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Construction Minerals in the Baltimore-Washington Metropolitan Area: A Land Management Analysis

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Abstract

The patchwork of government influences that shape the protection and management of construction mineral resources--sand, gravel, and crushed stone--includes statutes, regulations, guidance documents, and court decisions at the federal, state, and local level. Across the Washington-Baltimore metropolitan area, both these influences and the experiences that the counties have had in managing construction mineral resources range widely. Our principal objective in this study is to discuss the mechanisms that counties use to manage such resources; the level and source of concern that local residents have with respect to construction mineral extraction operations; officials' perceptions about trends in the supply and demand for mineral resources; and the level of interest in protecting mineral resources for future exploitation. Our study rests principally on a review of federal, state, and local planning documents, two detailed case studies of counties active in construction mineral management, and structured telephone interviews of thirty-six local planning officials and state and federal agency staff.

Key Words: construction minerals, aggregates, land use planning, Baltimore-Washington

JEL Classification Numbers: Q24, Q38, R52

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CONSTRUCTION MINERALS IN THE BALTIMORE-WASHINGTON METROPOLITAN AREA: A LAND MANAGEMENT ANALYSIS

Kris Wernstedt and Amy McAbee Cummings¹

1. INTRODUCTION

As noted more than thirty-five years ago in the professional planning literature (Stollman 1961), local planners may face a variety of conflicting objectives when they seek to control or manage the surface extraction of minerals through their comprehensive planning or zoning processes. On the one hand, they may desire to promote such mineral extraction to provide jobs and tax revenues within their jurisdictions, and to meet local public and private demand for mineral resources. At the same time, however, they may want to encourage higher-value alternative uses, such as commercial or residential development, that likely will permanently preempt mineral exploitation. Furthermore, they may wish to tightly control mineral resources development to protect local residents from the noise, traffic and other negative externalities often associated with mineral extraction. Even when they actively seek to promote mineral extraction and to minimize regulatory burdens, in most cases they will need to impose controls to ensure that the extraction activities leave a landscape that, with a modest amount of reclamation, can support post-extraction uses. In some cases, they may even wish to limit current mining activities so that the minerals are conserved for future exploitation.

Such conflicts are particularly trenchant with construction minerals, the sands, gravels, and crushed stones that constitute, literally, the foundation of the built environment. Ready access to these resources, which are also called aggregate minerals, is essential for any area's economy. Not only are they used in vast quantities for roads, parking lots, buildings, bridges, and other supporting infrastructure--over fifty tons of sand and gravel are used in a single average house, and over 400 tons in a one block stretch of a new subdivision street--but their bulk and low unit value make long distance transport problematic from an economic perspective. Delivery costs of sand and gravel, for instance, double if the user is more than twenty miles away from the supply (Maryland Office of Planning 1997, 8; Maryland-National Capital Park and Planning Commission 1993). In addition, the supply of these resources, while often thought of as being ubiquitous, instead occurs within specific geologic formations and may be highly localized.

The accretion of federal and state responsibilities and requirements on to the local management apparatus for construction minerals over the last two decades, as well as current debates over the scope of public oversight over private land activities, have added additional

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complexity to construction mineral management. While mining operations continue to be sited, operated, and reclaimed and local demand for construction minerals continues to be met, in the aggregate, few would claim that the current multi-jurisdictional, overlapping management of the construction mineral industry is ideal. Not only can the labyrinthine system of oversight reduce the predictability of siting a construction mineral operation, but it also can increase the costs of this siting, raise issues of federal or state preemption over local regulation, and promote an inefficient extraction and use of construction minerals. This may pose a wide array of problems for a large cast of stakeholders, including the industry as a whole, individual operators, federal and state resource management agencies, local planning offices, individual homeowners, environmental groups, and the public at large. Moreover, as development pressures continue and population densities increase, it is likely that such potential difficulties in managing construction mineral resources will increase rather than lessen.

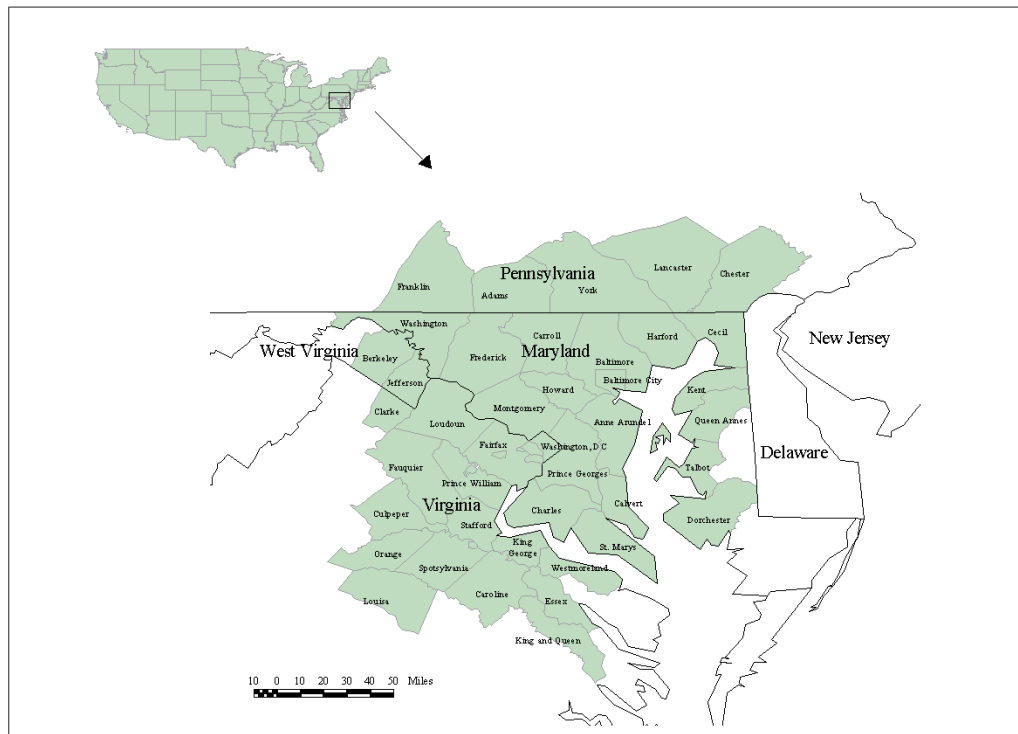
Our principal objective in this paper is to discuss the mechanisms that counties use to manage such resources; the level and source of concern that local residents have with respect to construction mineral extraction operations; officials' perceptions about trends in the supply and demand for mineral resources; and the level of interest in protecting mineral resources for future exploitation. Although we focus at the local level--because approval of applications for siting construction mineral operations typically takes place at the county or sub-county level--we also discuss the state and the federal context.

To ground the study, as it were, in actual planning practice, we investigate construction mineral management in the Baltimore-Washington metropolitan area (see Figure 1). This 17,000 square mile area, which consists of nearly forty counties in Maryland (17), Pennsylvania (5), Virginia (15), and West Virginia (2) has experienced explosive growth in the last several decades, and recent data from the U.S. Bureau of the Census show that since 1990 the Baltimore-Washington consolidated metropolitan statistical area has boasted more residential building permits than any other such area in the United States. This rapid pace of development, which brings both high demand for construction minerals and heightened encroachment on mineral resource lands, make the region an excellent case study for gaining insight into long term mineral development and management issues.²

Our analysis rests on a three pronged effort. First, we have reviewed local planning documents from most of the counties in the study area to collect information about the approach that counties have used in their mineral management efforts. As part of this prong, we also have briefly reviewed federal and state documents and interviewed a number of federal and state officials whose activities touch on construction mineral operations. Second, we have conducted case studies of two counties--one each in Virginia and Maryland--with active construction mineral management. These case studies rested on document review as

² The U.S. Geological Survey is using the region in an ongoing project (Mid-Atlantic Geology and Infrastructure Case Study) to document construction mineral trends and issues and to provide information and analysis for resource managers, planners, regulatory authorities, and other stakeholders. The analysis reported in this paper was supported under that project.

Figure 1
Baltimore-Washington Metropolitan Area



well as discussions with planning officials in each county. Third, we have used a formal, structured telephone survey to interview planning officials who have the primary responsibility for construction mineral management in each of thirty-six local jurisdictions.

The organization of this paper is as follows. In section 2, we start by describing the federal context that shapes construction mineral management, and then embed the general process of construction mineral management in each of the four states in this federal context. We then turn in section 3 to our two case studies, to describe in more detail the process and regulations by which counties manage construction mineral operations and their experiences with these operations. In section 4, we extend our discussion of the two counties to the larger metropolitan study area by drawing on our review of planning documents and our survey of local planning officials. Our objectives are to describe the similarities and differences between planning practices and experiences in our case study counties and the wider forty-county study area, as well as examine the pattern of public and county attitudes toward construction mineral operations. In section 5, we offer concluding comments.

2. THE GENERAL PROCESS FOR PERMITTING CONSTRUCTION MINERAL OPERATIONS

2.1 The Federal Context

Although state and counties have a primary role in construction mineral management and permitting--and are the focus of this study--a number of federal features may significantly shape the siting or operation of sand and gravel or crushed stone operations. Some of these relate to health, noise, and safety considerations at the site (through regulations and oversight by the Mine Safety and Health Administration and Occupational Safety and Health Administration in the U.S. Department of Labor), while others relate more specifically to environmental concerns. This latter group may touch on a wide range of federal laws and programs (e.g., U.S. Endangered Species Act, Pittman Underground Water Act, the National Environmental Policy Act), but the more common entrée on this front lies in two other bodies of federal legislation.

First, regulations under the federal Clean Air Act provide standards for particulate matter arising from plant operations, both for new sites and old sites. While the recently proposed standards for fine particulate matter are still in review, the aggregates industry has long been covered under coarser particulate matter standards. In addition, recent provisions under the Clean Air Act for New Source Performance Standards (for plants that have crushers or grinding mills) may influence siting and/or operations for new plants in some areas.

Second, and more pervasively, legislation provides opportunities for federal oversight when wetland or riverine areas might be disturbed, as well as the statutory authority for the National Pollution Discharge Elimination System (NPDES). Under section 10 of the federal Rivers and Harbors Act, the U.S. Army Corps of Engineers reviews dredging activities in the navigable waters of the country and needs to issue permits before such activities can take place. Furthermore, section 404 of the U.S. Clean Water Act provides the Corps of Engineers the authority to review applications for construction mineral operations in a broad range of

wetlands and riverine areas, including stream crossings.³ With respect to the NPDES requirements under Section 402 of the Clean Water Act, the U.S. Environmental Protection Agency has delegated the authority to issue NPDES permits to each of the four states in the study area. Such permits come into play when mining activities result in discharges or, under 1990 regulations that added stormwater management to the NPDES permit system, contribute to stormwater runoff. Permits for these different discharges can be combined in some cases and, in some states, regulators may offer a general class-of-action permit for some mining operations rather than a site-specific permit. In addition, Section 401 water quality certification requirements also can amplify the role of the state, particularly when the Corps of Engineers becomes involved in mining permits because of potential impacts on wetlands and riverine areas.⁴

Against this background of federal legislation and regulations, the bulk of the permitting and associated regulatory process occur at the state and local levels. Moreover, given existing human settlement patterns and the nature and location of these mineral resources in the Washington-Baltimore study area, county, rather than the city or town, governments typically are involved at the local level.⁵ In general, the counties regulate specific features (e.g., location, hours of operation, site design requirements) of construction mineral operations through their land use planning and zoning functions,⁶ whereas the states are responsible for administering federal requirements, reviewing reclamation plans, and issuing the actual permits for construction mineral operations. Given the single federal regulatory context that overlays our study area, the states and counties exhibit many

³ The reach of the Corps in regulating such activities is evolving at present, due to two recent federal court decisions. One case, a Federal District Court decision that was upheld in June, 1998 on appeal to the U.S. Court of Appeals threw out the so-called Tulloch rule, which the Corps had adopted in 1993. This rule had expanded the Corps authority over wetland dredging activities through the regulation of "incidental fallback." The Corps and others still may appeal this case to the Supreme Court and, in any case, mining activities that disturb wetlands continue to be subject to permitting under other section 404 rules. The second court case is from the U.S. Court of Appeals for the Fourth Circuit, and applies to Maryland, Virginia, West Virginia, and two other states outside the study area. This December, 1997 decision held that the Corps interpretation of its regulatory jurisdiction over isolated water bodies was not authorized under the Clean Water Act. This also may be appealed, but the Corps and EPA are likely to continue to assert jurisdiction over isolated water bodies on other grounds.

⁴ In the 1980s, a number of articles appeared in local newspapers in the study area that suggested that runoff from sand and gravel mining sites may have polluted rivers in the Washington, DC area (Lynton 1987, Thompson 1984, Phillips 1981).

⁵ An exception to this pattern occurs in Pennsylvania. As we discuss in the text, townships are the local jurisdictions that manage construction mineral activities in the state.

⁶ Zoning generally refers to an exercise of the police power; that is, the power of a sovereign government to enact legislation to protect the health, welfare, and safety of its people. The U.S. Constitution confers this power on the states--or more precisely the states never surrender it to the federal government--and the states, in turn, have delegated zoning powers to local governments. Zoning separates a jurisdiction into districts, and regulates buildings, structures, and activities that take place or are located in these districts. As a legislative act, it has the force of law. In concept, zoning follows from a comprehensive plan that outlines planning and zoning objectives, but this is not always (or perhaps even usually) the case.

similarities in how they approach the management of construction minerals. At the same time, however, there are some important differences among the states. We discuss some of these similarities and differences in the following four subsections.

2.2 Maryland

The State of Maryland has long shaped construction mineral resource management within its borders, both through the permit review process conducted by the Maryland Department of the Environment and through a requirement that all local jurisdictions that exercise planning and zoning powers include a mineral resource element in their local plan. The current permit review process dates back to the 1975 Surface Mining Law that established uniform, statewide permitting requirements for mining operators, whereas the current state mandated planning process at the local level was enacted in 1986 (Maryland Annotated Code Article 66B, section 3.05[a][1][v]). According to the Article 66B language, the local mineral resource plan must identify and preserve undeveloped land that can provide a supply of minerals, identify appropriate uses for this undeveloped land after mining occurs, and balance mineral extraction with other uses.⁷

Within the state's Department of Environment, the Minerals, Oil, and Gas Division runs the permit program. Although the program oversees a number of areas, the principle concerns center on environmental controls at construction mineral operations (those related in particular to runoff, sediment control, and erosion), other water issues (both appropriation and possible discharges as permitted under the NPDES process), site reclamation (a bond of \$1,250/acre is required), and, in the case of sites with blasting, air quality (Larrimore 1998). The Department also may engage in an full wetland review at certain sites where wetlands may be impacted,⁸ both through the state Non-Tidal Wetlands law (Section 26.23 of the Maryland code) and in conjunction with the Corps of Engineers. The maximum permit length is five years.

2.3 Virginia

Although the management of construction minerals in Virginia is similar to the approach in Maryland--the statutory base for the state permitting process comes from the state's mining law (Title 45.1, Chapter 16) and the Virginia legislature also has required

⁷ Prior to the enactment of the Article 66B requirements, in 1982 Governor Hughes had issued an Executive Order that directed authorities to "protect, regulate and provide for the recovery of Maryland's mineral resources, including sand and gravel, and provide for subsequent reclamation of land after extraction" (Executive Order 01.01.1982.08, cited in Maryland-National Capital Park and Planning Commission 1990, 55).

⁸ The state has four classes of review, depending on the wetland characteristics. At isolated wetlands less than one acre in size, or at any wetland less than five thousand square feet, it typically does not conduct a full wetland review. At wetlands above this threshold, it does conduct such a review process that, among other features, may require some type of mitigation if impacts are anticipated. At wetlands of special state concern, it provides additional protection. For instance, the state has identified Zekiah swamp in Charles County as a wetland of special state concern, and it requires larger buffers around activities that impact this wetland (Clark 1998). The area around Zekiah supports active gravel mining, and a number of residents recently have pressed for additional restrictions on the county's mining industry (Shields 1998).

counties to include mineral resources in their local planning process--the state permitting of construction mineral operations differs from the process in Maryland in several ways. The primary regulatory oversight comes from the Division of Mineral Mining in the state's Department of Mines, Mineral, and Energy, rather than from the Department of Environmental Quality. Perhaps because this regulatory oversight is housed in a mining department, some of the principal concerns in the permitting process are somewhat more oriented to mining. In addition to a review of erosion controls, drainage plans, diversion structures, and the reclamation plan,⁹ the Division takes an active interest in the operations plan. This latter includes attention to blasting, equipment, processing methods, chemical use, and worker safety, including the provision of proper equipment, training, and proper impoundment construction (Potter 1998). Once issued, there is no maximum total time period over which a permit can run, although it must be renewed annually.

In addition to the Division of Mineral Mining, the state's Department of Environmental Quality is involved in the permit review process. This typically occurs through NPDES permitting for stormwater runoff and wastewater/washwater discharge. Since 1994, the state has offered a general permit for all mining facilities, with a single permit able to cover both stormwater and process water/wastewater. Unlike Maryland, Virginia does not have a non-tidal wetland law, so the Department of Environmental Quality is involved in wetlands oversight less directly than in Maryland. Rather, it comes into wetlands and other water quality issues in the mining permit process primarily through water quality certification associated with the Corps of Engineers Section 404 responsibilities¹⁰ (Gregory 1998, Hassel 1998).

2.4 Pennsylvania

In Pennsylvania, the management of sand and gravel and crushed stone activities differs from that found in Maryland and Virginia principally in the locus of local decision making. Because townships, rather than counties, have the responsibility for planning and zoning outside of towns, boroughs, and incorporated areas in the state, local public regulation of construction mineral siting and operations takes place at this lower jurisdictional level. This suggests perhaps that the technical capacity to regulate siting and operations may be spread much thinner than in the other states in our study area--Pennsylvania has over 1,500

⁹ To support the reclamation process, Virginia requires the posting of a bond as a condition for a mining permit. For new operators in their first five years, this is \$1,000/acre of disturbed area. After five years of operating experience, operators are eligible to join the state's mineral reclamation fund, which substantially reduces their bond requirement. In their first year of a new operation, operators who qualify for this fund must post a bond of \$50/acre of area that they disturb in the first year, plus \$50/acre of land that they intend to disturb in the second year. In subsequent years, they must post a bond of \$12.50/acre (Potter 1998).

¹⁰ Given this, the Corps takes the primary lead on wetland issues in Virginia. Their concern with construction mineral activities in wetlands and riverine areas is perhaps most strong with impacts on turbidity and sediment load as it may effect navigation, but they also address fish and endangered species concerns and habitat quality (Williams 1998, Iseli 1998).

townships--but the actual approaches to construction mineral management at the local level are similar to those found in Maryland and Virginia.

The base for the state's permitting of sand and gravel and crushed stone operations comes from Pennsylvania's Noncoal Surface Mining Conservation and Reclamation Act and Title 25, Chapter 77 (noncoal mining) of the Pennsylvania code. The program is administered from the Division of Permits in the Bureau of Mining and Reclamation (which is under the state's Department of Environmental Protection), although district offices around the state perform the principal review of applications. The principal concerns in the review process include site reclamation (particularly so that the post-site use does not present a hazard to the surrounding area), the protection of groundwater and surface water (in terms of quality and quantity), the protection of endangered species, and the maintenance of the local water supply. Sand and gravel operations require the posting of a \$1,000/acre bond, with a \$5,000 minimum, while the bond requirement for crushed stone operations depends on the highwall height.¹¹ The permit runs for the length of the mining and reclamation operation (Shuster 1998).

As is the case with the other states in the study area, Pennsylvania administers the NPDES permitting process at construction mineral sites within its borders. At such sites, the Department of Environmental Protection issues site-specific wastewater/washwater discharge permits, rather than general class permits. The Department also plays an active role in wetland issues when they arise in a construction mineral context. Similar to the situation in Maryland, the Army Corps of Engineers has wrapped its wetland oversight in Pennsylvania around the state's wetland law (Phillip 1998). As a result, the state can issue permits under its Chapter 105 permit process for mining activities that may disturb wetlands and other Section 404 waters, without forwarding the permit application on to the Corps of Engineers for review, if the disturbed area falls below certain thresholds.¹²

2.5 West Virginia

The management of sand and gravel and crushed stone resources in West Virginia deviates substantially from the general approach described in the previous subsections. Unlike the situation in the other three states, neither counties nor townships are directly involved in managing construction minerals in West Virginia. Rather, the state almost completely dominates the regulatory landscape. Therefore, local comprehensive planning, zoning, and oversight and shaping of development generally are poorly integrated with construction mineral management. This situation probably reflects to a large degree, the

¹¹ In this context, highwall refers to the exposed face of the open cut of the operation, including the overburden.

¹² For wetlands and other bodies of water, the threshold is one acre. For streams, it is two hundred and fifty lineal feet (Commonwealth of Pennsylvania 1997).

historical importance of coal mining to the state's economy, and the state-level apparatus developed to manage the externalities from this mining.¹³

The state's law on non-coal surface mining and reclamation (chapter 22, article 4 of the West Virginia code) governs the permitting process, while the Office of Mining and Reclamation (under the state's Division of Environmental Protection) administers this program. Concerns of the program are similar to those described in the other states--water quality, soil erosion, site reclamation, and public safety, for example--although there appears to be a greater sensitivity to the concerns of residents over local environmental nuisances (e.g., noise from blasting). The state requires a performance bond for reclamation of a minimum of \$600/acre of disturbed area (with a minimum total bond of \$10,000), although operations that extract sand, sandstone, or limestone are exempt from this requirement. Permits are renewable annually (Halstead 1998).

The state runs the NPDES program with combined stormwater runoff and wastewater/washwater permitting. General, class-of-action NPDES permits are available, but the state is reluctant to issue these general permits for new mining facilities. For such facilities, it reviews the application on a site-specific basis and issues a permit accordingly. The Division of Environmental Protection also frequently plays an additional role when the Corps of Engineers is involved in section 404 wetlands and riverine permits (Pollitin 1998).

In addition to these regular points of entrée, a number of other state (and federal) agencies may be involved in the review of permit applications or, more broadly, in construction mineral management. For example, as noted below, a state's department of transportation or highways could shape mineral management and operations in significant ways. Not only would it comment on those extraction activities that have an impact on state roads, but it itself could may be a major user of construction minerals. Because of this, in principle it can directly influence where extraction operations are located, since the state typically is exempt from many local zoning and siting requirements. In addition, often the state's fish and game agencies (or even the U.S. Fish and Wildlife Service) may provide comments on biological impacts and, in some cases, these comments can result in stringent conditions being placed on operations. For example, they may impose time of year restrictions on dredging or surface excavation activities (Iseli 1998).

3. CASE STUDIES

To move beyond state-level permitting issues and ground the discussion, so to speak, in local land use planning, it is useful to examine in more detail the experiences of individual jurisdictions in managing construction minerals. To that end and to motivate our later discussion of survey results, we have chosen two counties--Loudoun County, Virginia and Prince George's County, Maryland--for case studies in construction mineral management.

¹³ As an interesting sidelight and relevant to this point, prior to 1991, the construction mineral permitting program was under the Department of Energy (which had previously been the Department of Mines), and prior to 1980, the Department of Natural Resources (Halstead 1998).

Both Loudoun and Prince George's counties lie in the Washington, DC area, both are major producers of construction minerals (crushed stone in Loudoun and sand and gravel in Prince George's), both face development pressures, and both have developed relatively sophisticated approaches to mineral management. At the same time, they differ in a number of respects, not least of which is the basic zoning framework that each relies on (mineral resource zones in Loudoun and special exceptions in Prince George's) and the disparity in the number of active operations (five in Loudoun and forty-five in Prince George's). Because of these dissimilarities, we have developed the discussion for each county somewhat differently. Both studies touch on the formal process and specific requirements of the mineral management planning apparatus, but in the Prince George's case, we delve far more deeply into the formal process by which operations are sited. Conversely, we place a greater emphasis on experiences with individual operations in the Loudoun study.

3.1 Loudoun County, Virginia

Loudoun County lies in Northern Virginia, within the Washington, DC commuting shed and, in common with many other counties in the second tier surrounding the metropolitan core, has experienced substantial development in the last twenty years. Between 1990 and 1997, for example, population increased fifty-five percent, and in one year alone (1996 to 1997), housing starts rose thirty-eight percent (Loudoun County Department of Economic Development 1998). The combination of this explosive residential growth and accompanying commercial development and the presence of significant diabase rock formations make the county a valuable case study in mineral resources planning. Moreover, the county has delineated mineral resources extraction as a land use priority, and developed mechanisms to minimize conflicts between the mining industry and other activities. This subsection will discuss these countywide mechanisms, as well as present the cases of individual quarry operations in Loudoun County to illuminate the relationship between mineral extraction and residential subdivisions.

The majority of construction mineral mining activity takes place along the County's once-rural eastern border, with three of the quarries located near the prime residential real estate adjacent to Fairfax County. The two other sites lie southeast of Leesburg (Saulny 1998). All five sites are diabase or traprock quarries. Four of these have a long operating history: Bull Run Stone Company has quarried the site nine miles northwest of Manassas since 1964; Chantilly Crushed Stone, Inc. has mined the Route 50 site since 1958; and the Luck Stone Corporation has operated two sites, one of which opened (under different ownership) in 1958 and the other (also under different ownership) in 1880.

The county's Department of Planning, which develops long-range land use goals, has placed a premium on diabase extraction. Indeed, the Loudoun County comprehensive plan, which guides local land use decisions, explicitly supports surface mining interests. Updated in 1991, the plan states that the industry must be "encouraged and protected" (Loudoun County 1991). Moreover, there was a high level of interaction and communication with quarrymen as the plan language was crafted. Little public concern about mining practices was

evident among residents during the public hearing and plan adoption process, and the plan noted the contributions that mining made to the local economy.¹⁴ At the same time, it also cited potential hazards and conflicts resulting from the nature of mineral extraction. Among these are adverse impacts on water quality, excessive noise and vibration, and heavy truck traffic. To address these concerns, the plan includes a number of broad policy goals that may mitigate conflicts between quarrying and other land uses (Loudoun County 1991, 116-117):

- the County will create a quarry zoning district to provide a minimum eight hundred acres designated for extraction in which no residential development is permitted;
- extraction should be located where quarries currently operate or in industrial communities in the airport noise corridor;
- quarries will be permitted to operate as long as they are viable, and encroaching new development will take existing quarries into account;
- standards will be developed to protect nearby developments that already exist or are planned; and
- quarries should have direct access to industrial standard roadways.

The overall plan includes Extractive Industry Communities and Mineral Resource Extraction Policies sections, while the subarea plans for the districts that house quarry operations (Dulles South and the Toll Road, for example) also contain more localized mining policy segments. The plan's mineral extraction policy area map delineates the currently operating sites, as well as one large unexploited deposit of diabase.

Beyond the guiding blueprint of the comprehensive plan, the county zoning ordinance provides specific language on site specifications and the regulation of quarry operations to mitigate potential public hazards and nuisance to other properties. For example, the Mineral Resource-Heavy Industry (MR-HI) district is the only zone under which quarry activity may occur. The ordinance (Loudoun County 1993, 48) states that the MR-HI district is,

". . . established to protect the mineral resources of the County for possible future economic development; to provide for diabase resource extraction operation at appropriate locations and under controlled conditions; to co-locate with quarries compatible heavy industrial uses; to permit continued agricultural practices; and to permit residential and other uses only to the extent that they may be compatible with resource extraction."

Existing quarries are permitted to continue extraction activities regardless of growth pressures from competing land uses. However, the Department of Planning also aims at having mining operations be as unobtrusive to residential and commercial neighborhoods as

¹⁴ In 1997, the industry's 186 employees constituted only 0.3 percent of the county's labor force. However, their average weekly salary of \$743 makes them the fourth highest earning group among the income categories listed in the County economic summary (Loudoun County Department of Economic Development 1998).

possible. It promotes this goal through three types of site specification requirements that are tied to the Mineral Resource-Heavy Industry zone.

First, the Department tries to keep the maximum distance between the mining use and residential and commercial uses that is practical. It requires a one-half mile buffer between quarry blasting and residential homes, and at least one thousand feet between the mining activity and the quarry zone district boundary. In addition, the zoning code requires large lot sizes. The minimum size of a MR-HI district is six hundred acres, with incremental additions of no less than ten acres. Individual lots within that district must be at least fifty acres, and operations on the lot must be two hundred feet or more from any road. The minimum lot width is five hundred feet, with fifty feet between any property lines. Quarry wall pits must be at least one thousand feet, and processing equipment five hundred feet, from a MR-HI district boundary. These setbacks may be reduced if the quarry lies adjacent to Dulles Airport or other industrial uses. Administrative buildings must be at least fifty feet from the property line, and quarry structures are limited to one hundred twenty feet in height (Loudoun County 1993, 53, 97).

Second, the Department of Planning requires landscaping and screening to shield adjacent property owners from excavation impacts. A one hundred-foot buffer between the quarry and zoning districts other than MR-HI must be landscaped with natural vegetation and bermed. The planting requirements are specified in the zoning ordinance: "existing trees and ground cover along all other boundary lines shall be preserved, maintained, and supplemented by selective cutting, transplanting, and addition of new trees, shrubs and other ground cover for the depth of the setback" (Loudoun County 1993, p. 97).

Finally, the third prong of the effort to minimize landuse conflicts comes from County zoning regulations that limit the blasting noise and earthborne vibration which may be sensed on adjacent property. The peak noise from any blast is limited to one hundred twenty-nine dB, and other noise from extraction activity may not exceed eighty dBA. Vibrations from sources other than blasting may not exceed a peak particle velocity of .03 inches per second. All blasting must occur between the hours of 7:00 a.m. and 6:00 p.m. When adjacent to residential districts, other noise sources are restricted by an additional five dba between 7:00 p.m. and 7:00 a.m. Activities within the Noise Exposure Forecast Areas in the vicinity of Dulles International Airport are exempt from the noise limitations (Loudoun County 1993, pp. 98-99).

Overarching these site specifications is the requirement that all quarry operations be restricted to the Mineral Resource-Heavy Industry zone. This typically requires a legislative rezoning of land, a process that could take up to one and one-half years and entail significant expenditures by the applicant (the county fee for rezoning is approximately \$16,000, a figure that does not include attorney and engineer fees, which may total an additional \$50,000). In addition, Special Exception Permits, which are required to begin a new surface mining operations even in a MR-HI zone, generally take ninety days to review. All applications go through a referral process, with plat and plan descriptions sent simultaneously to various agencies for comment. Referrals from the Comprehensive Planning Department, Zoning Department, Virginia Department of Transportation, Department of Natural Resources, Fire Marshal, and Parks and Recreation analyze the impact mineral extraction activity is likely to

have on each department's service plans. This information is incorporated into the Planning Commission's staff report. The Planning Commission holds a public hearing about the rezoning or special exception application, and then makes a recommendation to the Board of Supervisors. The Board of Supervisors, a group of elected county officials, also conducts a public hearing and makes the final decision about the request (Grandfield 1998).

Although most of Loudoun County's quarry activity was initiated over twenty years ago, the recent past has witnessed fresh requests for MR-HI rezonings and expansions of existing quarries. For example, eight years ago, a property owner requested the rezoning of his property, which was located south of Route 50 near Chantilly and Dulles Airport, to permit surface mining. The Board of Supervisors granted the request.¹⁵ In addition, since 1990, Bull Run Stone and Luck Stone both have been granted special exceptions to expand quarry operations and continue extraction for an estimated fifty years.¹⁶ The involvement of the public in each of these special exception processes is instructive.

In the Bull Run case, the public hearing held to discuss the quarry expansion revealed confusion and frustration on the part of local residents. The issues raised ranged from distress about increased noise, structural damage to homes, and deterioration of road conditions, to insinuations of County government corruption. The questions of one woman who lived on the west side of the quarry may reflect many of the concerns typical to the conflict between residents and quarry operators. As documented in the public record:

"She said it was not fair to her family to have a crusher that close to their home crushing rock all day. Mrs. Allen emphasized that her 79 year old mother who has a very bad nervous condition lives with her and the noise would not be good for her. Mrs. Allen said she was only asking for protection for her family and the surrounding neighbors."

Another interested citizen decried the "expensive, tedious, exasperating, long years of legal maneuvering" that led to the imminent expansion of the quarry. The citizen further indicated that, "the county, upon advice and input from special interest, rewrote the regulations and zoning ordinance" to allow the quarry which contributed insignificantly to the tax base, but provided ample nuisance and deteriorated the quality of life in the area. The

¹⁵ Shortly after this decision, however the Airport Noise Zone was reevaluated and the extent of the district reduced in size to reflect the advent of quieter airplane technology. As a result of this change, the owner's property became suitable for residential development, and he subsequently dropped the MR-HI zoning request (Grandfield 1998).

¹⁶ Bull Run Stone requested a modification of their existing special exception to allow quarrying and processing on sixty-six acres of their two hundred twenty-one acre site. Based on the previous zoning ordinance definition of "extractive industries," Loudoun County Circuit Court ruled in 1983 that although stone could be quarried from the sixty-six acre site, the crusher, screener, and washer on the premises could not be used to process it. In 1986 the Board of Supervisors redefined "extractive industries" in zoning regulations to permit accessory processing uses. The 1990 Bull Run request sought to incorporate this modified definition into their current special exception (Loudoun County 1990a, 2-15).

Bull Run Civic Association is also on record opposing the Bull Run Stone Company's expansion. In keeping with the policy established in the comprehensive plan, however, the planning staff and Commissioners supported the application (Loudoun County 1990a, 15-17).

In contrast to this contention, the Luck Stone application met little opposition.¹⁷ At its Goose Creek quarry site, it proposed to extract stone on an additional one hundred and forty-nine acres of industrially zoned land, and to build a conveyor bridge over Goose Creek to connect the expansion to the existing site. Although there was some concern regarding the effect of mining on well water quality, the Goose Creek Scenic Advisory Board submitted documents in support of the quarry. The Luck Stone operators had invested considerable effort in improving the company's "good neighbor" image, and company representatives had attended Goose Creek Scenic River Advisory Board meetings to negotiate problems with the proposed expansion well before the hearings stage. This resulted in the dedication of a scenic easement of fourteen thousand linear feet along Goose Creek, with a width of three hundred feet. Luck Stone further agreed to donate the one hundred forty-nine-acre property to the County for recreational or other purposes after quarry operations cease, and has opened a scenic overlook bicycle trail located to provide a view of quarry operations (Loudoun County 1990c). The company also has become involved with neighborhood community associations near its quarries. For example, Luck Stone mine managers have donated funds for landscaping and building projects to the Blemont Forest community association, and during a 1996 blizzard scraped snow from the neighborhood's roads (Stoughton 1998).

Such creative efforts to serve local communities likely has helped to build goodwill toward Luck Stone, and may provide a promising model to reduce possible future opposition to new or expanded construction mineral operations in other parts of the County. The fact that the County's comprehensive plan clearly establishes quarry activity as a protected land use--and the written sanction of surface mining has been upheld in individual land use decisions made by the Planning Commission and the Board of Supervisors--also suggests that robust crushed stone production will continue within the borders of the jurisdiction. Moreover, the County's implementation of zoning and site specification requirements in principle furnishes a system that would prevent future homes from abutting a mine site, thus reducing the chances of conflict.

At the same time, however, it is likely that the blasting, processing, and hauling of stone will continue to be a nuisance, or even hazardous, in the minds of many residents. The Department of Planning intends to keep incompatible land uses as distant from one another as possible, and thus far, complaints made to the County about the nuisance of quarries have been minimal. However, this may change in coming years (Grandfield 1998), and the growth pressure in Loudoun's housing market may make clashes over quarrying operations inevitable.

¹⁷ At a hearing on the special exception request, it became clear that an owner of an adjacent one hundred plus acre parcel had hoped to subdivide the parcel into residential lots. However, his representative at the meeting was advised that the "proposed General Plan had marked this area for quarrying purposes as quarries are thought to be a good resource for the county" (Loudoun County 1990b).

Indeed, about one thousand new homes are proposed off of Route 50 near Chantilly Crushed Stone. Fortuitously, the Board of Supervisors amended county regulations in June, 1998 to require new homebuilders to show official land use plans to prospective buyers. Builders must alert homebuyers to what may be built on adjacent properties, as well as disclose the locations of nearby quarries (Blum 1998). Such an effort, although no cure-all, may help stem some of the potential conflicts between new residents and existing operations at this and similar developments.

3.2 Prince George's County, Maryland

Prince George's County, which abuts the eastern edge of the District of Columbia, historically has been the top producer of sand and gravel in the state of Maryland. According to the latest data available (1995), its sand and gravel production exceeds that of any of the other thirty-eight counties in the study area, on both a metric tonnage and value basis.¹⁸ This feature, coupled with the fact that the level of sophistication in managing construction mineral resources in the County is quite high, make Prince George's a useful case study.¹⁹

Within the County, commercially viable sand and gravel deposits primarily occur in one of two formations: the Patuxent formation, which consists of thick beds of unconsolidated deposits in the northern part of the county near the Montgomery County line; and the Brandywine formation, a shallow bed of coarse sediments in the central uplands and the southern uplands adjacent to Charles County. Approximately forty-five sites in the county are active at present, with most of these split roughly equally between the northern Patuxent and southern Brandywine formations. Nearly another seventy sites are inactive, closed, or reclaimed (Maryland-National Capital Park and Planning Commission 1996).

With its rich history of sand and gravel extraction, the County has long taken an active role in the management of these mineral resources. Language in the 1982 General Plan for the County provides for "preserving for future use adequate supplies of water, sand and gravel . . . [and] the staging [of] future development so that the extraction and rehabilitation of mineral areas may be accomplished in an orderly manner" (cited in Maryland-National Capital Park and Planning Commission 1993, 35-36). This emphasis on protection extends to the master plans for each of the planning subareas in the county with significant sand and gravel resources. Subregions I (the northern part of the County near Laurel), V (the southwestern part of the County toward the Potomac River), and VI (the southeastern part of the County toward the Patuxent River) all have sections on sand and gravel resources. The objectives vis-à-vis sand and gravel in each of these subareas (see, for example, Maryland-National Capital Park and Planning Commission 1990) are to:

¹⁸ However, due to the depletion of deposits and development pressures, this production has generally trended downward over the last twenty years. This contrasts markedly with the general upward trend in crushed stone production in Loudoun County.

¹⁹ For an excellent overview of the County's construction mineral management see Carstea et al. (1991). Much of the following discussion borrows from that overview.

- identify properties containing significant sand and gravel deposits;
- ensure an adequate supply and sand and gravel for future development;
- phase future development to provide for the orderly extraction of sand and gravel resources and discourage the premature commitment of these areas to permanent development;
- plan development to promote the orderly rehabilitation of areas previously mined; and
- promote guidelines for evaluating extraction proposals that preclude adverse effects natural and human environment and to reduce land use conflicts.

Planners in each of the subareas have evinced concerns with protecting sand and gravel resources for future extraction. For example, as far back as 1973, the Master Plan for Subregion VI called for the preservation of upland gravel deposits for future mining. The master plans for subregions V and VI note that roughly one-quarter and one-fifth, respectively, of the subregion's Brandywine formation is precluded from future sand and gravel exploitation because of existing residential and commercial development or development restrictions. When this unexploitable area is combined with the area of the formation already devoted to mining (active mines, reclaimed areas, inactive areas with reclamation in process, and abandoned or reclaimed areas with no State permits), roughly one-half of the Brandywine formation in each subregion is unavailable for future exploitation (Maryland-National Capital Park and Planning Commission 1993, 1992). In perhaps the clearest call for mineral resource protection, the Subregion 1 master plan recommends that mineable natural deposits be delineated as Mineral Resource Areas and given priority over other land uses, and that the County stage resource extraction prior to development. To promote this approach, the plan also recommends that areas with completed mining operations that are abandoned or reclaimed should be developed for commercial or residential use before those areas with unexploited mineral resources (Maryland-National Capital Park and Planning Commission 1990).

Concomitant with this interest in preservation, however, the County evidences a strong concern with the possible impacts of extraction activities on a host of natural and human environmental concerns. Under Article 28 of the Maryland Code, the Maryland-National Capital Park and Planning Commission (MNCPPC)--an agency empowered by the State of Maryland to prepare and administer a plan for the physical development of Montgomery and Prince George's counties--must prepare an Environmental Impact Report when an applicant applies for permission to mine sand and gravel. The trigger point for the Environmental Impact Report is an applicant's request for a Special Exception to allow sand and gravel mining.²⁰ The Development Review Division of the County's Planning Department (under the MNCPPC) refers the Special Exception request to a range of other planning offices within

²⁰ As discussed in the next section, this is a request to allow mining to take place in those zones where legislation has predetermined that the mining activity is compatible with the land use activities that are permitted by right in the zone. In Prince George's County, this is all zones except the urban light industrial zone (rare) and the overlay zone of the Chesapeake critical area.

the MNCPPC (including the Natural Resources Division and Transportation Planning Division, the offices primarily responsible for the analysis in the Environmental Impact Report) and to County agencies with operational responsibilities outside of the MNCPPC. The latter include the County's Department of Public Works and Transportation and Department of Environmental Resources (for use and occupancy permits).

As detailed in the Carstea et al. (1991) paper, the analyses that constitute the core of the Environmental Impact report touch on a number of features. In general, this report must evaluate the potential impacts of the mining activity on environmental factors that relate to the health, safety, and welfare of the County residents (Maryland-National Capital Park and Planning Commission 1996). In addition, the County has laws that in some cases amplify these areas of concern. For example, the Prince George's County Woodland Conservation and Tree Preservation Ordinance requires forestry conservation efforts. Applicants are thus required to submit a number of county and/or state-mandated plans that detail specific impacts and possible mitigation. These include the general site plan, which shows all proposed structures, driveways, access points, and other site improvements; a landscape plan; a grading and erosion plan; a traffic plan that identifies the expected traffic volumes and truck routing; a noise plan; a forest delineation plan, which maps the composition and extent of woods; and a tree conservation plan, which details how the activity will accommodate woodland preservation.²¹ In addition, MNCPPC staff evaluate potential impacts on air and water (surface and ground) quality and quantity, the area's flora and fauna, and general aesthetics.

After these evaluations and accompanying recommendations, the Environmental Impacts Report becomes part of the technical report that the Development Review Division forwards to the county Planning Board. This Board, which consists of five members appointed by the County Executive and confirmed by the County Council, issues opinions or recommendations on the special exception request. It does not have the authority to make a final decision on the application, but it can decide to hold a public hearing on it if interested parties request that it do so. Ultimately, a Zoning Hearing Examiner holds a judicial hearing on the special exception application, with attorneys present and able to call on experts to bolster their cases. Following the decision of the Zoning Hearing Examiner, parties can appeal the decision within thirty days. Such appeals are standard, and typically center on issues related to the conditions of a special exception such as the alignments of roads, size of excavation, time of operations, etc. The Prince George's District Council (which is the Prince George's elected County Council constituted to sit on zoning and land use matters) makes the final decision in appealed cases.²² Generally, the entire process from initial application to final decision takes six to twelve months.

²¹ This latter could involve off-site mitigation.

²² In principle, applicants can appeal a decision of the District Council to a higher court. In one recent case, the Court of Special Appeals of Maryland sided with Brandywine Sand and Gravel, an applicant for a special exception, who had appealed an automatic statutory denial by the Prince George's District Council on the application (Anonymous 1996; County Council of Prince George's County, Maryland v. Brandywine Enterprises, Inc., 1995).

The relative sophistication of the County in reviewing an application for a special exception not surprisingly does not guarantee a completely smooth and trouble-free process in permitting or operations. A number of factors militate against such a harmonious scenario. Perhaps most centrally, even though the County has a long history of sand and gravel extraction operations and even though opposition to such *existing* operations appears largely absent, nearby residents almost always voice opposition to *proposed* mining operations. Their concerns typically involve traffic, safety, noise, wildlife and woodland loss, and, occasionally, potential impacts on groundwater.

From the other side of the special exception application table, the fact that an applicant can incur significant costs in submitting an application can introduce tension. Although special exception application fees can be relatively minor--less than \$2,000 for sites of twenty-five acres or less²³--attorney and consultant fees can be substantial. Although no hard data are available, one MNCPPC staff member active in reviewing sand and gravel special exception applications estimated that applicant costs in some cases could exceed \$50,000. Such an expense can clearly place a burden on an applicant, and create a reasonable expectation that the special exception request ultimately will be approved with revisions that are modest enough to allow an applicant to recover costs and make a profit.

In addition to these possible tensions from the county process, state regulatory requirements for operations also can pose difficulties. Reclamation costs exceed \$1,000 per acre, as already noted, and sediment controls, erosion controls, riverine and wetland buffer requirements, and time-of-season operating restrictions may impose additional costs and/or limit extraction activities. And once operations begin, operators are subject to inspections and monitoring which to some may seem onerous or misdirected. For example, in one recent case, a sand and gravel processing facility in the northern part of the County argued in Maryland's Court of Special Appeals that an inspector's water quality monitoring was flawed, because it had used an inappropriate sampling technique. It asked that the Court to overturn nearly \$50,000 in fines for violating wastewater standards under the Clean Water Act. The court, however, rejected this argument (Brennan 1997).

Finally, the long history of sand and gravel production in the County--and its legacy of sand and gravel pits--has on occasion raised tensions over the post-extraction use of the pits. For example, in the southern part of the County, three former pits are used as rubble fills for rocks, asphalt, concrete, roofing, and other building materials. Several years ago, the County Council rejected a proposal to convert a nearly depleted sand and gravel quarry into another

²³ More precisely, according to information provided in our survey, fees are \$800 for sites of less than five acres, \$1,100 for sites between five and ten acres, \$1,600 for sites between ten and twenty-five acres, \$2,600 for sites between twenty-five and fifty acres, \$4,000 for sites between fifty and seventy-five acres, \$5,300 for sites between seventy-five and one hundred acres, and \$5,300 for one hundred acres plus \$500 for every fraction of ten acres above one hundred acres. Fees for revision are one-half of the filing fee. This appears to be most burdensome fee structure of all counties surveyed, at least for large sites. One of the MNCPPC staff interviewed for the case study noted that the county is sensitive to the cost imposed on special exception applicants, both by the fee structure and by the *de facto* requirements for expert consultants and attorneys. Given the lack of data on costs, he suggested it would be useful to do a study on the costs that the industry incurs.

rubble fill in that part of the County, in part due to the opposition of more than one hundred local residents who attended a County Council hearing on the proposal. Many of these residents said that their communities are already overrun with rubble fills and gravel pits (Varner 1995).

In addition to these site-specific difficulties, two other factors have complicated mineral resources management in the County. First, according to one MNCPPC staff member, the general County policy of extracting sand and gravel from a site before allowing residential or commercial development at the site can run squarely into the reality of how development occurs. Despite the best County efforts to stage or shape development, development usually occurs at the initiative or acquiescence of the property owner (as does sand and gravel extraction). If a developer comes into an area that the County thinks is suitable for development, the County may find it quite difficult to reject a development proposal merely to protect sand and gravel resources (Rovelstadt 1998). And second, post-extraction development of sand and gravel sites is problematic because State and County laws do not allow septic disposal systems on such disturbed soils. If sewerage is not available, post-use options are limited to agriculture, forestry, and other low-intensity actions (Maryland-National Capital Park and Planning Commission 1992).²⁴

Despite all of these above difficulties, however, sand and gravel management in the County appears successful on a number of fronts. To some degree, this success piggybacks off of other non-mining-related planning objectives and efforts. For example, the County has identified areas that are off limits to development, and has consciously not supported sewerage and avoided upzoning these lands (from agriculture to a higher intensity use). This has both reduced the extent of potential opposition from local residents to sand and gravel operators that find the areas desirable for mining--since population densities are by definition low in these areas--as well as likely lessened residential and commercial development pressure in sand and gravel rich areas that are being exploited.

At the same time, the local planning apparatus for sand and gravel resources has itself yielded benefits. The master planning process supports an active reclamation and land restoration process, and the zoning process has greatly limited the number of sand and gravel extraction sites that are operating as a non-conforming use.²⁵ With the special exception review process, nearly all of the twenty applications over the last ten years--sixteen of these for operations at new sites--have required substantial revisions, yet only one has been rejected. Furthermore, although there is always opposition to proposed operations, once an operation is sited, there is seldom any opposition. In addition, to address some of the concerns of citizens over sand and gravel mining activities, an Advisory Committee on Sand and Gravel Operations

²⁴ It is important to note that many of the rural areas of the County have bad soil percolation characteristics. Even without disturbance by sand and gravel activities, many of these areas would not support septic systems (Rovelstadt 1998).

²⁵ In the northern part of the county near Laurel, a number of operations are non-conforming, grandfathered activities in non-zoned land (Carstea 1998, Stanton 1998).

was established in the 1980s. This Committee consists of nine members--three from the sand and gravel industry, three citizen representatives, and three County representative--and technical advisory staff from MNCPPC's Natural Resources Division (Carstea et al. 1991). It has been particularly effective in addressing some of the concerns that members of the community have with respect to safety issues at sand and gravel sites.

4. SURVEY OF COUNTY PLANNING DOCUMENTS AND OFFICIALS

The central elements of our study of construction mineral management in the Washington-Baltimore metropolitan area are a examination of local planning and zoning documents and a telephone survey of local planning officials.²⁶ In general, the planning and zoning documents provide background on the goals, objectives, and generic requirements of mineral resource planning and management in each local jurisdiction. The survey, on the other hand, helped furnish review requirements that may not be codified, as well as the experiences that local officials have encountered in mineral resource management.²⁷

At the outset, it is important to emphasize two features of our analysis. First, on the substantive level, local interest in mineral resource planning and protection is quite mixed across the study region. Although state officials and legislators have encouraged local attention to mineral resource management--as evidenced by the aforementioned efforts at the state level in Maryland and Virginia to promote local construction mineral resource planning, for example--the apparent concern with construction mineral management varies substantially across the region. Second, on a methodological level, all of the results from the analysis of plans and survey results should be interpreted with caution, since some of the plans may not reflect current attitudes and policies toward mineral resources and survey respondents may not necessarily represent the official view of their local jurisdictions. In addition, while the response rate of our survey subjects is one hundred percent--due in large part, we believe, to our pre-interview contact--the actual number of respondents is quite small. Thus, most inferences can not pass any formal statistical test for significance.

4.1 Background

By way of background, both the plans and the survey responses suggest broad attention to construction mineral management. As Table 1 shows, about seventy percent of the local plans that we examined included construction mineral resources as a substantive

²⁶ For the forty jurisdictions in the study area, we reviewed planning documents for thirty-two jurisdictions and administered the survey to thirty-six officials. Because Washington, DC does not have any sand and gravel or crushed stone operations, we omitted it from our study. In addition, we did not review planning documents from the five Pennsylvania counties or the two West Virginia counties that are in our study area since counties are not the principal loci of construction mineral planning in these two states. However, we did include two Pennsylvania counties and two West Virginia counties in our survey.

²⁷ In this survey, we first contacted the appropriate local level planning official in each jurisdiction, scheduled an interview time, and then faxed our interview questions (Appendix B) to that individual. We followed this with a structured telephone interview at the appointed time.

planning element. The fact that this percentage is not even higher in part may reflect the lack of sand and gravel or crushed stone production in some counties. When we asked local planners in our set of interviews whether their local comprehensive plans mentioned construction minerals, over eighty-five percent of the respondents replied affirmatively.

Table 1. Local Attention to Mineral Resources Planning

Does the Local Government Include Construction Mineral Resources as a Planning Element? (proportion of useable responses)		
	based on review of plans	based on survey of planners
yes	.69	.86
no	.31	.14
	n = 29	n = 35

The apparent interest in construction mineral management that shows up strongly in planning documents persists in the implementation arena, through zoning, permitting, and other regulatory requirements. Nearly all of the local jurisdictions have a formal application process that all sand and gravel or crushed stone operations are required to go through before they can begin operations.²⁸ Typically, one of three zoning approaches underlies this process.

First, several jurisdictions, such as Loudoun County, rely on the designation of a "mineral extraction" zone. This involves a legislative rezoning process to establish a zone in which current and future mining activities, although still subject to the review and approval of site and reclamation plans, are permitted by right.²⁹ Incompatible uses, such as high-density residential development, are excluded. In addition to the area designated as suitable for mining the mineral extraction zone also may include a buffer away from which development would be clustered, or in which only very low-density development (e.g., one dwelling unit per fifty acres) would be allowed.³⁰ This can offer a quite sophisticated planning approach for

²⁸ Typically, the only mineral extraction operations that are not required to go through a formal process are small-scale operations associated with unrelated grading activities (e.g., grading for a new residential subdivision), small-scale operations for on-farm personal use, and operations by state highway departments (which may be exempt from local oversight).

²⁹ In some secondary categories of mineral extraction zones (such as Mineral Extraction District B in Cecil County, Maryland), mining is allowed only by special exception, rather than by right, where there is potential concern with land use conflicts.

³⁰ The local jurisdiction may construct the mineral extraction zone as part of a comprehensive rezoning process across an entire planning area to avoid the problem of piecemeal or spot rezoning, which the courts have limited. Alternatively, it also can involve an overlay zoning mechanism--such as in Fairfax County, Virginia--whereby the local jurisdiction overlays mining areas on existing zones, and then prohibits all uses that preempt mining in that zone.

managing construction mineral resources. It provides for a comprehensive, unified, transparent treatment of such resources, while at the same time furnishing opportunities for flexibility.³¹

Second, a few jurisdictions in the study area use a "floating zone" approach, where mining operations are permitted in certain locations that are described in the local plan. Floating zones are established in the zoning ordinance, but are generally not located on specific sites of the zoning map. Rather, they float until the local legislative body determines where to "settle" them (Cullingworth 1993). For example, Frederick County, Maryland has a comprehensive regional zoning that designates some agriculturally zoned land as being appropriate for a mineral mining district designation. Its floating zone allows the underlying agricultural and forestry activities to continue, but it also establishes mineral extraction and processing as permitted activities. These latter activities still must meet all site requirements and garner approved site and reclamation plans. As noted by the Maryland Office of Planning (1997), the advantage of floating zones is that they provide some flexibility and discretion, but are not as vulnerable on legal grounds to piecemeal rezoning or spot rezoning limitations.

Third, the bulk of jurisdictions in our study area (over two-thirds for both sand and gravel and crushed stone) use a special exception process (also known as conditional use). This is not a variance--which is a relaxation of the zoning ordinance--but rather a process that is permitted under the ordinance. In this context, a mining activity may be permitted in those zones where the zoning legislation has predetermined that the activity is compatible with the land use activities that are permitted by right in the zone. Applicants must apply to the local Zoning Hearing Examiner (as in Prince George's County), Board of Appeals, or elected Board of Supervisor for an exception to the closed list of activities that are permitted by right in the zone. Requirements can be quite extensive, but upon meeting these, special exceptions generally can not be denied; that is, the administrative granting authority has little discretion if the applicant meets all requirements. By their nature, special exceptions and conditional uses can be very flexible, an advantage in many respects, but, like all comprehensive zoning deviations, they may be somewhat at odds with the overall intent of the comprehensive planning and zoning process.

4.2 Regulatory Requirements

The specific requirements imposed by the above three zoning approaches range widely across the counties and townships in the study area. Nearly all jurisdictions and all of the zoning approaches require an application fee for a local mining application,³² site plan, and a

³¹ In the Carroll County, Maryland zoning ordinance, for example, the mineral resource overlay language requires that applicants for a mining site plan approval host a site visit and tour and present the site plan at a community meeting. It also allows property owners to transfer development rights in areas identified under the overlay designation as having potentially recoverable mineral resources--where preemptive residential or commercial development is prohibited--to other parcels, in order to allow more-intensive development than the County would otherwise allow at those parcels (Carroll County 1996).

³² The application fee is typically well below \$1,000, although in a few jurisdictions application fees for large sites of fifty acres or more may run into several thousand dollars.

public hearing, and some mandate a traffic plan, noise plan, statements of impacts on local infrastructure (*e.g.*, sewer), and/or some type of formal environmental assessment. A number of local jurisdictions also require a reclamation plan and a performance bond, in conjunction with those imposed by the state.

Site-specific requirements also vary among the jurisdictions, depending in part on the underlying zones in which mineral extraction activities may be permitted to operate. For all three zoning approaches, agriculture zones are the most common zones in which to find mineral extraction activities, for the obvious reasons of their extent (these zones make up the biggest share by far of many counties), their low concentration of residential development, and the fact that only a small amount of development in these areas has preempted extraction activities. Industrial or manufacturing zones are also common hosts to mining activities, and several jurisdictions even allow such mining to take place in residential zones if the appropriate requirements are met.

Regardless of the underlying zone, the most common site requirements relate to minimum setbacks from roads (ranging from seventy-five feet to three hundred feet), property lines (ranging from fifty feet to three hundred feet), and residential areas (ranging from one hundred feet to one thousand feet); minimum lot sizes (ranging from less than one-half acre to fifty acres); and hours of operation (typically none on Sunday). A number of jurisdictions also have noise and vibration standards and blasting limitations; requirements for fencing, landscaping, and screening; on-site road specifications; and buffer requirements if adjacent to waterbodies. Oftentimes, additional standards are imposed on applicants for local permits on a case-specific basis.³³ These may be in response to advice provided by local agency staff³⁴ or derive from input from the public hearing associated with the decision process. With respect to the latter, a local legislature (*e.g.*, the County Supervisors) is responsible for the decision in more than one-half of the jurisdictions surveyed, and a Planning Commission, an administrative officer, or a Board of Appeals responsible in the other cases.

On average across the study area, the entire process from initial application to final approval takes from five to six months, although in some jurisdictions it can typically take more than one year. Counties closer to the Washington, DC urban core tend to take longer than those in the periphery of the study area (Figure 2), although with the limited sample size, this pattern is not statistically significant. More than one-third of counties who responded to the survey question about revisions have required major revisions of some of the sand and gravel applications in their jurisdiction, and one-quarter of the counties had done so with crushed stone applications. Typical revision requests include further environmental safeguards, more limited hours of operation, and increased screening and fencing. However,

³³ In some cases, a local jurisdiction may have few or no generic site requirements, but instead will evaluate every application on a case-specific basis.

³⁴ This may include review from a local planning commission, agricultural and forestry advisory committee, zoning department, environmental review division, community development department, code administration department, utilities department, health department, fire and rescue department, soil conservation service, parks and recreation department, and public works department.

very few of the applications are rejected outright. Although forty percent of the jurisdictions who responded to our question about sand and gravel permit rejections had denied applications in the past (and thirty six percent had denied applications for crushed stone applications), only three counties had denied more than one application. In addition, as Figure 3 shows, there appears to be no obvious spatial pattern to the denial rates.

Figure 2
Average Time of Permitting
(sand and gravel and crushed stone combined)

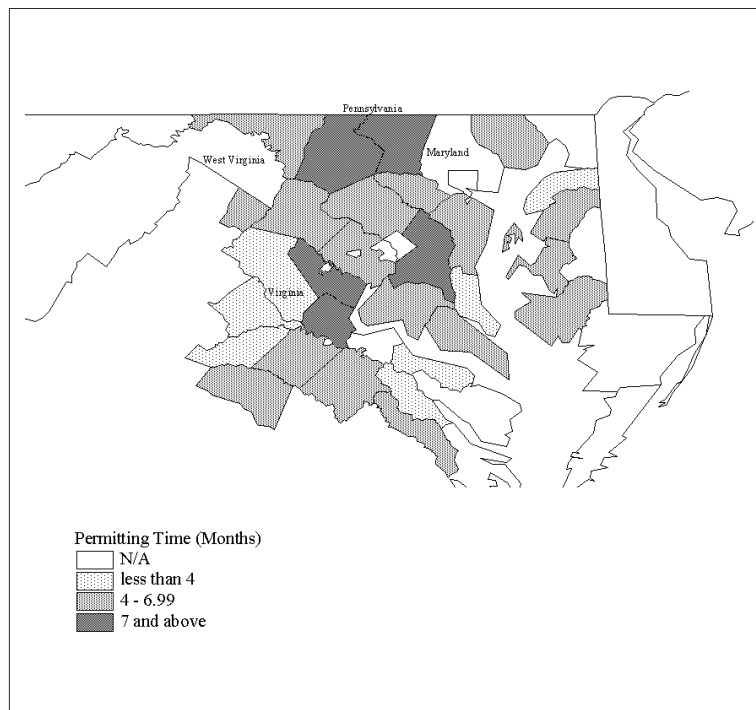
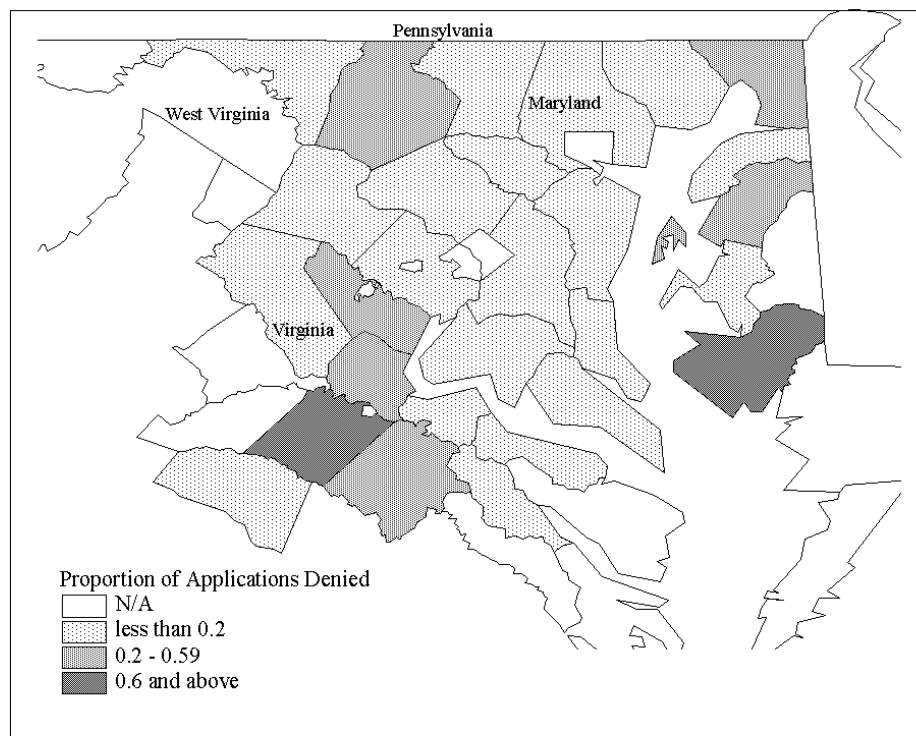


Figure 3
Permit Denials
(sand and gravel and crushed stone combined)



4.3 Opposition to Construction Mineral Operations

The relatively low denial rate of applications for construction mineral operations does not mean that public opposition to sand and gravel or crushed stone activities is not common. To the contrary, more than two-thirds of the planners who answered our questions about opposition to applications for construction mineral operations said opposition has occurred on one-half or more of the applications over the last ten years. The frequency of this opposition typically varies along two dimensions, namely whether the activities already exist or are being proposed, and whether they involve sand and gravel or crushed stone.

As Table 2 highlights, crushed stone operations and proposed operations generally attract opposition more frequently than do sand and gravel operations and existing operations, respectively. According to our interviews, there is "never any" or "seldom any" opposition to *existing sand and gravel* operations in eighty-three percent of the jurisdictions, and "always" opposition to *proposed crushed stone* operations in sixty-four percent of the jurisdictions, a notably stark contrast. Moreover, if we map the opposition (Figures 4 and 5), using the strongest indicator of opposition provided by each jurisdiction (i.e., the maximum of the opposition to sand and gravel and opposition to crushed stone), we see another contrast. Whereas opposition to existing operations seems to be distributed fairly randomly across the study area, a higher degree of opposition to proposed operations appears in the counties closer to Washington, DC.

Table 2. Frequency of Opposition to Proposed and Existing Construction Mineral Operations

How Common is Opposition to Existing or Proposed Construction Mineral Operations?
(proportion of useable responses)

	existing sand & gravel	existing crushed stone	proposed sand & gravel	proposed crushed stone
never any opposition	.08	.00	.19	.00
seldom any opposition	.75	.80	.25	.07
often opposition	.13	.15	.06	.21
usually opposition	.04	.00	.13	.07
always opposition	.00	.05	.38	.64
	n = 24	n = 20	n = 16	n = 14

When opposition does occur, it almost always comes from individual residents, in both residentially zoned areas and, more commonly, agriculturally zoned areas. Over ninety percent of the responses that noted the source of opposition to existing or proposed construction mineral operations identify individual residents as being the most common source. Organized community groups also are frequently listed. The most common concerns of opposition for both existing and proposed construction mineral activities, not surprisingly,

Figure 4
Opposition to Existing Construction Mineral Operations
(sand and gravel and crushed stone combined)

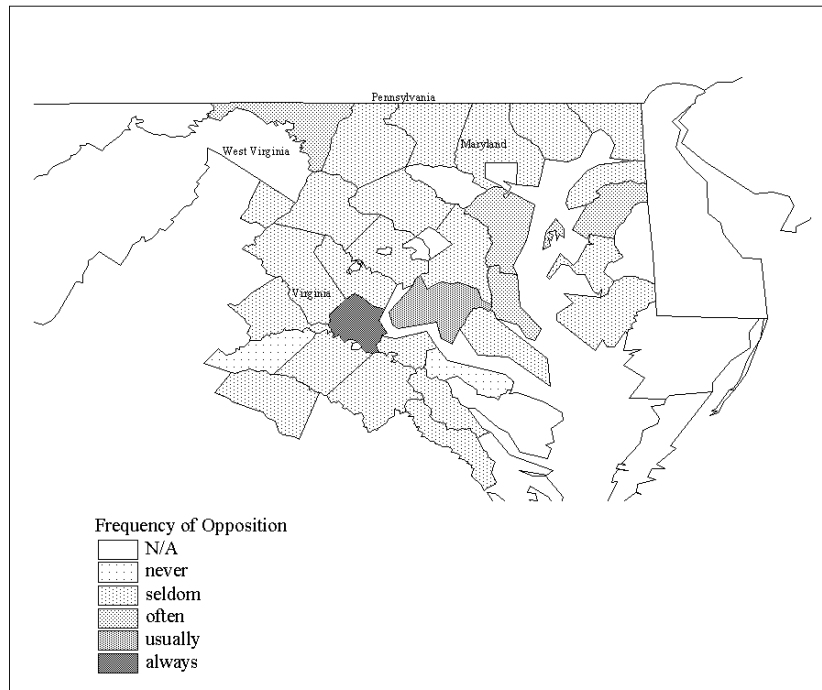
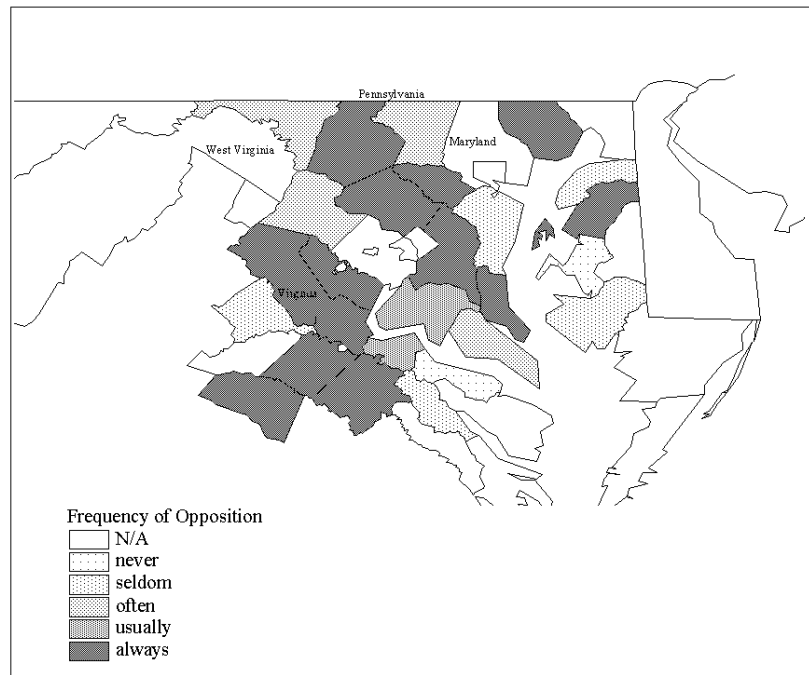


Figure 5
Opposition to Proposed Construction Mineral Operations
(sand and gravel and crushed stone combined)



are noise and traffic. Environmental concerns--impacts on water and air quality and the loss of open space and woodlands--also frequently appear among opponents complaints. The public hearing or comment period that the mineral planning and management process typically provides furnishes a forum to vent many of these concerns.

4.4 Concern with the Protection of Construction Mineral Resources

Given the well-developed planning apparatus across the study area, it may seem likely that the local jurisdictions attach high significance to construction mineral management. However, the high proportion of plans that mention construction minerals and the accompanying corpus of regulations belie to some extent the degree of concern over protecting these resources. As Table 3 shows, forty-four percent of planners in jurisdictions with active sand and gravel operations have indicated that their jurisdiction is "not at all" or "not very" concerned with protecting sand and gravel resources, and another twenty-two percent have indicated that their jurisdiction is only "somewhat" concerned with such protection. Thus, only a little more than one-third are "strongly" or "very strongly" concerned with protecting sand and gravel resources. Responses in jurisdictions with active crushed stone operations exhibited more concern with protecting these resources, as nearly half indicated a "strong" or "very strong" concern. However, only thirty-eight percent of the active crushed stone jurisdictions indicated that satisfying their jurisdiction's demand for crushed stone with production from within its borders is a goal of the county (Table 4), fourteen percentage points lower than the analogous response on sand and gravel.

Table 3. Local Concern with Protecting Construction Mineral Resources

How Concerned is the Local Government with
Protecting Construction Mineral Resources?
(proportion of useable responses)

	sand & gravel	crushed stone
not at all concerned	.09	.07
not very concerned	.35	.20
somewhat concerned	.22	.27
strongly concerned	.30	.40
very strongly concerned	.04	.07
	n = 25	n = 22

Table 4. Local Concern with Meeting Construction Mineral Demand from Local Production

Is satisfying demand for construction minerals with production from inside the local jurisdiction a goal? (proportion of useable responses)		
	sand & gravel	crushed stone
yes	.52	.38
no	.48	.62
	n = 29	n = 21

While a number of officials have noted the value of local production for maintaining local jobs and revenues, others have indicated that ample supplies in surrounding counties were an equally acceptable alternative.³⁵ Figure 6 (concern) and Figure 7 (production) suggests that this concern may rest in part on the level of mineral production in a county, as well as its location within the study region. Nearly all of the top producing counties of sand and gravel, for instance, exhibit a "strong" or very strong" concern with protecting these mineral resources, while lower tier producers typically responded with lower level concern. Moreover, some counties (*e.g.*, St. Marys and Calvert) that show high concern but are not in the top one-fifth of producers of either sand and gravel or crushed stone may be responding to outward development pressures from the Washington, DC core.

Notwithstanding these patterns, however, both Table 3 and Table 4 are somewhat surprising, in that they indicate a lower level of concern with protecting in-county production of mineral resources than anticipated. One possible interpretation of the surprisingly qualified concern with protecting construction minerals is that the local officials that we interviewed are not aware of trends in sand and gravel and crushed stone production and demand. For all but a few of the interviewees, construction mineral resources are but one small part of their portfolio of responsibilities. Furthermore, most of their work centers on zoning and permitting issues, rather than more general resource planning. In addition, a number of the interviewees had been working on construction mineral issues for only a short time. Given these mitigating circumstances, it is not surprising that impressions of construction mineral production and demand trends deviate somewhat from objective data.

³⁵ Both the concern with maintaining "local" production and the willingness to go to other jurisdiction for construction mineral supplies is, to some extent, an artifact of jurisdictional boundaries. In parts of a county, for example, the closest and lowest cost supply of sand and gravel or crushed stone may well lie in another county. Although obvious, it bears noting that data collection and political constraints may obfuscate the efficiency of going outside one's own borders to satisfy local construction mineral demand.

Figure 6
Concern with Protecting Construction Mineral Resources
(sand and gravel and crushed stone combined)

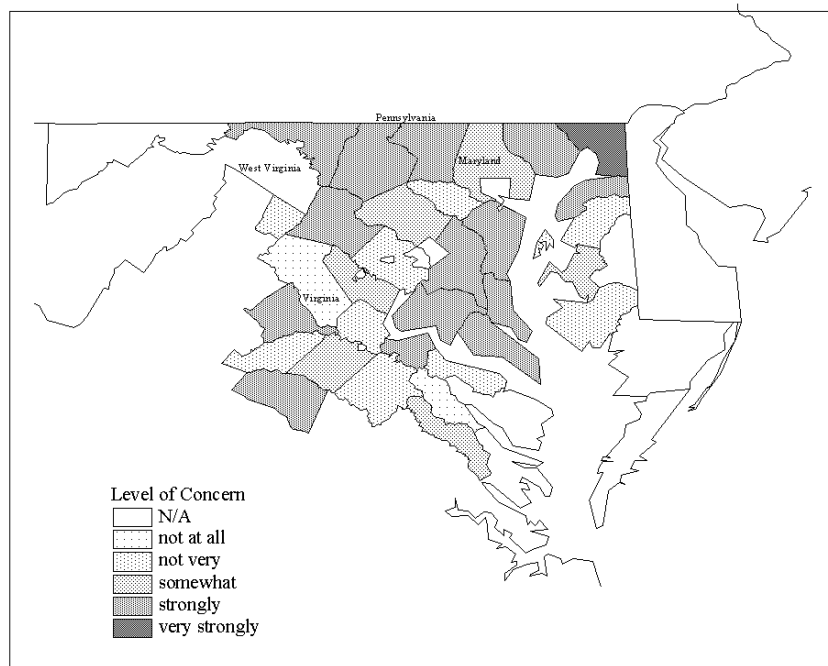
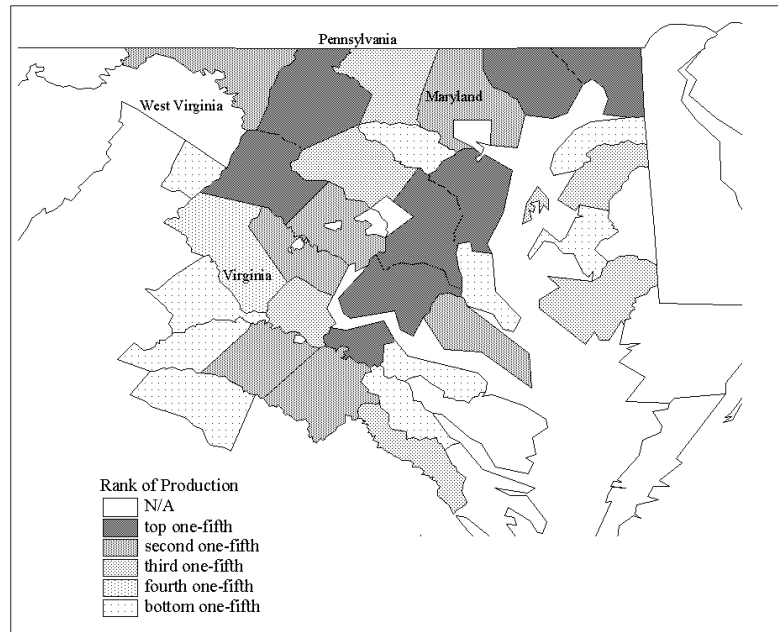


Figure 7
Construction Mineral Production
(sand and gravel and crushed stone combined)



Tables 5 and 6 compare planners perceptions of trends in construction mineral production and ability to meet local demand over the last ten years with 1985 and 1995 data on these variables from the U.S. Geological Survey (USGS).³⁶ In Table 5 we can see that planners from three-fourths of the surveyed jurisdictions responded that they had perceived no appreciable change in sand and gravel production, whereas the USGS data indicate that over three-fifths have experienced decreases. The gap between the planners perceptions and the USGS data on crushed stone is less pronounced, but again a significantly higher proportion of the former indicated that production had not changed than the USGS data show.

Table 5. Trends in Local Construction Mineral Production

In the last ten years, what has been the trend in the local jurisdiction's production of construction minerals?
(proportion of useable responses)

	sand & gravel		crushed stone	
	survey	USGS*	survey	USGS*
increased	.15	.28	.39	.60
decreased	.10	.61	.17	.24
no change	.75	.11	.44	.16
	n = 20	n = 18	n = 18	n = 25

* based on USGS data supplied to the author (includes five Pennsylvania counties rather than two Pennsylvania townships)

In Table 6, the disparities between planner's perceptions and the USGS data also appear in the context of the ability of local jurisdictions to meet within-jurisdiction demand with within-jurisdiction production. Planners seem to believe that this ability over time has increased more and decreased less than the data suggest, although the small number of responses in these categories necessarily make this conclusion fairly weak. With respect to the planners who believe that no appreciable change has occurred--the largest category of responses by far--there is rough agreement with the USGS data.³⁷

³⁶ For sand and gravel, we used 1986 and 1995 production data for comparison since 1985 data were not available. For purposes of the comparison, we considered any increase or decrease of twenty percent or more over base levels to be an increase or decrease in production. (Note that we included only those counties that have measurable production in the comparisons.)

³⁷ In general, we believe that the data fairly indicate the objective reality of sand and gravel and crushed stone production. As the text indicates, there are a number of reasons why the planners responses may be less accurate. Interestingly, however, in some limited situations planners may have more current and accurate information. For instance, the USGS data typically do not include small, non-commercial sand and gravel and crushed stone operations, whereas planners may. When we asked planners for the number of sand and gravel operations in their jurisdictions, sixty-five percent of the planners identified more operations than the USGS data suggest, twenty-nine percent roughly the same number, and only six percent identified fewer operations. The differences on crushed stone were not nearly as pronounced, where over two-third of the planners identified roughly the same number of operations as the USGS data.

Table 6. Trends in the Ability to Meet Local Demand for Construction Minerals with Local Production

In the last ten years, what has been the trend in the ability to meet demand for construction mineral with production from within the local jurisdiction
(proportion of useable responses)

	survey data		USGS data*
	sand & gravel	crushed stone	total agg.
increased	.11	.19	.04
decreased	.05	.06	.17
no change	.84	.75	.78
	n = 19	n = 16	n = 23

* based on USGS data supplied to the author (includes five Pennsylvania counties rather than two Pennsylvania townships)

5. SUMMARY

The local regulation and management of construction minerals operations has fundamentally shaped the landscape in which sand and gravel and crushed stone extraction and processing can take place, since it is at this local level that mining sites are located or, perhaps, prevented from locating. This regulation is inherently a complex process with competing objectives. As pointed out by Stollman (1961), local planners must simultaneously balance the need to make construction minerals available for private and public uses, conserve these minerals, encourage development that will not preempt their exploitation, protect competing uses from the noise, traffic and other negative externalities associated with mineral extraction, and promote use of reclaimed mining areas after the resources are extracted. In a report prepared to assist local planners with construction mineral management responsibilities, Wertz (1980, 1) articulated these tough tradeoffs perhaps the most cogently:³⁸

Sites with sand and gravel deposits are often also good development sites. Is it better to allow development in those particular locations or try to discourage it in order to have the sand and gravel resources? Also, while the resources are important to the general economy of an area, mining can depress the value of property in the immediate vicinity – particularly residential property. What is the balance between the rights of the surrounding property owners and the general welfare of the community? As with other resource protection programs, protecting sand and gravel resources may provide windfalls for some and not others. If some deposits are to be protected and others are not, what effect does this have on competition in the industry?

³⁸ On a historical note, Wertz and the American Planning Association prepared this report for the U.S. Geological Survey and the U.S. Environmental Protection Agency.

Furthermore, the accretion of federal and state responsibilities and requirements on to this local management apparatus over the last two decades, as well as current property rights debates, have added additional complexity to construction mineral management.

To a large degree, the local planning and management apparatus that has developed in each county or township in our study region has shown remarkable resilience to this dynamic regulatory landscape. Mining operations continue to be sited, operated, and reclaimed and local demand for construction minerals continue to be met, in the aggregate, despite the explosion of growth in the Baltimore-Washington metropolitan area. However, few would claim that the current multi-jurisdictional, overlapping management of the construction mineral industry is ideal. Not only can the labyrinthine system of oversight reduce the predictability of siting a construction mineral operation, but it also can increase the costs of this siting, raise issues of federal or state preemption over local regulation, and promote an inefficient extraction and use of construction minerals.³⁹ This may pose a wide array of problems for a large cast of stakeholders, including the industry as a whole, individual operators, federal and state resource management agencies, local planning offices, individual homeowners, environmental groups, and the public at large. Moreover, as development pressures continue and population densities increase, it is likely that such potential difficulties in managing construction mineral resources will increase rather than lessen.

In the face of this, planning and zoning practices associated with construction mineral management at the local level must continue to evolve. To this end, the development of mineral extraction zones in Carroll and Loudoun counties and several other jurisdictions, although no panacea, offers an attractive model to address some of the inherent tensions in managing construction minerals. If current trends in residential development continue, mitigation of nuisance and hazard issues may come to depend more urgently on increasingly sophisticated zoning requirements and performance standards such as these.

³⁹ For a useful discussion of some of these issues and, more generally, an excellent presentation of mineral resource planning in Maryland, see Maryland Office of Planning (1997).

APPENDIX A

ORGANIZATIONAL AFFILIATIONS OF INTERVIEWEES

Maryland Local Planning Offices

Anne Arundel County Department of Planning and Code Enforcement
Baltimore County Office of Planning
Calvert County Department of Planning and Zoning
Carroll County Department. of Planning and Development
Cecil County Government, Planning, Zoning and Parks
Charles County Department of Planning and Growth Management
Dorchester County Planning and Zoning Office
Frederick County Planning Commission
Harford County Department of Planning and Zoning
Howard County Department of Planning
Kent County Office of Planning and Zoning.
Montgomery County, Community Development and Housing
Montgomery County, Department of Environmental Protection, Division of Policy and Compliance
Maryland-National Capital Park and Planning Commission, Natural Resources Division (Prince George's County)
Maryland-National Capital Park and Planning Commission, Development Review Division (Prince George's County)
Maryland-National Capital Park and Planning Commission, Community Planning Division (Prince George's County)
Queen Anne's County Department of Planning and Zoning
St. Marys County Department of Planning and Zoning
Talbot County Office of Planning and Zoning
Washington County Planning Department

Pennsylvania Local Planning Offices

Brecknock Township, Lancaster County, Pennsylvania
West Cocalico Township, Lancaster County, Pennsylvania
York County Planning Department

Virginia Local Planning Offices

Caroline County Department of Planning and Community Development
Clarke County Planning Department
Culpeper County Department of Development
Essex County Zoning Administrator
Fairfax County Department of Planning and Zoning
Fauquier County Department of Community Development.
King and Queen County Zoning Administrator and Board of Zoning Appeals
King George County Planning and Community Development Department

Loudoun County Department of Planning
Louisa County Planning and Zoning
Orange County Planning Commission
Prince William County Planning Office
Spotsylvania County Department of Planning
Stafford County Department of Planning
Westmoreland County Land Use Administration

West Virginia Local Planning Offices

Berkeley County Planning Commission
Jefferson County Planning Department

State and Federal Planning and Resource Management Agencies

Maryland Department of the Environment
Pennsylvania Department of Environmental Protection, Bureau of Mining and
Reclamation
Virginia Department of Mines, Minerals, and Energy, Division Of Mineral Mining
Virginia Department of Environmental Quality
West Virginia Division of Environmental Protection
U.S. Army Corps of Engineers, Baltimore District
U.S. Army Corps of Engineers, Norfolk District
U.S. Army Corps of Engineers, Norfolk District, Central Virginia Field Office

APPENDIX B

Preliminary Questions for Local Planning Officials

- 1) Does the county have a formal application process for siting and permitting sand and gravel or crushed stone operations, and are all sand and gravel and crushed stone operations in the county required to go through this process?
- 2) What county bodies are involved in the application process?
- 3) What county entities need to sign off on an application?
- 4) What county entity has the final approval (for example, zoning Board, planning office, county Supervisors or Council)?
- 5) What are the requirements in the application process (for example, site plan, public hearing, posting bond, environmental impact statement, noise plan, traffic plan, application fee)?
- 6) What other government jurisdictions (federal, state, town) are typically involved in the application process?
- 7) What has been the average length of time it has taken from initial application to final approval?
- 8) What is the zoning method, if any, for sand and gravel or crushed stone operations (for example, overlay zoning, mineral district) and what zones are such operations permitted in?

- 9) What site-specific specific conditions for sand and gravel or crushed stone operations does the county require (for example, minimum lot size, distance to property line, distance to road, distance to nearest residential zone, screening, noise, vibration, water quality/runoff, hours of operation, permit length, monitoring, reclamation)?
- 10) Over the last ten years, approximately how many applications has the county received for sand and gravel and crushed stone operations, and what proportion of these have come from new operations (*i.e.*, those at a new site)?
- 11) What proportion of the applications have been accepted with no revisions required (in size of operation or operating hours, for example), what proportion have required revisions, and what proportion have been denied?
- 12) What expense does an applicant incur in a "typical" application, in addition to direct application fees?

- 13) How many sand and gravel or crushed stone operations have been in production in the county in the last ten years?
- 14) How many operations at present are located in the county?
- 15) How often is there opposition to existing or proposed sand, gravel, or crushed stone operations, from any source?
- 16) What are the three most common sources of possible opposition (for example, individual residents, organized community groups, businesses, local elected officials, other operators)?
- 17) What are the three most common concerns of opposition to mineral extraction operations (for example, air quality, noise, open space loss, traffic, water quality, wildlife impact, woodland loss)?
- 18) What are the three most common land use settings in which opposition occurs (for example, residential, commercial, industrial, agricultural, forest)?

- 19) What has been the trend in the county's production of sand and gravel and crushed stone in the last ten years?
- 20) What has been the trend in the ability of the county to meet demands with production from within the county in the last ten years?
- 21) Is satisfying demand for construction minerals with production from inside the county a goal of the county?
- 22) Is the county contemplating changes in how it manages construction mineral resources?

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