extracted from "bog" deposits. These were small pockets of limonite that were literally deposited in swamps. At the same time, limonite occurred in weathered pockets of rock in the Hudson Highlands and was used for ore. These deposits soon proved to be too small and lean, and further exploration revealed many deposits of magnetite. This mineral became the iron ore of choice. The ore was reduced to metal in local refineries and used for cookware, tools, weapons, and construction materials. The earliest iron mines of this period were located in Columbia and Orange counties. Lead and copper were also metals that the people of the colonial period sought. Galena and chalcopyrite were mined in several counties in the Hudson Valley and in the Mid-Hudson region. The lead ore mineral galena also contains traces of silver, and unsuccessful attempts were made to establish mines for the latter metal. In addition to metals, stone of several types was quarried for building purposes. Depending on the local geological resources, marble, limestone, and sandstone were quarried for building stone. Clay deposits, which are common in the Hudson Valley and across the state, were mined for brick and rough pottery.

The Nineteenth Century to World War I

New York's mining industry achieved its height during this period. The center of iron mining migrated from the lower Hudson Valley to the Adirondacks, although the Mid-Hudson limonite mines and siderite mines still produced iron ore. At the time of the Civil War, iron from the Adirondacks constituted 25 percent of the

Mineral Industry of the State of New York, by William M. Kelly, New York State Museum Record 3

nation's production and was critical to the war effort. From stoves to cannons to horseshoes, many essential items were made in North Country blast furnaces. Between 1880 and 1918, 23 million tons of iron ore worth $70 million were mined statewide, mostly in the Adirondacks. Also in this region, mines for galena for lead; pyrite for sulfur; graphite for pencils, crucibles, and electrical components; garnet for abrasive; and talc, used in paint and soap, were established during this period. A single mine in the southern Adirondacks yielded diatomaceous earth, known as "infusorial earth," which was used for polishing. Emery, a mixture of magnetite, corundum, and other minerals, was mined at Peekskill and used as an abrasive. Quartz, derived from rocks in Ulster County and sand in Oneida County, was used for glass manufacturing. Molding sand, primarily recovered a few inches below the surface of Albany County, was used by the iron foundries.

Granite, sandstone, slate, marble, and limestone continued to be mined for construction purposes and mill stones. The type of stone mined, and hence the final product, depended upon the geological formations of each region of the state. Clay was mined statewide for brick, terra cotta, roofing tile, and pottery. Small iron mines appeared in hematite deposits in central New York south of the Mohawk Valley, but these were rather quickly converted to pigment mines, to provide the raw material for "barn red" paint. Red and green paint pigment was made from finely ground slate from Washington County.

In central and western New York, halite and gypsum were mined. Halite was produced in underground mines and also was extracted from brines from specially prepared wells for use as a food preservative and in chemical processes. For most of this period, the New York State government controlled a large portion of the state's salt brine industry. Gypsum, used for fertilizer and plaster, was mined in open cuts. Limestone of a special composition was mined for the raw material for portland cement across the state where it was available.

The Modern Period

During the period from the end of World War I to the beginning of World War II, mining in New York generally declined. In some cases, commodities whose availability had been restricted during the war, and hence were mined in New York, appeared again on the world market, rendering the New York mines uneconomic. Some New York mines simply ran out of ore. Graphite mining ceased. Quarries for building stone greatly diminished. Only a few of the largest iron mines survived and only two garnet mines remained in operation during the early part of this period. Two small emery mines in Westchester County continued to operate but eventually failed. However, World War II brought resurgence in some quarters of the mining industry. Because of the necessity of a domestic source for certain raw materials, large iron mines in the Adirondack counties of Essex, Clinton, and St. Lawrence were rejuvenated. From 1938 to 1945, more than 8 million tons of ore were produced from the mines at Mineville, Essex County, alone. A nineteenth-century iron mine at Tahawus in Essex County was activated as an ilmenite mine to provide titanium dioxide, an essential component of paint pigment and chemical smoke screens. The titanium oxide operation remained in operation for forty years but closed in 1982 and all of the iron mines had closed. Neither iron nor titanium was being mined in New York by the beginning of the twenty-first century. Lower-cost ore available offshore made the iron mines uneconomic, and the loss of processing facilities in New Jersey forced the closure of the ilmenite mine. Mining for sphalerite (zinc ore) and industrial talc began in the post–World War I period and continued until the beginning of the twenty-first century. The last of the gypsum mines closed in 1999. Mined gypsum in New York was supplanted by synthetic gypsum derived from exhaust scrubbing equipment at coal-fired electrical power plants.

Some mines did fare well in the modern period. Industrial talc mines in St. Lawrence County expanded, although the last of these operations closed permanently in early 2009. The talc was used for filler in paper, ceramics, and rubber. It was not used for cosmetics. Mines for sphalerite, a primary zinc ore, were established in 1920 and continue to operate sporadically in St. Lawrence County, and there was interest in sphalerite produced as a by-product of limestone quarrying south of Patterson in the Mohawk Valley. As of this writing, the last of these mines is on furlough. Halite, extracted both as rock salt and brine, is still an important commodity. Clay is mined primarily for landfill liner and cover material. Small mines produce "peat" for agricultural purposes, primarily potting soil. Garnet is still produced for abrasives and water filtration. During this modern period, a new commodity came to maturity. The mineral wollastonite entered the market as a filler material and found particular utility in the manufacture of molded resin automobile body panels. Two New York mines in the Adirondacks produce a third of the world's supply of this mineral. Granite, slate, and bluestone (sandstone) quarries show continued strength. By far the most important mines in the State of New York in the modern period are those that produce construction aggregates (crushed stone, sand, and gravel) and portland cement.

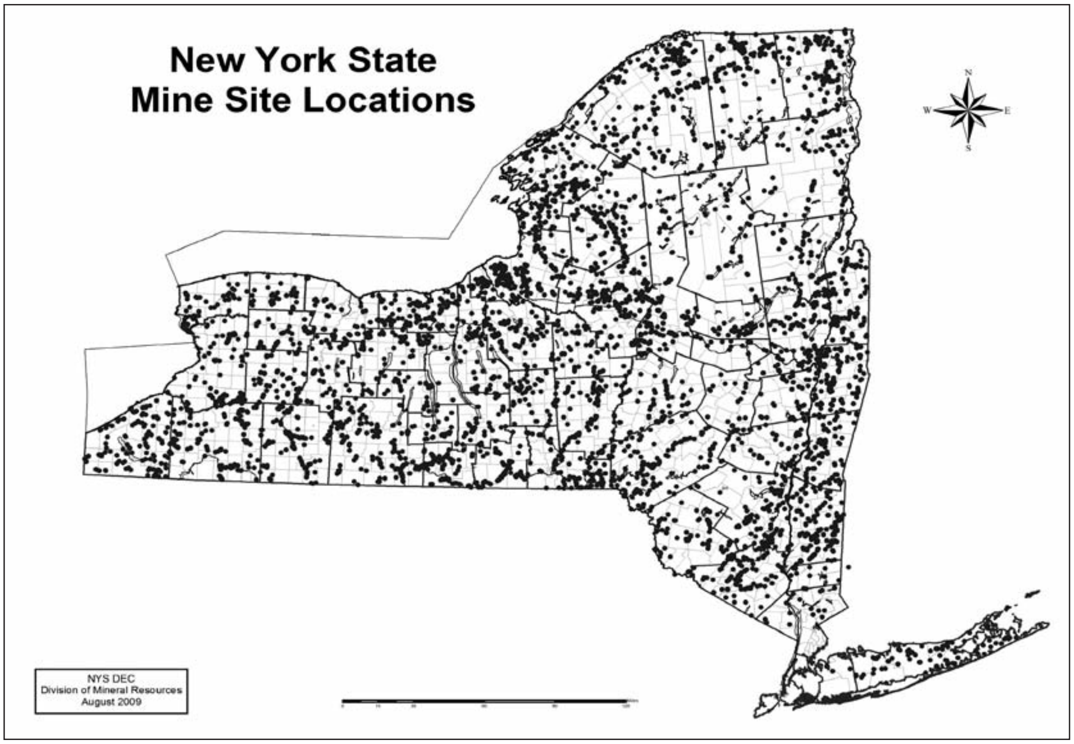

Figure 1. Location of mines of all types in New York.
Source: NYS Department of Environmental Conservation, Division of Mineral Resources.

CURRENT PRODUCTION

In 2009, there were approximately 2,200 permitted mines in New York (NYS Department of Environmental Conservation 2007) (Figure 1). Of these, about 460 were operated by governmental agencies. Mines operated in fifty-six counties in the state. During the last five to ten years, there has been a steady decrease in the number of mines and mining applications in New York. Mines are distributed relatively evenly across the state. This is because most mines produce materials used for construction aggregates, that is, crushed stone and sand and gravel. These are products that are high in volume but low in value. They must be produced close to market lest the value of transporting the material to the site of use exceeds the valued of the product itself. Depending on variables such as the cost of fuel and traffic congestion, the cost of hauling distances of thirty miles or less can be greater than the value of the material being delivered. A total of 64,000 acres in New York were affected by mining in 2007. Mining disturbs more than 0.30 percent of the land surface in only eight of New York's counties. The maximum disturbance is 0.41 percent. For comparison, 4.6 percent of New York is paved for roads and parking lots. Since 1975, 22,688 acres of mined land have been reclaimed (Figure 2).

Dimension stone (e.g., pavers, landscape stone, and architectural elements) is produced dominantly from sandstone (bluestone) deposits (Figure 3) but also from metamorphic rocks of generally granitic composition (Figure 4). A prominent exception is the anorthositic gneiss quarried in the Adirondack region under the guise of "granite." Colored slate, particularly red, is

Figure 2. Reclaimed talc mine with grasses and trees restored, Talcville, New York.

Figure 3. A wire saw is used to quarry blocks of sandstone, commercially known as “bluestone,” for use as dimension stone, Walton, New York. The blocks will be re-sawn to desired size and thickness.

Figure 4. Blue “granite” (anorthosite gneiss) is quarried in Ausable Forks, New York.

Figure 5. Crushed stone quarry, near Saranac Lake, New York. Rocks being extracted are marble (white) and granitic gneiss (dark).

quarried in Washington County. Several slate mining and distribution companies operate there but much of the slate is actually quarried in Vermont. Crushed stone used for construction aggregate is also primarily sedimentary rock in the form of dolostone, limestone, and sandstone. But in regions where these rocks do not occur or are of poor quality, metamorphic rock (Figure 5) and diabase (trap) are used. It should be noted that most of the “granite” mines operating in New York are actually producing crushed (granitic gneiss) stone. By far the largest numbers of mines in the State produce sand and gravel, a material widely deposited at the end of the last Ice Age. Clay was also widely deposited at the end of the last glacial period. The most extensive deposits, and the thickest, are in the Hudson River Valley. Once used for brick and tile manufacture, clay is now primarily used for landfill liner and cover. A special type of sand deposit, called industrial sand, yields fine-grained, uniform sand for molds used in casting metal.

Shale, till, marl, and topsoil are mined for fill or cover material. Peat, in the form of swamp deposits or

Figure 6. Peat mine, Columbia County, New York. Organic-rich muck (peat) is mixed with manure and sand to make potting soil. White material is marl.

"muck," is a component of potting soil or is used for agricultural improvement (Figure 6). The muck is piled to dry, then mixed with manure and sand and then reground to produce a marketable product. Garnet is mined for abrasive uses, both coated abrasives and loose powders, for fine grinding or garnet-assisted water jet cutting (Figure 7). By-product garnet is separated from wollastonite tails and used for sand blast grit. Rock salt, used mostly for melting ice and snow, is produced from underground mines (Figure 8). Salt is also produced as brine by solution mining in New York for medical use and chemical feed stock. Wollastonite is mined and either marketed raw or, after chemical modification, for use as filler (Figure 9). This product has found a substantial market in automobile body panels in the past three decades. Commodities mined in New York, number of mines, and location are given in Table 1.

Mineral resources can only be mined where they occur. The bedrock and surficial geology and geologic history of New York control where materials can be mined. Not all resources are located advantageously close to markets. Some resources simply do not occur in large areas of the state. An example is the lack of high-quality carbonate rock sources in the Southern Tier. In this case, materials must be transported into the area, with attendant increased product cost. Furthermore, because a particular resource, such as limestone or sand and gravel, is present in a region, it does not necessarily follow that the resource is available for mining. Many issues can restrict or preclude mineral extraction. For example, road access may not be sufficient for heavy trucks, or environmental constraints may exist that preclude mining in an area. The establishment of a mine may not be compatible with wetlands or scenic rivers. Soil type, such as prime agricultural land, archeological

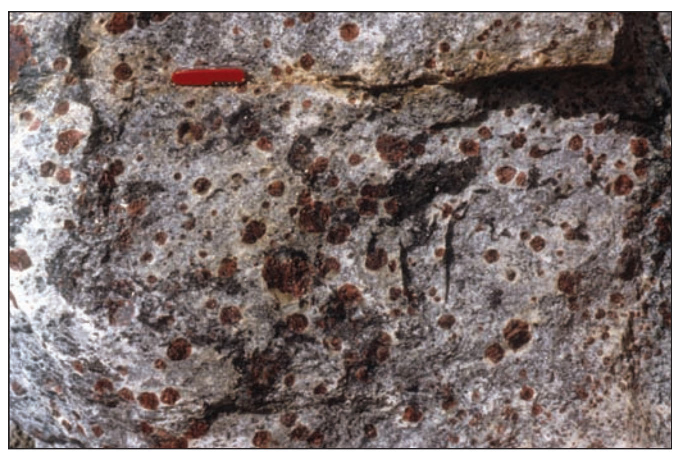

Figure 7. Garnet ore at Barton Corporation's Ruby Mountain Mine. Knife is 4 inches long. Tenor is approximately 15% garnet of the pyrope-almandine variety.

Figure 8. Pillar of halite (rock salt) in an underground mine in central New York. The ore is greater than 95% halite.

Figure 9. Wollastonite mine face, Lewis, New York. Tenor of the ore is up to 60% wollastonite. Dark streaks are pyroxene (diopside) and grossular-rich garnet.

resources, and the presence of existing mines, must be considered. A mineral resource may already have something built on it. If a commercial shopping mall or private residence is constructed on a deposit of gravel or limestone, that resource will not be available for mining no matter what the quality of that resource. Finally, local zoning or land-use laws may not permit establishment of a new mine or expansion of an existing one.

MONETARY VALUE

New York consistently ranks fourteenth to sixteenth in mineral value produced in the fifty United States. The USGS (2008) annually surveys mineral producers in New York and estimates that the total value of mineral products mined in the state in 2007 was $1.6 billion (see also: Appendix 1 on economic impact, this volume). Crushed stone is generally the leading mineral product. Following this in value are cement, salt, and construction sand and gravel. New York is the only source of domestic wollastonite in the United States. New York is first in the production of industrial garnet, third in salt production and, until early 2009, fourth in talc. Total production and value are given in Table 2.

Table 1. Commodities Mined in New York.

Commodity	No. of mines	Produced in: (county)
Bluestone	84	Albany, Broome, Chenango, Delaware, Tompkins, Ulster
Clay	35	Albany, Cayuga, Chautauqua, Delaware, Erie, Niagara, Onondaga, Rensselaer, Saratoga, St. Lawrence, Ulster, Washington, Yates
Dolostone	25	Clinton, Dutchess, Hamilton, Herkimer, Monroe, Montgomery, Niagara, Orange, Orleans, Rockland, Saratoga, St. Lawrence, Ulster, Washington, Wayne
Garnet	1	Warren
Glacial till	2	Cayuga, Onondaga
Granite	23	Dutchess, Essex, Franklin, Fulton, Jefferson, Oneida, Saratoga, St. Lawrence, Warren, Washington
Industrial sand	1	Oneida
Limestone	82	Albany, Cayuga, Clinton, Columbia, Erie, Genesee, Greene, Herkimer, Jefferson, Lewis, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orleans, Oswego, Putnam, Saratoga, Schenectady, Schoharie, Seneca, St. Lawrence, Tompkins, Ulster, Warren, Washington, Wayne
Marble (crushed)	2	St. Lawrence, Rensselaer
Marl	1	Genesee
Peat	5	Cattaraugus, Columbia, Rensselaer, Schenectady
Salt (rock)	2	Livingston, Tompkins
Salt (wells)	124	Schuyler, Wyoming
Sand & gravel	1,744	All counties except: Bronx, New York, Queens, Richmond, Rockland, Westchester
Sandstone	27	Chenango, Clinton, Delaware, Franklin, Greene, Orange, Orleans, Rensselaer, St. Lawrence, Steuben, Sullivan, Ulster, Washington
Shale	46	Albany, Allegany, Broome, Chenango, Erie, Greene, Jefferson, Lewis, Orange, Rensselaer, Saratoga, Schenectady, Schoharie, Sullivan, Ulster, Washington, Westchester
Slate	11	Washington
Topsoil	22	Chemung, Erie, Herkimer, Jefferson, Niagara, Oneida, Oswego, Otsego, Saratoga, St. Lawrence, Steuben, Tioga, Washington
Wollastonite	2	Essex, Lewis
Zinc	1	St. Lawrence

Source: New York State Department of Environmental Conservation 2009.

Table 2. Mineral Production and Value* in New York as Measured by Shipments, Sales, or Marketable Production.

Commodity	2005 quantity	2005 value	2006 quantity	2006 value	2007^p quantity	2007^p value
Clay	785	11,657	813	30,430	699	28,488
Gemstones	NA	78	NA	90	NA	96
Gypsum	2,226	11,409	413	2,118	299	1,535
Salt	6,835	326,518	4,885	257,312	7,985	400,491
Sand & Gravel	31,293	203,537	34,962	235,857	33,301	277,740
Stone, crushed	52,583	446,601	52,636	437,847	46,780	426,943
Stone, dimension	42	7,471	39	3,856	49	6,450
Combined: cadmium (zinc by-product, cement, garnet (industrial) talc, wollastonite, zinc)	XX	286,252	XX	368,282	XX	393,174
Total	**XX**	**1,293,523**	**XX**	**1,335,792**	**XX**	**1,534,917**

*Thousands of metric tons and thousands of dollars, ^{p}Preliminary, XX not applicable, NA not available. Data are rounded to no more than three significant digits; may not add to totals shown.
USGS 2008.

Chapter 3

CRUSHED STONE

The use of crushed stone for construction projects has a long history in New York. The State Geologist, Frederick Merrill, reported in 1895 that crushed stone was the material of choice for making durable roads of good quality. At that time, trap rock, granite *sensu lato*, and metamorphic rock, limestone, sandstone, and shale were used for road metal. Merrill noted that limestone was the best material as the fine-grained detritus produced in the crushing process acted like mortar when placed on a road surface. Igneous and metamorphic rocks did not produce cohesive fines and were less favored. He also noted that if these rocks were micaceous, they disintegrated rapidly. Shale was to be avoided except for local, light-duty roads. Sand and gravel were relegated to base layers (Merrill 1895). The production and use of crushed stone grew as New York's economy expanded. While the total amount of stone quarried in New York remained relatively constant, the advent of concrete use for building and construction projects caused the amount of dimension stone produced in New York to decrease while crushed stone tonnage increased. By the 1920s, crushed stone accounted for 50 percent of the total value of stone produced in the state (Newland 1921).

In the late nineteenth century, small crushed stone operations were widespread in New York. Often, the stone to be crushed was stripping waste that was produced as a quarry was developed for another resource. However, even at that time there were some larger quarries established specifically for the production of crushed stone (Merrill 1895). Trap rock (diabase) from the Palisades in Rockland County was quarried in large quantities. Dolostone from quarries farther north on the Hudson River provided what was then recognized as a superior product for road surfaces. Quarries in the Hudson Highlands (e.g., Iona Island) were established to feed the construction and concrete industries; the fine residue from the crushing process was sold as polishing compound. One of the largest quarries in the state at the time was located in South Bethlehem, Albany County. Dedicated crushed stone quarries existed west of Albany in Schoharie County.

GENERAL GEOLOGY

As noted above, several types of stone were used for crushed stone in the past. That is also true currently. In the past, materials used for making roads varied locally. If a road was intended for light to moderate traffic, local stone, whatever it consisted of, could safely be used. Shale was an exception to this rule. However, if traffic was anticipated to be heavy, use of high-quality aggregate was economically warranted. Unfortunately, rocks that produce good-quality crushed stone are not evenly distributed geographically in New York and this results in the necessity to import suitable stone.

At present, several types of rock can be used for crushed stone in New York. These included igneous rocks such as diabase (trap) and granite; metamorphic rocks such as gneiss and marble; and sedimentary rocks, most prominently represented by limestone, dolostone, and sandstone. Figure 11 shows the distribution of rocks that can be quarried for crushed stone that will meet modern quality specifications. In practice, igneous rock is rarely used for crushed stone as little of this rock type exists in New York. Trap rock is only quarried from the diabase sill in Rockland County and there is little unmetamorphosed granite in New York.

However, rocks of high metamorphic grade are abundant in the Adirondacks and in the Hudson Highlands and Manhattan Prong of southeastern New York. Commonly, what is called crushed "granite" is in fact metamorphic rock such as granitic gneiss. The mineralogical composition of these rocks is variable in terms of modal percent quartz, plagioclase, and K-feldspar. So strictly speaking geologically, the rocks are meta-granite, meta-syenite, meta-quartz diorite, and so on. Some marble units and calc-silicate rock produce acceptable-quality aggregate. Perhaps surprisingly, a micaceous pelitic gneiss is the source of crushed stone at a quarry in Dutchess County.

Among the sedimentary rocks, sandstone and carbonate units produce suitable stone. Within the realm of carbonate rocks, all other properties being equal, the amount of noncarbonate minerals present, expressed as

Figure 15. Wheeled loading and hauling equipment is used to move blasted rock to the crushing plant.
Courtesy Callanan Industries, Inc.

Quarry blasts typically liberate between 10,000 and 15,000 and between 70,000 and 100,000 tons of material. The size of the blast and layout of the shot pattern must take the geology, structure, and weaknesses in the rock (mud seams), and neighboring properties, into account. A typical crushed stone quarry is shown in Figures 13 and 14 on page 14. The blasted material is loaded into haul trucks (Figure 15) to be transported to a fixed or movable crusher (Figures 16a, 16b), but it is not uncommon for "load and carry" procedures to be used. Trucks vary in capacity, dependent on the needs of each operation, but typically range from 30 to 35 tons to 75 tons with about 50 tons capacity being the average. The crushed product is screened and stockpiled (Figure 17).

Figure 16a. Truckload of blasted rock at primary crusher.
Courtesy Callanan Industries, Inc.

Figure 16b. Rock dumped into primary crusher.
Courtesy Callanan Industries, Inc.

Figure 17. Typical crushing and screening operation. Primary crusher (right) feeds material to secondary crushers and sizing screens. Material is stockpiled by size (background).
Courtesy Callanan Industries, Inc.

PRODUCTS AND USES

The term "crushed stone" is applied to rock that has been broken into small, irregular fragments of specific particle size (Table 4). In 2006, 52,100,000 metric tons of crushed stone were used in New York (USGS 2006). Due to the economic downturn of the past two years, the 2008 total production of crushed stone was about 43,852,000 metric tons (Table 5). The material is used in metallurgical and agricultural operations, but by far, the majority of crushed stone used in New York is consumed by the construction industry. It can be used without a cement or bitumen binder or it can be mixed with a binding substance such as asphalt or portland cement. Unbound materials are used for a variety of purposes including road base, road surfacing, railroad ballast, or filter stone. Bound crushed stone is used in concrete and black top for road construction and repair, airports, dams, sewers, and residential and commercial foundations (Tepordei 1985).

Information about companies that produce crushed stone in New York is published by the New York State Department of Environmental Conservation, Division of Mineral Resources. Data organized by commodity is available in electronic format at http://www.dec.ny.gov/cfmx/extapps/MinedLand/standard/commodities. More specific information is available in a searchable mines database available at http://www.dec.ny.gov/cfmx/extapps/MinedLand/search/mines.

AVAILABILITY

Many geological formations in New York that can be used as a source for crushed stone have been mapped and adequately described in the past century. As a result, exploration for and development of new mines will most likely occur in one of the known formations. However, as has been shown, geological materials suitable for good-quality crushed stone are not uniformly distributed in the state. It will be necessary to continue to transport certain products (e.g., concrete sand or high-friction aggregate) from one part of New York to another, or import the material from out-of-state. Furthermore, the environmental and land-use issues that affect sand and gravel mines also impact the crushed stone industry.

It is very important that there be planning, at the state and local levels, for future mineral resources of all kinds, but specifically for construction aggregates. These geological materials directly support the physical infrastructure and economic development of New York's communities. Zoning and land-use planning can effectively direct most industrial operations into areas reserved for such activities. Preserving these resources for sustainable growth will require that the rocks be identified, characterized for suitability and, in the best case, protected from uses that would prohibit mining.

QUALITY

Details regarding the chemical and physical properties of crushed stone products to be used in New York are specified by the New York State Department of Transportation, Standard Specifications (New York State Department of Transportation 2008). The following generalized description of quality requirements for construction aggregates is derived from Herrick (1994). Stone to be used for aggregates should have a tendency to break into equant, roughly cubic particles with a minimum of flat and elongated shapes. Important physical

Table 4. Definitions and Specifications of Selected Aggregate Products.

Product	Specification
	Large coarse aggregate
Macadam	3.5 to 1 inch (90 to 25mm)
Riprap, jetty stone	Heavy, irregular rock for river, harbor, dam, and shore embankment protection
Filter stone	Crushed stone in sublayer under riprap or jetty stone
	Graded coarse aggregate
Concrete aggregate	3.5 inch to No. 4 sieve (90 to 4.75mm)
Bituminous aggregate	3.5 to No. 4 sieve (90 to 4.75mm)
Bituminous surface aggregate	1.5 inch maximum
Railroad ballast	75 to 1.5 inch (1905 to 37.5 mm)
	Fine aggregate, stone sand
Stone sand – concrete	Crushed fine aggregate produced from quarried stone, No. 4 sieve to No. 200 sieve (4.75 to 0.074mm)
Stone sand – bituminous mix and seal	Crushed fine aggregate produced from quarried stone, No. 4 sieve to No. 200 sieve (4.75 to 0.074mm)
	Combined coarse and fine aggregate
Graded road base or sub-base	2 inch to No. 200 sieve (50 to 0.074mm)
Unpaved road surfacing	1 inch to No. 200 sieve (25 to 0.074mm)

Source: New York state Department of Transportation 2008.

Table 5. Crushed Stone Production in New York.

Type of stone	Number of quarries	Quantity (Metric tons)	Value
Limestone	59	24,412,000	$220,500,000
Dolostone	18	10,063,000	84,093,000
Sandstone	14	2,348,000	27,759,000
Granite	8	1,194,000	13,517,000
Slate and marble	5	228,524	2,211,000
Other	24	5,606,500	44,388,000
Total	**128**	**43,852,024**	**392,430,000**

Source: USGS 2008.

properties for crushed stone are strength, porosity, and the ability to resist volumetric change in freeze/thaw conditions. Fine-grained rocks tend to be stronger and more abrasion resistant. Tightly interlocking grains produce the best aggregates.

Well-cemented sedimentary rocks, often found in older geologic formations, yield acceptable aggregate. High clay-content rocks, such as shale, produce crushed stone dominated by flat, elongated fragments. Furthermore, these rocks will often disintegrate when subjected to repeated freezing/thawing or wet/dry cycles and hence are unacceptable. Clay content may also make dolomitic rocks unsound. The presence of easily weathered minerals such as feldspars, ferromagnesian silicates, and sulfides can be deleterious.

Rocks to be used for construction aggregates should be chemically inert. Rocks containing silica in the form of chert or chalcedony may react with highly alkaline cement and cause concrete to deteriorate. Certain carbonate rocks in New York, for example, the Onondaga Formation, contain abundant chert. Dolomitic limestone with moderate to high clay content also is not acceptable due to potential microfracturing caused by chemical reaction between the aggregate and the cement. Iron sulfide minerals in aggregate will react to form hydroxides and sulfates and can be deleterious if present in excessive amounts. The minerals pyrite and marcasite are very common in some of New York's limestone and dolostone. Breakdown of these minerals, when present in concrete, can lead to discoloration and also to expansion and weakening of the mix. Aggregate rich in quartz can have high negative surface charge on the particles that causes bituminous cements to separate from the aggregate. Water can penetrate between the aggregate particle and the binder, causing separation (stripping) and failure of blacktop mixes. Quartzite, along with some granite and high-grade metamorphic rocks, can have this effect. However, chemical additives can mitigate the problem.

In some cases, unusual chemical properties of New York rocks can increase their utility and market value. Chemically pure forms of carbonate rocks can be used for chemical stone, flue gas scrubber, and cement. Stone for filters and flue gas scrubbers call for $CaCO_3$ content of 90 percent or greater. That used for cement requires limestone with low (<4%) MgO and low total Na_2O and K_2O. For example, in central New York, the Jamesville Member of the Manlius Formation and the Edgecliff Member of the Onondaga Limestone are chemically suited for use in the Solvay process for the production of soda ash. Limestone, which can be used for flue gas desulphurization, can be quarried from the Chamont Limestone of the Black River Group in northwestern New York. The Beacraft, Manlius, and Coeymans Formations of the Helderberg Group have long been a raw material source for the manufacture of cement.

DISTRIBUTION

Carbonate rocks are the most commonly used for construction aggregates in New York. These rocks are generally found statewide with some notable exceptions. The generalized distribution of carbonate rocks in New York is shown on Figure 18. Statewide, the youngest carbonate units have the simplest distribution patterns. These strata, and the noncarbonates with which they are interlayered, are nearly flat-lying but generally dip slightly to the south and west. In central and western New York, the carbonate rocks are exposed in east–west trending outcrop belts. Along the Hudson River in eastern New York, carbonate rocks crop out in belts that trend north to south. No carbonates are exposed in the Southern Tier of counties along the Pennsylvania border. Sandstone and shale conceal the limestone and dolostone in this area.

The youngest carbonate unit in New York is limestone of the Middle to Late Devonian Tully Formation. It is exposed to the north of the Pennsylvania border in central New York. Its outcrop belt trends east–west. Eastward, where rocks of equivalent age are exposed, the Tully Limestone is completely replaced by shale and sandstone units. North of the Tully outcrop belt (and stratigraphically older rocks) are the Middle Devonian Hamilton Group, Middle Devonian Onondaga Formation, Early Devonian Onondaga Formation, the Early Devonian Helderberg Group, and the uppermost Silurian carbonates. These units are exposed in parallel east–west outcrop belts. These carbonate units extend to Albany County where the units change orientation to become north–south trending outcrop belts immediately to the west of the Hudson River. The rocks extend from there southward into New Jersey. The outcrop pattern of the oldest and northernmost carbonate unit exposed in central and western New York, the Lockport Group, trends east–west only and disappears near Utica.

Older Late Cambrian and Early Ordovician carbonate rocks underlie the carbonate units exposed in central and western New York and also form north–south trending outcrop belts in eastern New York. Uplifts of the Adirondack Dome and the Frontenac Arch have been sufficient to expose the older carbonates on the flanks of these areas. Outcrop patterns of carbonate units outcropping around the dome and arch reflect the structural complexity of the areas and the limited lateral extent of some of the units.

In the Hudson Highlands of southeast New York, Lower Cambrian quartzite and Middle Cambrian–Upper Ordovician carbonate strata are exposed. Tectonism imparted a northeast–southwest trend to the outcrop patterns of these carbonate rocks. The irregularity of the carbonate outcrop pattern reflects the extensive folding and faulting of the strata. All of the carbonate rocks described below are being, or have been recently, used for aggregate resources in New York.

CARBONATE ROCK RESOURCES

Tully Formation

The Tully limestone crops out in the Finger Lake region of central and western New York from Canandaigua Lake in Ontario County eastward to the Chenango River Valley in Chenango County. Heckel (1973) subdivided the Tully into two members, Upper and Lower. The Lower Member extends only as far eastward as the east branch of the Tioghnioga Valley between DeRuyter and Sheds in Madison County, where it is truncated by the Upper Member. Farther east in the Chenango River Valley, the Upper Member is replaced by shale and sandstone. Heckel (1973) described the Tully as a well-bedded, hard, dense, medium-gray to light-gray fine-grained limestone. The uppermost part of the Tully from Cayuga Lake eastward is interbedded with black shale and is transitional with the overlying shale. To the east of the Skaneateles Lake area, the Tully becomes progressively more sandy and shaley to the exclusion of the carbonate rock. The Tully averages 7 meters (22 feet) in thickness. Locally it exceeds 10.7 meters (35 feet). The Tully thins laterally, disappearing westward and thinning to 7 feet in its last exposure to the east.

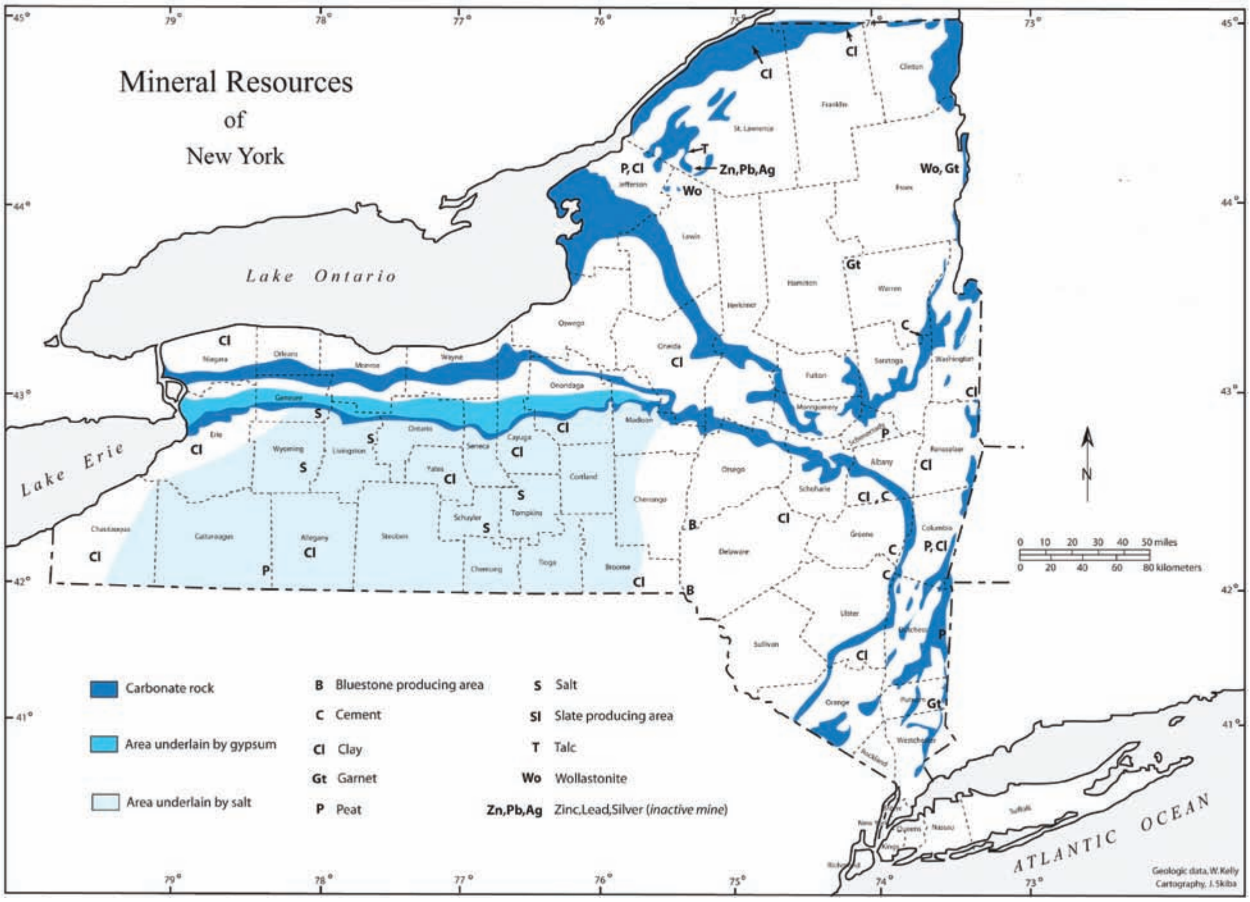

Figure 18. Distribution of carbonate rock in New York.

Onondaga Formation

The lower Middle Devonian Onondaga is a very widespread unit in New York. The limestone extends from Illinois eastward through New York and southward into Tennessee. In New York, it crops out from the Buffalo to the Helderberg region in Albany County where its outcrop belt sharply changes orientation and extends southward to Kingston and then southwestward to enter New Jersey near Port Jervis. Oliver (1954, 1956) was able to distinguish four members of the Onondaga based upon fossil content and lithology. The members are from oldest to youngest: Edgecliff, Nedrow, Morehouse, and Seneca. Chert is very abundant in some of the strata above the Edgecliff and below the Nedrow in the western part of the state. Ozol (1963) designated the strata in this interval as the so-called Clarence Member of the Onondaga. The fossil content, lithology, and the gamma-ray pattern recorded in wells (Rickard 1975) indicate that the Clarence is a chert-rich facies referable to the Edgecliff. Lindholm (1967) subdivided the Onondaga in the Buffalo to Albany County area based on lithology and fossil abundance. There is little correspondence between the subdivisions of Oliver and those of Lindholm. The relationship between Lindholm's lithofacies and the members of Oliver and Ozol is shown in Lindholm (1967). There has been no attempt here to reassign the named members to the lithofacies of Lindholm (1967).

The Onondaga limestone is to various degrees chert-bearing throughout, although the stratigraphic position of the chert-rich horizons and the overall abundance of chert varies. The unit is mostly fine-grained limestone except for the lower part, which is coarse-grained and composed predominantly of fossils. From the area south of Utica and west to Geneva, the middle of the unit contains more clay and dolostone than elsewhere. Near Syracuse in Onondaga County the Onondaga limestone is about 21 meters (70 feet) thick. Its thickness increases both to the west and to the east—reaching nearly 46 meters (150 feet) in thickness in the Buffalo area, about 33 meters (110 feet) in Albany County, greater than 49 meters (160 feet) near Kingston, and an estimated 61 meters (200 feet) near Port Jervis.

The Economic Impact of the New York State Mining and Construction Materials Industry

October, 2011

Prepared for:
New York State Geological Survey / New York State Museum

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TABLE OF CONTENTS

INTRODUCTION

The mining and construction materials industry (MCMI) in New York State makes an economic impact on the state's economy as great as 30,000 jobs, $1.3 billion in total payroll and about $100 million in public sector revenues. Total sales for the industry are between $3.3 billion and $3.5 billion. The Center for Governmental Research developed these estimates using a number of resources, including a survey of industry participants. Details of the approach used and assumptions applied follow.

The mining industry in New York State is large and diverse, encompassing commodities such as bluestone, clay, dolostone, garnet, granite, industrial sand, limestone, peat, salt, shale, sandstone, talc, trap rock, wollastonite, zinc, sand and gravel, gypsum, glacial till, marble, marl and topsoil. Highway construction, new housing construction, ice control, and landscaping are among the wide variety of projects that use these materials.

The majority of mining in New York provides construction materials that are used to build and maintain the State's infrastructure. Thus, in addition to the products listed above, three other critical project resources include hot mixed asphalt (HMA), ready mix concrete (RMC) and cement. Together with crushed stone of all types and sand & gravel, these materials drive the New York State mining and construction materials industry (MCMI).

Other economically-significant uses of the output of this industry are bridge construction, commercial and public construction projects, drainage control, parking and driveway paving.

CGR surveyed firms within the MCMI industry to obtain production, sales, employment and wage information. CGR then estimated MCMI's impact on the NYS economy as a whole, but does not provide estimates of the local impact on communities in which the mines are located. Both economic and fiscal impacts are estimated; CGR reports economic impact in terms of jobs and wages generated, and fiscal impact in terms of sales tax and income tax generated.

This report helps to shed further light on the very important role that the mining and construction materials industry plays in the state. In addition to the traditional economic impact study, CGR estimated the effect of reducing the number of mines in the state. If all communities were to adopt a "not in my backyard" mentality, the cost of construction would increase. This report illustrates the potential impact of the removal of mines from close proximity to construction sites. While the method used does not begin to address the cost impact on all construction projects in NYS, it provides a starting point for consideration and discussion.

OUTLINE OF REPORT

CGR's findings are presented in five parts:

(1) *Survey Results:* CGR summarizes the results of a survey sent to 204 companies.

(2) *Extrapolation of Survey Data:* CGR uses the results of the survey to extrapolate information about the remaining operations in NYS in order to estimate the potential sales revenue in NYS for 2007.

(3) *Economic and Fiscal Impact Estimates:* CGR estimates the economic impact of the mining and construction materials industry using the IMPLAN input-output modeling system. In addition, CGR provides sales and personal income tax estimates for the labor income generated in the industry, fuel taxes, corporate taxes paid to NYS from the mining industry, and fees paid under the Mined Land Reclamation Law.

(4) *Impact of Reduced Number of Mines:* CGR considers the impact on costs of NYS Thruway capital and maintenance projects if some mines were to "disappear."

(5) *Methodology:* CGR describes the methodology used throughout the report to extrapolate data and provide estimates.

FINDINGS

Survey Results

The New York State Department of Labor provides data on wages and employment for the mining industry. However, the category "mining" does not include the construction materials included in MCMI. Thus, CGR determined that it was necessary to collect primary data on the industry through a survey of mine operators. A copy of the survey can be found in the appendix.

Of the 204 companies who received surveys, 91 of them completed the survey.[*] These 91 companies will be referred to as the survey

[*]The 204 companies were chosen to fairly represent the different types of minerals as well as both the small and large players in the industry. In addition, all companies attending the NY Construction Materials Association meeting in May 2008 were given an opportunity to participate.

respondents, and it is their responses which are discussed in this section. The survey responses pertaining to employment, sales and production provide an illustration of the industry-wide numbers, but not industry totals. The results of the survey indicate that the MCMI is a powerful force in the NYS economy, as illustrated in the following tables.

- The survey respondents alone account for 6,500 full time jobs in New York State and about $310 million in payroll.

- The survey respondents alone totaled $1.7 billion in product sales in 2007.

Characteristics of Survey Respondents	
Number of Firms	91
Full Time Employees	6,419
Part Time & Seasonal Employees	460
2007 Payroll ($million)	$310.4

Summary of Survey Respondents: Sales & Production

	Mining	HMA	RMC	Cement	Total
Number of Permitted Mines/ Number of Plants	331	129	95	3	558
2007 Production (millions of tons, except RMC - millions of yards)	69	12.6	2.9	2.4	N/A
2007 Sales (millions of dollars)	$779.8	$450.5	$235.1	$254.1	$1,719.5

Extrapolation of Survey Data

The tables above do not represent the entire industry. As the following figures attest, this $1.7 billion represents only a small portion of the total sales and production of the industry. CGR used the following data to extrapolate the survey results for each segment of the industry, ultimately allowing sales estimates for the entire industry.

Mining Operations

The 91 firms from the survey represent 191 operational mines with sales of about $780 million. As CGR estimates total mining sales as between $1.4 billion and $1.6 billion, the survey captured about half of the industry.

Hot Mixed Asphalt

According to the Asphalt Institute, NYS produced a total of 19.5 million tons of HMA in 2006.* Thus, the survey respondents represent 64% of the estimated NYS HMA industry.

Ready Mixed Concrete

According to the National Ready Mixed Concrete Association, NYS produced 11.615 million cubic yards of RMC in 2007. The survey respondents account for approximately 25% of the total 2007 RMC production in NYS.

Cement

Similarly, the Northeast Cement Shipper's Association calculates that there were 3,748,916 tons of cement shipped within New York between 10/1/05 and 9/30/06.† The survey responses represent 63% of the cement shipped within NYS during that time period. Some of the cement shipped is imported from outside NYS, so 3.7 million tons is larger than the total produced in NYS. The analysis includes all three NYS cement producers.

Sales Estimates

As stated, the 2007 sales and production figures reported by survey respondents are only a portion of the more substantial sales and production totals for the industry as a whole. CGR has extrapolated the survey data to

Total Sales of Mining & Construction Materials Industry (millions of dollars)	
Mining	
High Estimate	$1,630
Low Estimate	$1,441
Hot Mixed Asphalt	$704
Ready Mix Concrete	$940
Cement	$254
TOTAL	
High Estimate	$3,528
Low Estimate	$3,339

* The statistic is calculated from the data on liquid asphalt by using a conversion factor that HMA is produced using 5% liquid asphalt.

† Latest data available

estimate the potential sales revenue generated by the MCMI industry. CGR estimates that in 2007 the MCMI generated between $3.3 billion and $3.5 billion in sales.*

Economic and Fiscal Impact Estimates

An economic impact study estimates the wages and jobs that an industry is responsible for generating as a result of its economic activity. Essentially, it answers the question, "How is the economy larger because of this industry's activity in the community?"

Economic impacts are measured in terms of two types of expenditures: direct and spillover. The **direct** economic impact consists of the actual expenditures of NYS MCMI, i.e., the industry is directly involved with the transaction. **Spillover** expenditures result from the subsequent spending of those who receive the direct expenditures. Thus, an employee of a sand and gravel mine is part of the direct employment impact. The employees of supplier firms or of retailers who receive the patronage of mine employees are considered part of the spillover employment impact.

Labor Income and Employment Impacts

CGR reports the economic impact in terms of labor income and employment, as the following table shows.

Economic Impact of the MCMI

	Direct	Spillover	Total
Labor Income (millions of dollars)			
High Estimate	$833.6	$482.4	**$1,316.0**
Low Estimate	$765.1	$442.8	**$1,207.9**
Jobs (thousands of jobs)			
High Estimate	17.5	12.9	**30.4**
Low Estimate	16.1	11.9	**28.0**

CGR estimates that the MCMI generated between $1.2 billion and $1.3 billion in wages and was responsible for 28,000 to 30,000 jobs throughout New York State in 2007.

By way of comparison, the wood product manufacturing sector is responsible for about $335 million in payroll and employs about 9,300.

* See methodology section for more details about the extrapolation procedure. The sales estimate assumes the survey respondents produce the same revenue per unit of product as those not responding to the survey.

Primary metal manufacturing pays about $700 million to 12,000 workers, while the warehousing and storage sector pays its 20,000 employees about $800 million. The average direct payroll per worker used in the study was about $48,000, slightly higher than the median salary for NYS industry .

Fiscal Impact

CGR provides a conservative estimate of the fiscal impact of the MCMI. Not all taxes and fees were included in these estimates. We include:

- Local and state sales tax, and personal income taxes paid by individuals employed by the industry (both direct and spillover);*
- Fuel taxes paid by industry participants;
- Fees paid according to the Mined Land Reclamation Law; and
- Corporate franchise taxes (we used the latest data available--2004—from the New York State Department of Taxation and Finance for C Corporation taxpayers in the mining industry).†

Fiscal Impact of the MCMI (millions of dollars)

	Direct	Spillover	Total
NYS and Local Sales Tax			
High Estimate	$22.6	$13.1	**$35.7**
Low Estimate	$20.8	$12.0	**$32.8**
NYS Personal Income Tax			
High Estimate	$28.6	$13.3	**$41.9**
Low Estimate	$26.3	$6.5	**$32.8**
Corporate Tax*	$5.8	n/a	**$5.8**
*As reported by the NYS Department of Taxation & Finance - 2004- mining only			
Mined Land Reclamation Law (MLRL)	$2.9	n/a	**$2.9**
Motor Fuel Tax			
High Estimate	$14.8	n/a	**$14.8**
Low Estimate	$13.1	n/a	**$13.1**
Total Fiscal Impact			
High Estimate	$74.7	$26.4	**$101.1**
Low Estimate	$68.9	$18.5	**$87.4**

* Depending on the residency of the direct and spillover employees, there may be additional local income taxes generated (e.g. NYC personal income tax).
†When considering the entire MCMI industry (not just mining), the corporate tax generated is obviously much larger than that reported in the fiscal impact table.

Based on CGR estimates, in 2007 the public sector in NYS gained between $87 million and $100 million as a result of the MCMI.

Impact of Closing Mines on Transportation Costs & Cost of Construction

Mining operations within the mining industry are often forced to defend their existence. Many voters would prefer not to have a mine in their community. To illustrate the cost implications of not having operational mines in the vicinity of construction projects, thereby increasing the distance from mines to construction sites, CGR analyzed the impact that removing a percentage of mines would have on the transportation costs of aggregate.

CGR considered the 496 miles of the NYS Thruway mainline in constructing this hypothetical scenario. Given the sporadic nature of construction, CGR used the average metric tons of aggregate utilized by the NYS Thruway over the last three years to calculate the cost of transporting aggregate from the mine to the highway construction site.[*] CGR calculated the mileage from each mainline Thruway exit to the nearest of the76 limestone, dolostone, and traprock mines (commodities most heavily used in construction) across New York State. Given the rising cost of fuel over the last year, CGR computed the cost of transporting the metric tons of aggregate for various fuel costs and found that:[†]

- Randomly removing one-quarter of the mines increased transportation costs by 42%, regardless of the price per gallon of fuel, by increasing the distance from an exit on the NYS Thruway to the nearest mine. If the price of fuel were to rise again to $4 per gallon, the cost of transporting the average amount of aggregate used by the NYS Thruway each year would increase by $1.6 million if one-quarter of the mines were randomly taken away, and by $2.2 million if the number of mines were reduced by one-half. This means that if any random one-half of the mines were no longer in operation, transportation costs for construction projects would increase by 59%—ultimately affecting NYS taxpayers.

[*] The average annual tonnage of aggregate used by the NYS Thruway is 768,800 metric tons.
[†] See the methodology section for details on the assumptions made for this illustration.

Annual Cost Implications of Increasing Transportation Distance				
	Cost of Fuel per Gallon	All mines included	One-quarter mines taken away	One-half mines taken away
Average Distance from Exit to Nearest Mine (miles)	----	13.5	19.1	21.4
Cost of Transporting Aggregate for Thruway Projects (millions of dollars)	$2	$3.4	$4.8	$5.3
Cost of Transporting Aggregate for Thruway Projects (millions of dollars)	$3	$3.6	$5.1	$5.7
Cost of Transporting Aggregate for Thruway Projects (millions of dollars)	$4	$3.9	$5.5	$6.1
Percentage Change in Cost (from all mines included)			42%	59%

METHODOLOGY

There is no one data source that gives an accurate picture of the mining and construction materials industry. The New York State Department of Labor provides data on wages and employment for mining, but this does not include the construction materials side of the MCMI. Furthermore, the DEC provides data on the number of active mines, and the number of affected acreage for these mines. However, not all permitted acreage is actively being mined. For these reasons, CGR determined it was necessary to first estimate the acreage being actively mined and then to collect primary data from mine operators via the survey. Details on the methodology used for both aspects, as well as for calculating the economic and fiscal impact, are included in this section.

Creating the Data Set

The DEC provides data on the number of permitted mines, with about 64,000 acres affected statewide. Not all the affected acreage is actively being mined. To estimate the number of acres currently being mined, CGR consulted with DEC's Division of Mineral Resources, including Director Bradley Field and Christopher McKelvey of the Bureau of Resource Management and Development, Resource Development Section and reviewed the data provided by their offices. CGR also consulted with industry experts, including NY Construction Materials Association Executive Director Dave Hamling, NY State geologist William Kelly and consulting geologist Paul Griggs. In addition, CGR used the data collected from survey respondents. To be conservative in our estimate of the economic impact of the mining industry, CGR determined that it would use a range of affected acres of 55,000 to 62,000. As 83% of affected acres among survey respondents were used for mining, CGR applied the same proportion to all mines included in the study. Thus, the operational acreage for the study analysis ranged from 46,000 to 52,000 acres.

Survey of Mine Operators

With support from the New York State Geological Survey / New York State Museum and the New York Construction Materials Association, CGR distributed 204 surveys to companies in the MCMI. Potential respondents were given the option of returning the survey via mail, fax, or e-mail, or completing an online version. The 204 companies were chosen to fairly represent the different types of minerals as well as both the small and large players in the industry. In addition, all companies attending the NY Construction Materials Association meeting in May 2008 were offered an opportunity to participate.

As seen below, survey respondents represented at least half of the industry. With such a firm foundation of actual responses, we make our extrapolations to the entire industry with confidence.

CGR received 103 responses, 12 of which were designated not applicable based on the respondent's self-reported status such as "out of business" or "sold out." Thus, the data CGR reported from the survey encompasses the 91 companies who completed the survey.

The survey specifically asked how many mines permitted by the DEC each respondent had. The 91 firms from the survey represent 191 operational mines with sales of about $780 million. As CGR estimates total mining sales as between $1.4 billion and $1.6 billion, the survey captured about half of the industry.

The commodities produced by the 191 operational mines accounted for in the survey are presented below.

Commodities Produced by Survey Respondents (Operational Mines only)				
Commodity	**Number of Mines**	**Percent of All Operational Mines**	**Total Acreage**	**Percent of All Operational Acres**
Bluestone	5	12%	44	13%
Dolostone	16	84%	1,903	85%
Garnet	1	100%	107	100%
Granite	7	47%	542	71%
Limestone	38	66%	6,877	77%
Salt	2	67%	9,932	99%
Sand and Gravel	104	15%	6,742	32%
Sandstone	7	15%	783	81%
Topsoil	2	22%	37	12%
Shale	4	29%	260	45%
Trap Rock	1	100%	153	100%
Wollastonite	3	100%	261	100%
Zinc	1	100%	432	100%
Total	191		28,073	

In all cases but topsoil, the percentage of operational acres represented by survey respondents is equal to or larger than the percentage of operational mines. This suggests that the mines in the survey represent, on average, the larger acreage mines of the commodities represented. Four commodities (clay, glacial till, marble and peat) are produced by operational mines but were not represented by the survey respondents.

Payroll Estimates

In order to estimate the payroll of the MCMI, CGR used employment and payroll information from the survey data to estimate wages and employment for the remaining mines for which we had no direct data beyond that included in the DEC's database of permitted mines.

Characteristics of Survey Respondents	
Number of Firms	91
Full Time Employees	6,419
Part Time & Seasonal Employees	460
2007 Payroll ($million)	$310.4

Since we did not ask survey respondents to attempt to estimate payroll and employment for each product—and many mines produce more than one—we did not have sufficient detail to estimate employment and payroll information by product. We did, however, separately estimate payroll and employment for mining operations on the one hand, and HMA/RMC/Portland Cement on the other.

Potential Total Sales Estimates

In order to estimate the potential total sales of the mining component of the MCMI, CGR used sales and production information from the survey to estimate sales per operational acre.

To estimate the potential total sales of the HMA component of the MCMI, CGR used sales and production information from the survey to estimate sales per ton of HMA produced. CGR then combined survey responses, the sales per ton estimate, and information from the Asphalt Institute on the total amount of HMA produced in New York State in 2006* to estimate the potential total sales of the HMA component of the MCMI.

Similarly, CGR estimated the potential total sales of the RMC component of the MCMI by using sales and production information from the survey to estimate sales per cubic yard of RMC produced. CGR then combined survey responses, the sales per cubic yard estimate, and information from the National Ready Mixed Concrete Association on the total amount of RMC produced in 2007 to estimate the potential total sales of the RMC component of the MCMI.

Using information provided by survey respondents producing HMA and RMC on payroll and employment, CGR estimated direct payroll and employment for nonrespondent firms.

Total Sales of Mining & Construction Materials Industry (millions of dollars)	
Mining	
High Estimate	$1,630
Low Estimate	$1,441
Hot Mixed Asphalt	$704
Ready Mix Concrete	$940
Cement	$254
TOTAL	
High Estimate	$3,528
Low Estimate	$3,339

Estimating the Economic Impact

CGR used IMPLAN, a regional input-output modeling system, for estimating the economic impact. IMPLAN is widely acknowledged as one of the best models of economic activity available. The IMPLAN database, created by MIG, Inc., consists of two major parts: 1) a national-level

* Latest data available.

technology matrix, and 2) estimates of sectorial activity for final demand, final payments, industry output and employment for each county in the U.S., along with state and national totals. Data are updated annually. IMPLAN estimates the direct and spillover (indirect and induced) impacts of economic change through the use of multipliers, and estimates the impact of an increase in demand in a particular sector on 511 different industries/sectors of the local economy.

Estimating the Impact of Reducing the Number of Mines

In order to calculate the additional cost of removing mines from proximity to the construction sites, CGR first mapped the 76 operational limestone, dolostone, and trap rock mines throughout NYS.* Using DEC data on the mines' latitude and longitude along with cartographic tools, we calculated the average distance from each of the 75 exits on the NYS Thruway to the nearest operational mine that produced one of these three commodities.

To calculate the absolute cost, CGR used the following assumptions:

Assumptions for Transportation Cost Analysis	
Labor cost per hour	$20
Overhead per hour (depreciation/maintenance of truck, etc)	$40
Cost per gallon of fuel	$2-$4
Number of miles driven in a day	240
Miles per gallon	4.5
Number of tons hauled in one load	20
Number of metric tons hauled in one load	18

The assumptions above equate to assuming $76 per hour per truck when gas costs $3 per gallon, $81 per hour per truck when gas costs $4 per gallon, and $87 per hour per truck when gas costs $5 per gallon. This includes all costs, including labor, depreciation, insurance, overhead and fuel.

CGR obtained information on the metric tons of aggregate used on the NYS Thruway for 2005, 2006 and 2007 from the New York State Thruway Authority to calculate the absolute costs of transporting aggregate. While the absolute costs are dependent on the previously explained assumptions, the percentage change in costs is in direct relationship to the percentage change in the average miles from the mine to the construction site. To that extent, this illustration can be extended to any type of construction project using aggregate. If the closest mine to a given construction site does not receive a permit and the distance to the

* These commodities are commonly used in construction projects.

nearest relevant mine increases by 50%, one can expect the costs of transporting the aggregate to increase by 50%.

These conclusions are applicable to the entire industry. Transportation costs are a significant share of the total cost of aggregates. Continued shrinkage of the industry will drive up the cost of new construction and highway reconstruction. Our data did not permit a more detailed analysis by region, but clearly the impact would be more pronounced downstate.

CONCLUSION

This analysis makes a powerful statement about the significant contributions that the Mining & Construction Materials Industry makes to the New York State economy. **This important industry pays $1.2 to $1.3 billion in wages to 28,000 to 30,000 workers. Total sales for the industry are $3.3 to $3.6 billion. In addition the industry provides possibly $100 million in payments to the public sector.**

Moreover, the cost of the products of the MCMI industry affects expenses for the entire construction sector, particularly the construction and maintenance of the state's critical road network. State and local government alike should recognize this industry's importance and take steps to preserve its viability.

APPENDIX: SURVEY OF MINES

Thank you for taking the time to fill out the survey. If you filled out the survey online, you do not need to do anything else. You are finished and may disregard the paper form of the survey below. If you have elected to fill out the survey in paper form rather than online, please fill out the following survey **ASAP** and return it to Rochelle Ruffer via fax: (585) 325-2612, e-mail: rruffer@cgr.org or mail to: CGR One S. Washington Street, Suite 400 Rochester, NY 14614. If you have any questions, feel free to contact me via e-mail or phone (585-327-7056).

All answers are confidential. If you are unwilling or unable to provide answers to all questions, please fill out the survey to the best of your ability and send back the survey with those questions for which you have provided answers. In order to cover all aspects of the mining industry, we've included cement plants in the survey. Please only respond to those questions relevant for you. In addition, the survey is specific to your New York State (NYS) operations.

Economic Survey of the Mining and Construction Materials Industries in New York State

1. List the number of operations you own or control in New York State for the following:

Mining operations covered by NYSDEC Permits	
Hot Mix Asphalt Plants	
Ready Mixed Concrete Plants	
Cement Plants	

2. Provide your 2007 production from all NYS operations for the following:

Mining / Aggregate production	tons
Hot Mix Asphalt	tons
Ready Mixed Concrete	yards
Cement	tons

3. Provide the total sales of your NYS production in 2007 for the following:

Mining / Aggregate production	$
Hot Mix Asphalt	$
Ready Mixed Concrete	$
Cement	$

4. What percentage of NYS sales goes to public works projects for the following:

Mining / Aggregate production	%
Hot Mix Asphalt	%
Ready Mixed Concrete	%
Cement	%

5. What product(s) do you produce at your locations? ____________________________

6. What is your ton-mile cost for delivering products? $______________ per ton-mile

7. What is the mileage of your typical / average delivery? _______________miles

8. Under which 4-digit NAICS Code do you report company data? ***(Check all that Apply)***

❑ **2122** (Metal Ore Mining) ❑ **2123** (Nonmetallic Mineral Mining and Quarrying) ❑ **Other**____________________

9. How many employees did you employ in 2007? **Full Time**________ **Part Time**_________

10. Provide your 2007 payroll. $ __________________________

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