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DELAWARE'S EXTRACTIVE MINERAL INDUSTRY

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### INTRODUCTION

The purpose of this report is to provide information on the mining industry of Delaware as an essential component of a growing economy. The industry, particularly in sand and gravel mining, must deal with uneven regulation, land use competition, and environmental pressures. It is hoped that the information gathered here will assist planning and regulatory agencies as well as an interested general public in evaluating the role of the extractive mineral industry. Funding for this Report was supplied by a contract with the Delaware Office of Management, Budget, and Planning, No. CEIP-78-5.

The report presents an overview of the mineral industry in Delaware, its history, commercial mineral resources, and, for each resource, a description of mining methods and potential environmental impact. It also examines the relationship between the industry and governmental regulation and discusses the particular problems created by increased competition for land from developers, ground-water supply requirements, conservationists, and sand and gravel producers.

The latter sections of the report consider the future of the Delaware mining industry, oil and gas potential in Delaware coastal waters, and recommendations for increased production and value in the mining industry.

### MINERAL RESOURCES OF DELAWARE

The State's primary mined production is not now accurately measured, but is a multi-million dollar industry. Minerals are more important to the State's economy, however, even than such figures indicate. If the values of minerals produced, minerals, fuel, and chemicals processed are all considered, the total contribution is estimated at \$1.4 billion according to the U. S. Bureau of Mines (Sutton et al., 1979).

The mineral resources of Delaware can be divided into several categories: (1) construction minerals (sand, gravel, clay, and dimension and crushed stone), (2) heavy mineral sands, (3) glauconite, and (4) "other" and "potential" resources including oil and gas. For the purpose of this study, two mineral groups: "Hard Minerals," and "Oil and Gas," will be used to classify these resources.

### Hard Minerals

The principal hard mineral resource group present in Delaware is the construction minerals: sand, gravel, clay, crushed stone, and dimension stone. All of these are mined by open pit or quarry operation that result in alteration of the land surface and that may affect the water quality and flow regimes of both surface and ground-water.

Sand and gravel are the principal mineral resources recovered in the State. They often occur together in large masses of coarse-grained material lying in discrete bodies, five to fifty or more feet thick, on or near the surface, and covering several acres. Such bodies usually occur in the Coastal Plain. They are permeable, well-drained, and usually contain large amounts of clean, near-surface, ground water. These characteristics make gravel bodies easily accessible mining targets, excellent building localities, and high-value water resource areas. Competition for these areas has been inevitable, and mining has come out a distant third. The competition for gravel lands is just one constraint on the industry. The extractive process will, if not carefully planned and conducted, modify the local environment and change the aesthetic character of the land at and adjacent to a pit. The high cost of truck transportation requires that pits be located in deposits as close to the consuming area as possible, making potential conflict and competition even more severe.

Some of these same problems are equally common to stone quarries. The hard bedrock required for stone quarrying occurs only in northern New Castle County where urban-suburban buildup has successfully competed for the necessary space to accommodate a quarry operation. Concerns about the blasting necessary to quarrying are particularly serious in the increasingly urban environment near Wilmington.

An additional complication that has become particularly serious in Delaware for all hard mineral extraction is the

tendency to dispose of solid waste in abandoned mined areas. Subsequent weathering of wastes endangers surrounding groundwater supplies.

Construction material resources essential to maintenance and growth of our economy are thus becoming less available in our expanding, land-hungry, urbanized society. In addition, our environmental consciousness constrains the producers in their efforts to open, operate, or enlarge pits. A large but uncalculated percentage of the sand, gravel, and stone used in construction is imported from Maryland and Pennsylvania at high cost and causes much wear on our highways. Recent attempts in certain parts of the State to open new pits have been faced with the need for multiple permits, jurisdictional controversy, and vehement opposition. These problems, coupled with increasing competition for potential mine lands, have had a negative effect on this small but essential industry. Many areas of Delaware that are attractive for industrial and residential development are also geologically suitable for mining and water supply development. The recent pressure to find appropriate sanitary landfill localities has intensified the competition for land resources. Only by intelligent management can the resulting conflicts be rationally resolved.

This trend can best be reversed by more farsighted land use management planning. In particular, construction might be given to a comprehensive surface mining law to provide a balance between the production of construction materials and maintenance of the environmental values. Given standardized permit procedures and reasonable operating rules, industry may be encouraged to develop in-state resources more effectively and in an environmentally prudent manner. Such a law should be supplemented with a balanced view of land use planning. State and local government should recognize that the increased cost of importation from out-of-state of construction materials is to be balanced against the cost and inconvenience of maintaining local sand and gravel operations. Future land planning decisions must include mining as a legitimate use of land.

The federal government, in large part through the Office of Surface Mining (OSM), is becoming increasingly active in mining regulation as indicated by the terms of the Surface Mining Control and Reclamation Act of 1977 (P.L. 95-87). Its objective is to protect "... society and the environment from the surface effects of mining." The focus is on coal, but Section 709 of this Act requires that a special study be

undertaken to determine the effects of surface mining of minerals other than coal. Sand and gravel open pit mining was specifically cited in Section 709. This study has been completed and a report of the National Research Council (Surface Mining of Non-Coal Minerals, 1979; National Academy of Science, Washington, D.C.) has been submitted to the federal government. Although no action to regulate non-coal surface mining has been taken, there are indications that both OSM and the U. S. Bureau of Mines (USBM) anticipate congressional consideration of regulation of non-coal surface mining.

### Oil and Gas

These resources occur in rock sediments like those found beneath the Atlantic Coastal Plain and the adjoining submerged continental shelf. Nearly all of the State is underlain by such rocks. Oil and gas deposits require specific conditions within such a framework, including source rocks to generate the oil, reservoir rocks to hold the oil, and sealing rocks to keep the oil from leaking out into the atmosphere (or ocean) and polluting. For further discussion see Benson (1979).

Drilling in the federally-owned mid-Atlantic offshore, which is a geologic continuation of the Coastal Plain, indicates that the oil and gas potential of the entire province is being seriously considered. Within State-owned lands, the authority to grant permits and leases to allow drilling in an environmentally-sound fashion lies with the State government.

A law was passed by the General Assembly in 1966 to control these activities, and regulations were subsequently prepared. Unfortunately, these laws and regulations are out-of-date and difficult to administer because drilling techniques and conservation practices in the industry have changed greatly in recent years. Also, the administrative structure of our State government has been modified since 1966. These older provisions are neither attractive to potential oil exploration companies, nor do they provide a sufficiently balanced protection of the environment and the rights of all affected parties. A draft of a Revised Oil and Gas Law has been prepared by the Delaware Geological Survey (DGS) and is presently being reviewed by appropriate State agencies.

## HISTORY AND DESCRIPTION OF DELAWARE MINERAL RESOURCES

This section describes the various aspects of the mineral resources found in Delaware, including the history, geologic setting, resource potential, distribution of deposits, mining or extraction methods, environmental hazards, and rehabilitation methods. The mineral resources considered are sand and gravel, crushed and dimension stone, clay, glauconite (greensand), heavy minerals, and chemical limestone.

The mineral industry of Delaware during the last 75 years has involved the production of basic construction materials: sand and gravel, crushed and dimension stone, and brick clay.

At the present time, mineral production in Delaware comes almost entirely from sand and gravel mining with pits scattered throughout the State. The value of this mineral production over the past several years has varied between \$2½ and \$4 million a year according to the U. S. Bureau of Mines Mineral Industry Survey Reports (Table 1). Brick clay from one open pit area in northern Delaware was mined until the end of 1979, when all clay production in Delaware was ended.

### History of Mining in Delaware

The earliest recorded mining in Delaware is the extraction of iron ore from deposits in New Castle and Sussex counties. Iron ore was first mined in the Iron Hill region south of Newark in 1703 (Sharf, *et al.*, 1888). The early miners extracted weathered iron ore from deposits of limonite derived from the weathering of an iron-rich gabbro in several low-lying hills of the Iron Hill area. This was mostly pick and shovel mining with the extracted material being processed in crude furnaces near the Christina River. The first of these furnaces was built in 1723 and operated until 1734. Subsequent mining operations extracted tens of thousands of tons of weathered iron ore, processed in a more advanced blast furnace operation. The heaviest mining was conducted between 1841 and 1884. Production from the deposits ceased in 1884 when the readily available deposits of ore were exhausted and the larger and more economical deposits in Michigan and other parts of the United States came into production. Iron mining in Sussex County began before 1760 and continued for at least 50 to 60 years

Table 1. Annual Delaware Mineral Production, 1971-1980.

Year	COMMODITIES			
	Sand and Gravel		Brick Clay	
	Tonnage	Value	Tonnage	Value
1980*	1,000,000	\$2,500,000	no production in 1980	
1979	1,674,000	3,281,000	11,000	\$ 9,000
1978	1,449,000	2,408,000	10,000	8,000
1977	1,351,233	2,084,096	11,000	7,000
1976	1,117,000	1,829,000	11,000	8,000
1975	976,000	1,900,000	9,000	6,000
1974	2,396,000	3,783,000	14,000	8,000
1973	3,408,000	3,678,000	15,000	9,000
1972	2,257,000	2,660,000	15,000	9,000
1971	2,205,000	2,231,000	14,000	8,000
*Preliminary				

Source: U. S. Bureau of Mines Annual State Mineral Survey, 1980.

(Sharf, et al., 1888). These early mines extracted limonite "bog iron" ore which is similar to the composition of the ores extracted from the New Castle County deposits. However, this material was derived from limonite beds which developed in stagnant water bogs near streams. Bog iron mining often included dredging from an open water bog. As with the New Castle County mining operations, the Sussex County deposits were exhausted or faced competition from the larger deposits in other parts of the country. Mining ceased in the early 1800's.

Another major element of the early mining industry in Delaware was the extraction and processing of kaolin and feldspar from small open pit mines in the pegmatite deposits in the Piedmont of northern and western New Castle County. Pegmatites are small, linear bodies of rock which have the appearance of very coarse-grained granite. When the pegmatites were heavily weathered, kaolin was formed and this was mined down to the fresh unweathered rock. The fresh rock beneath the weathered zone was then mined selectively for feldspar and sheet mica (insulating mica). The remaining quartz and other waste materials were used in road construction or general fill.

Kaolin is a white, soft clay mineral which is used for making high quality china and other ceramic materials. The kaolin was extracted by pick and shovel or dragline system, processed and sold to the china clay manufacturers. Mining began in the mid-1700's and continued sporadically until the early 1900's. Production ceased when the deposits were nearly depleted or reached depths in the ground which made mining impractical and dangerous. There may be some reserves of kaolin in the area, but competition from less expensive sources and the economic difficulties in mining very small, narrow deposits ended mining of kaolin in Delaware.

Sodium-rich feldspar from these Piedmont pegmatites was mined extensively during the last century (Sharf, et al., 1888). The "spar" was melted to form the procelain glaze on fine china. Muscovite, or white mica, was mined along with the feldspar and used as a heat and electrical insulating material in the ceramic and spark plug industry. Competition from mica mines in South Carolina and the problems of mining similar to that for kaolin caused a decline and eventual shutdown of these operations. Feldspar and white mica mining was concentrated near the upper White Clay Creek and in the Hoopes' Dam area. Considerable feldspar and mica were recovered from pits north of Wilmington.



The history of rock quarrying for both limestone and crushed stone goes back to the early 1800's or before when high calcium limestone was burnt to make lime, an important ingredient when mixed with gypsum to make wall plaster. Plaster walls were then a critical component in construction. The marble quarries were also exploited to produce ground agricultural lime for the southern Delaware produce farms. With the decline of the plaster industry in the late 1800's, the "lime quarries" became less important to the economy and production declined, becoming an occasional source for aggregate material or agricultural lime. Aggregate is the crushed stone which is mixed with concrete or macadam. Several other types of hard rock from the Piedmont were also quarried from the mid-1800's until just a decade ago as a primary source of construction and road building aggregate material in Delaware.

Limestone, "granite," and other hard rock are excellent aggregate material and quarries would perhaps still be in operation had it not been for the expanding suburban and urban development. The pressure from this expansion has forced shut-down of all of the operations in the State. The last operation was the Petrillo Quarry on Penny Hill which closed in 1968. Rock aggregates are now imported from Pennsylvania and Maryland where there are still sufficient open areas for quarry operations to take place.

During the same time, from the beginning of this century onward, sand and gravel pits began to appear throughout the State. These pits in large part, have replaced the rock quarry operations in New Castle County as a source of construction material. During the last 50 years there have been approximately 500 large and small sand and gravel pits which have intermittently operated providing material for construction in the State.

Deposits of greensand, of glauconite (its mineral name), have been mined sporadically in Delaware since the mid-19th century as a source of potassium in agricultural fertilizer, but not now. Booth reported 75 active greensand pits operating in the St. George-Odessa area in 1840 (Booth, 1841).

#### Description of Hard Mineral Resources

The characteristics common to all of the common hard mineral resources in Delaware are:

1. low per unit value
2. large volume operation

3. thin profit margin and competitive marketing
4. high transportation costs
5. extraction by surface cut operations
6. capital intensive activities
7. alteration of the physical environment
8. all are very basic and essential resources to our economic system.

### Sand and Gravel Mining

In 1979 and 1980, sand and gravel mining represented most of the value of primary mineral production in Delaware. The U. S. Bureau of Mines (USBM) "Annual State Mineral Survey" reports 1.7 million tons of sand and gravel was mined and sold in 1979, and 1.0 million tons in 1980. The decline in production can probably be attributed to an increase of out-of-state imports, and a lower level of road construction. The 1980 USBM report does not include any production from Sussex County, where there are several operations mining sand and gravel. Based on a brief survey of the active operations throughout the State, we estimate that there may be as many as 40 sand and gravel pits either producing material or on temporary stand-by. We tentatively conclude, therefore, that the U. S. Bureau of Mines Annual Report figures are unrealistically low, perhaps showing only one-half of the actual production. More detailed and accurate production and value calculations will not be available until a much needed and thorough survey of the industry is completed. Recommendations for such a survey are discussed in a later section of this report.

We do know that the unverified statistics from each of the three county zoning permit records show that there are, Statewide, approximately 230 pits for which zoning registration has been received since 1970. These pits embrace over 18,000 acres, 75 percent of which are in Sussex County. Given the brief time spent in our survey, it was possible to verify the existence, status, and production history of only a few of these large pits. In addition, there are a number of sand and gravel operations owned by, or under the supervision or lease by the Delaware Department of Transportation (DOT). These pits in most instances are not registered with the county zoning offices, although some private DOT supervised pit locations may be included in the

county statistics. Accurate information on sand and gravel operations is difficult to obtain from any source.

Sand and gravel resources in Delaware may be separated into three kinds of deposits: coarse stream channel cobbles and gravel, mixed sand and gravel banks, and coarse to fine sand deposits. In general, the coarser (and scarcer) deposits are of highest value. The principal source of sand and gravel in Delaware is the Columbia Formation, a 20' to 200' thick fluvial to marine sequence of sand, gravel, and cobbles present at the surface over much of the State. The Columbia Formation thickens and becomes sandier in lower Kent and Sussex counties. It is present as far north as the Fall Line in upper New Castle County. Coarse gravel deposits are rare in Sussex County.

Sand and fine gravel are used as general fill material where high crushing strength or load stress is not required. This coarser fraction can be used with asphalt or as concrete and block aggregate, but crushed bedrock stone is preferred. Coarse deposits - gravel and cobbles - are valuable for all types of construction, from highway fill to concrete aggregates.

Sand and gravel is mined by open pit methods. The soil surface is stripped in front of the mined face and material is dug up with heavy machinery. Then, depending on its use, the product is processed in four ways, almost always at the pit site. These use/processes are:

Mine (or bank) run material. This material is extracted and transported to the user without further processing.

Washed gravel. The extracted material is washed by running water through it to remove the fine silt and sand fraction. It is then shipped to the user.

Sized material. This is washed gravel that is mechanically size-sorted and stockpiled at the onsite pit in large mounds until sold.

Crushed gravel. Washed or sized gravel, or both, are crushed on site to produce broken aggregate, and again sorted and stockpiled.

With the exception of a tangential reference to "other mineral resources" in the Statement of Policy section of the

Department of Natural Resources and Environmental Control (DNREC) oil and gas regulations (DNREC, 1971), and the definition of a "mineral" in Title 7, Section 6106 of Chapter 61 of the Delaware Code, there are no State laws governing the extraction of sand and gravel from the upland areas of the State.

There are specific sections of the Delaware Code dealing with sand and gravel on the beaches, public and private, and the seabed resources within State jurisdiction. These sections are Title 7, Chapter 68, "Beach Erosion Control," and Chapter 70, "Coastal Zone Act." In Chapter 68, DNREC has authority to prohibit, or control and administer, any alteration of beaches. The law does not specifically cite commercial borrow extraction within DNREC jurisdiction. The DNREC regulations for the Beach Erosion Control Act in Section 4, Item 4.02b, "other activities," states that a permit from the Department is necessary to "mine, remove, and take away" beach material from State-owned public beach. In Section 3, 3.01b, of the DNREC regulations, the alteration or carrying away of any substantial amount of sand is prohibited from ANY coastal beach, without a permit.

The Coastal Zone Act is an administrative statute, with the Office of Management, Budget, and Planning (OMBP) serving as the lead agency for activities in all of the Coastal Zone, that includes most of the State and the off-shore submerged land. Other State agencies provide technical advice for the permit process under the Act. The Act does not cite mining of borrow specifically.

The Wetlands Control Act, Title 7, Chapter 66 of the Code also refers, in Section 6603, "Definitions," to "mining, drilling and excavation." Such activities require a permit from DNREC. Conditions for application and operations plan are similar for those required in the Beach Erosion Control Act. A set of regulations governing activity in the wetland zone have been prepared by DNREC.

All three counties have separate jurisdiction over sand and gravel extraction under the administration of the planning office or the zoning commission in each county. This zoning authority is based on enabling acts in Title 9 of the Delaware Code. Each county ordinance has different wording and procedures, but, in general, each follows the description given below.

Sand and gravel extraction is included as a "conditional use," defined as a variety of acceptable land use

activities, which by their nature, require individual review and processing by the planning commissions. The requirements of other regulatory authorities must be satisfied prior to issuance of a permit. In the case of borrow mining, a comprehensive engineering plan for mining, processing, transportation, and rehabilitation must be submitted to the appropriate agency. In some instances a public hearing is held on a permit application. Each plan must include a complete description of the operations, impact on the health, safety, physical environment, and quality of life in the area of the pit, plus a projected rehabilitation plan upon abandonment. Performance bonds are not specified but may be required. Periodic inspection of the operation during the life of the pit is not clearly defined. In most cases inspection is left to the building inspector or zoning commission engineer. Inspection and enforcement of a permit infraction appear to be the weakest parts of the county administration of the code. In each county ordinance, borrow operations in existence prior to the implementation of the ordinances are exempt from jurisdiction. State agency sand and gravel pits are also exempt from jurisdiction. These pits are primarily Department of Transportation operations.

### Crushed Stone

Crushed stone can be mined from open pit quarries dug into the crystalline bedrock that forms the underlying strata in the Piedmont section of Delaware north of Newark and Wilmington. Tough, hard rock types are most desirable, and can be mined from greenish-black altered and metamorphosed schists and metavolcanics, white and gray marble, and a granitic-like rock unit. These rocks are distributed in folded patterns throughout the Piedmont.

Stone quarries have not operated in Delaware for 12 years. At one time quarrying was relatively widespread in northern New Castle County, but competing land use activity from expanding urban development and public pressure against quarry operations have been in part responsible for the cessation of quarry operations. Discussions with crushed stone operators in adjacent States, however, do point to a renewed interest in rock quarry development in Delaware. This interest is generated by a very marked increase in transportation cost from Pennsylvania and Maryland quarries, which are 30 to 70 miles from the consuming areas in Delaware.

Crushed stone operations use the open pit quarry method, blasting a series of concentric benches into rock, removing

the broken stone to a series of on-site crushing and grinding units which reduce the blasted rock into various sized stone. The sized material is stockpiled for sale at the quarry or at storage areas distributed within the consuming area. Water washing is used in most of the crushing and grinding operations. The source of water is generally the ground-water flow in the quarry itself.

A single quarry has a life use controlled by the economics of mining and the size of the deposit from which the material is obtained. Occasionally quarry operations cease when extremely heavy ground-water flow or the depth configuration of the quarry makes it uneconomic to continue.

There are no State laws in Delaware dealing specifically with crushed stone operations. The planning-zoning ordinances in New Castle County which control borrow pit activities have jurisdiction over rock quarries as well. As explained above, no suitable rock is present in Kent or Sussex counties.

### Brick Clay

There are deposits of "mineral" clay material in northern Delaware from the Potomac Formation, a slightly gritty clay that is an excellent source for the manufacture of brick clay and other ceramic products. (See DGS Report of Investigations No. 14 for detailed description of brick clays.) This clay is characterized by its unique red, pink, and purple coloring. Areas with potential for mining industrial clay lie between Newark and New Castle, concentrated around Christiana and New Castle. Clay has been mined elsewhere in Delaware in the past, but on a smaller scale than in the northern part of the Coastal Plain.

There is only one brick clay plant in this area: the Delaware Brick Company pit at New Castle. The Company produced 11,000 tons of brick clay in 1979 according to a recent USBM minerals report. Production ceased at the clay pit in early 1980, when the mine and extractive plant were shut down. The Company continues to manufacture brick, but now uses clay imported into the State.

Brick clay is extracted from a "bank" layer by scraper and dragline, dried, mascerated, and cut into brick shape, then fired in a kiln. Water is used in the brick forming process.

At the present time commercial extraction of brick clay is included within the mining section of the New Castle County Zoning Ordinance.

### Glauconite

Glauconite is a distinctive green-colored, sandy-textured clay mineral rich in iron and potassium that is found in scattered localities throughout the Atlantic Coastal Plain. Unconsolidated glauconite greensand deposits occur at near-surface depths in southern New Castle County, centered around the town of Odessa. The glauconite layers reach thicknesses of 70 feet. This material has been used, without any processing, as a long-release source of potassium for agricultural fertilizers and to improve the tilth of some soils. It has never been mined on a large commercial scale in Delaware, but has been in parts of central New Jersey.

Another potential use of glauconite is as a leachate filter in sanitary landfills. Glauconite serves as a primary filter removing a large percentage of heavy metals and particulates from the leachate (Spoljaric and Crawford, 1979). Glauconite from New Jersey is used as a "zeolite" for potable water treatment and has been found to have potential for treating certain types of waste water.

The extractive operation to mine glauconite would be similar to that for mine run and processed washed gravel, and might be combined with it.

### THE FUTURE OF MINING IN DELAWARE

Sand and gravel will continue to be the principal mineral resource to be mined in the future. However, importation of sand and gravel from Maryland is increasing even though there are many available sources of undeveloped sand and gravel material still present in the State. Unless means can be found to allow growth of the sand and gravel industry, Delaware consumers may pay higher and higher transportation costs for the material and the several million dollar mining industry may decline.

The potential for production of other minerals in Delaware does exist; however, actual development is uncertain and unpredictable. Major industries have conducted exploration programs to study Delaware's sands for possible use in glass

manufacturing and as a source of ilmenite, a "heavy mineral" ore of titanium. Engine sand, casting sand, ceramic clay, and clay for expanded light weight aggregate have also been considered. All of these potential resources are marginal because of quality, quantity, or land use considerations, but may someday receive serious consideration.

#### OIL AND GAS POTENTIAL IN DELAWARE

The rocks of the Coastal Plain and continental shelf of the East Coast are part of a major seaward-thickening sedimentary basin possibly containing petroleum accumulations. As of Spring 1981 at least 26 holes have been drilled offshore Delaware-New Jersey in federal waters to evaluate the presence of hydrocarbons. At least 5 have had shows of gas. The search for oil and gas is still proceeding in these federal waters far off our coast in the Baltimore Canyon trough. It is a general rule that the thicker the sedimentary section, the more resource beds and reservoir rocks may be present. The part of the Baltimore Canyon trough beneath Delaware waters is in the inner part of the basin. The inner parts of such basins generally have a thinner sedimentary section and a smaller potential for petroleum accumulations than farther off shore. However, recent work by the Delaware Geological Survey suggests that conditions favorable to the formation of petroleum deposits may be present near or within Delaware waters (Benson, 1976).

An Outer Continental Shelf (OCS) sale of federal land tracts scheduled for December 1981 (the third such sale) will include areas in very deep water far from shore. If all of the tracts in this scheduled sale are leased, the next important play could be the nearshore margin of the basin close to Delaware waters. This may be the next area offered in a subsequent sale to take place in December 1983.

If the results of drilling in the nearshore area subsequent to the 1983 sale are positive, we may assume that interest in submerged lands under Delaware jurisdiction may result in exploration of that region. For that reason, Delaware submerged lands have a resource potential which must be considered for the future.



## RECOMMENDATIONS

There is a need to re-evaluate the existing laws and regulations and attitudes regarding sand and gravel extraction. Toward that end the Delaware Geological Survey has reviewed the mineral laws of the State as a project supported by the Office of Management, Budget, and Planning (OMBP), with Coastal Energy Impact Program (CEIP) funds. Draft recommendations are being reviewed by the various State agencies at the present time. They call for systematic and orderly methods of exploration, development, and leasing of land in the State, and more careful regulation of surface mining activities. Particular emphasis in these draft recommendations has been given to laws and regulations dealing with maintenance of the environment, protection of the public, and an orderly rehabilitation of any lands affected by mineral extraction operations.

The Delaware Geological Survey recommends an inventory of the sand and gravel industry to determine: total consumption, mine source both in and out of State, cost, transportation, and availability of the resources within the State. This inventory should also include an evaluation of the policies of local governments, communities, and State agencies in regard to environmental impacts caused by any increased surface mining. This inventory will be a first step in making a proper evaluation of the needs of the State for construction material and the best method of providing those materials from in-state producers while causing the least possible environmental harm to the land.

It is also important to continue research on the use of greensand as a possible fertilizer and filter material. The distribution of greensand deposits in the State are in areas where mining could take place without interference with home sites construction areas.

The possibility of oil and gas development and production in Delaware offshore waters remains at present a question which cannot be answered until further exploration is conducted near Delaware waters. If there is to be exploration in State waters, we can expect this to come within the next decade. Any petroleum resources found in Delaware waters will probably be in the form of natural gas.

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