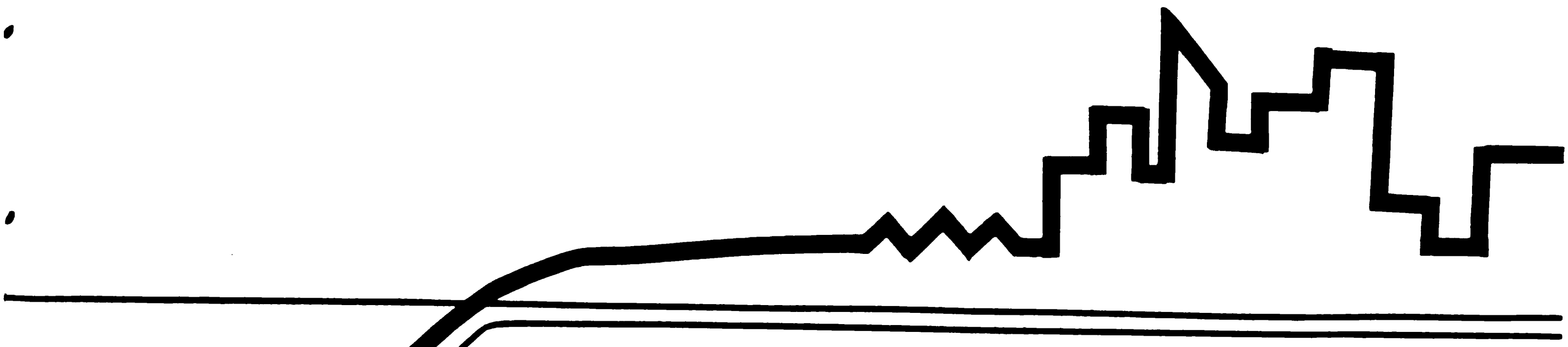
PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE

the natural environment and social interface: mineral resource management



mary s. nardo
michigan state university

THE NATURAL ENVIRONMENT AND
SOCIAL INTERFACE:
MINERAL RESOURCE MANAGEMENT

BY

MARY S. NARDO

A PLAN B PAPER

Submitted to

Michigan State University

in partial fulfillment of the requirements

for the degree of

MASTER OF URBAN PLANNING

School of Urban Planning and Landscape Architecture

1984

TABLE OF CONTENTS

PREFACE

In land management issues the problem of wise management often lies in understanding the synthesis of natural resource processes, effects of change on natural systems and associated management programs. These resource management programs may be established through government agencies, community groups or land owners' associations. In my professional work experience and academic case studies, I have come to realize that the greatest need for information and direction in resource management is at the local level. There are often programs and technical information available at the State or Federal level but this information is not in a form readily applied to local needs. Further, information that is available is not often adequately disseminated to these community units. This problem has been magnified in Michigan due to unfavorable economic conditions. State and Federal program personnel that once were able to "field" questions from local resource managers are no longer available to assist due to constraints in time and program priorities.

The intent of this paper is to communicate technical information concerning natural resource processes to enable better development of resource management objectives. This communication will be directed at those local officials who do not have a background in natural resource-related issues on which to base their physical development decisions or to hire specialized consultants to address specific projects.

In studying and presenting the topic of resource management, I have elected to concentrate on mineral resources which is a subset of the

overall resource management area. Mineral resource management, especially sand and gravel, is the responsibility of local directives but has far-reaching effects both locally and regionally in land, economic and social development of a community. This paper is intended to further aid community leaders and local governmental decision makers in their understanding of systems, both natural and social, that affect mineral resources and development decisions.

THE NATURAL ENVIRONMENT AND SOCIAL INTERFACE: MINERAL RESOURCE MANAGEMENT

Introduction

1. Problem Statement

The process of urbanization entails social conflict over use of the physical environment. On the suburban fringe, the very combination of natural amenities that sustain a productive rural landscape, also entice development. The amount of land that is needed for the development of cities is a fraction of total surface area, but the amount of developed area is growing rapidly. There are protests about the waste of good agricultural land in development of cities; many opponents feel that the natural fertility of the soil is the most precious resource and is sacrificed in our current process of land development. In general, less expensive argricultural land is unprotected against development pressures and therefore the easiest to build upon. Population growth in metropolitan areas of corresponding development results in many conflicts over the use of the land. Among these conflicts is the extraction of mineral resources. There is a need to assure integration of this valuable industry into the expanding city yet the conflict between mining activity and the surrounding environment has intensified in recent years.

The dramatic and immediate changes brought about by mining activities usually cause greater public attention and protests than more damaging activities that are slow and gradual. Sand and gravel operations are usually perceived as unwelcomed neighbors in local jurisdictions and, as such, are treated as nuisances. Nuisance characteristics are present in the mining operations, but the industry is also necessary to urban development. Many mining impacts are interdependent and need to address resources of a variety of disciplines and specializations. The possible detrimental impacts of mining upon land, air and water are effects that may be of concern for many years after the initial activity has taken place.

Unlike oil or cooper resources, sand and gravel supplies are not likely to be exhausted in an absolute sense, but they can become scarce within a locality which results in cost impacts on the provision of materials. These conflicts may be mitigated by planning in advance of immediate pressures and understanding the need and use of the industry at the local level along with its impacts on the natural and social environments of the community.

2. Intent of the Paper and Scope

In recent years, an acceleration in public awareness about environment problems has created mass movements directed toward government and industry for action to be taken against degradable effects of industrial activities. "With cities and counties possessing the principal powers of control over use and development of land, it is vital that local planning programs embrace the full range of resource considerations permitted by existing structures as an essential element of the planning process."[1] There is a greater need for intergovernmental cooperation and industry-government cooperation to best address mineral resource management problems. Remaining uncertainties regarding the effects of ecological disorganization coupled with lack of political and economic resources allocated to explore these issues hinders an intelligent decision-making process in regard to these questions. Polar positions that may be taken are either: a) "business as usual" or b) "stop production". Neither of these positions fits reality. The basic question that remains, "whether production is to be assumed safe or unsafe", remains a political issue. Continued confrontation of certainties and uncertainties on environmental issues, necessitates that decision-making elements of society possess an intelligence system that is attuned to these issues. Industrial societies, for the most part, have failed to develop such a system.

Technical information concerning natural resource systems and known effects of change on those systems, that we do know, is not often assembled in a package for application at the local decision-making level. The intent of this paper is to discuss the various natural elements and their respective systems, that are involved in determining potential effects of a mineral extraction process. In addition, major considerations at the local level of social impact, governmental coordination, regulation and planning, will be addressed.

3. Extractive Processes

A mineral resource is defined as: "a concentration of naturally occurring solid, liquid or gaseous material in or on Earth's crust in such form that economic extraction of a commodity is currently or potentially feasible".[2]

Sand and gravel operations, more than any other extractive

industry, are located in urban areas. These mineral resources are used in various construction projects with their primary use being in highway and street developments, secondary uses are in heavy construction and general building, and minor uses are in concrete material molding, glass sand, abrasive products and fill. About 90% of produced sand and gravel is processed in fixed plants and sold commercially.[3] Most extractive pits, of a limited size, are near job sites. Market limit for transportation (per Southern California figures) is about 20 miles. The cost of transportation equals time plus equipment costs plus man power wage. Due to transportation costs, deposits are more valuable the closer they are to the site where they will be used. In 1978 the value of sand/gravel at the site was $2.50 per ton with haulage rates of 13¢ per mile. Price of the commodity doubles at 20 miles from the pit.[4] Based on these figures the importance in estimating the value of a deposit is in its place value. There is little that can be done with depleted sources but planners may protect available resources when they are limited (this is a problem for each locale).

Truck traffic is the nuisance reported most often but there are also problems with environmental changes of the site that affect adjacent property, land uses and site safety. Major environmental considerations are impacts to surface water, ground water, air pollution, noise and erosion. The nature of these problems involve:[5]

a) direct hazard to human safety

b) indirect hazard to human well-being via air pollution, water pollution, noise and dust

c) damage to property, crops and livestock

d) nuisance and loss of amenity

Some factors which influence the nature and extent of impacts are:

a) size of the operation

b) geographical and locational factors of population density, topography, climate, economics and society

c) method of mining

d) mineral characteristics

Sources that affect visual impact may be:

a) surface excavations

b) waste disposal areas

c) the plant (fixed or mobile)

d) air and water pollutants

Elements of a landscaping plan should:

a) minimize undesired visual impact through the life of the operation

b) maximize benefits with respect to other environmental impacts

c) economically and effectively rehabilitate the mining site for productive use after mining has ceased

Major factors in rehabilitating a site involve:

a) stockpiling available topsoil for later use

b) use of earth sculpturing and benches in slopes for erosion control and planting

c) planting for buffer and erosion-prevention

It is important that objectives for rebuilding the site and landscape be established prior to any disturbance. Various terms used to define the rebuilding of a site are:[6]

restoration - where the exact condition of the site before disturbance will be recreated.

reclamation - where the site is habitable to organisms originally present in approximately the same composition and density after the reclamation process is completed. Reclamation is acceptable if it fills the same ecological niche or native inhabitants.

rehabilitation - where the site is returned to forms and productivity that conform to prior use plans; this implies stable conditions will be established and will not sub-substantially deteriorate the projected land use plan.

4. Components of Mineral Resource Management Issues

Our society, with emphasis on differentiation and specialization, has developed two insular scientific communities--the natural and the social--with little communication between them. Ethics have origination in the tendency of independent individuals or groups to evolve modes of co-operation. The extension of ethics is actually a process in ecological evolution. Co-operative mechanisms tend to increase in complexity according to population density and the efficiency of tools. An ethic - ecologically - is a limitation on freedom of action in the struggle for existence. An ethic - philosophically - is a differentiation of social from anti-social conduct. Primary ethics exist between individuals; later ethics exist between the individual and society.[7] As yet, there does not exist an ethic to deal with man's relationship to plants, animals and land. Land relationships are currently based on economic privileges while negating associated responsibilities. This third extension of ethical relationships may be an evolutionary possibility and ecological necessity. All ethics rest upon the idea of the individual as part of a community; instincts prompt competition for place and ethics serve to preserve co-operation and community.

Evaluation of good land use depends on: 1) the ecological potential of the area, 2) determination of wants and needs of society for that area, 3) development of political and social institutions to allow people to obtain what they want from the land and stay within its carrying capacity for a particular use. Any rehabilitation effort must be site-specific. Pre-planning efforts plus government and industry commitment is necessary if a rebuilding program for a land area is to be successful.

II. The Natural Environment

Within a stable system man and nature are conceptually parts of the same. Early societies (hunters and gathers) followed general rules of ecosystem organization but as societies developed, the significance of ecosystem principles dimished. Western societies, especially, have undergone major shifts from a compatible man and nature orientation to an orientation of man vs. nature. These changes produced by man which accelerate destruction of natural processes are more serious than natural changes which man is not responsible for.

Man's evolution has been marked by an expansion of his niche in the ecosystem. Ecological expansion is carried on in succession within restructed locales where initial conditions are favorable for development. An antagonistic model exists between societal production and environmental resources; this leads to conflict in growth and maintenance of a community. "Human societies exploit surroundings ecosystems to survive but those that overexploit, may destroy the very basis of their own survival".[8] Further resource discovery is possible only to the limitation of a particular ecosystem, then either a new ecosystem must be tapped, or societal production must be altered.

Historically, in the development of land areas in the United States, public opinion has favored development concerns irrespective of the associated costs incurred to the environment. Current laws and institutions, many of which evolved during these periods favoring development at all costs, reflect this prodevelopemnt bias. Institutional processes that do allow for sensitive accommodations and balances to protect critical natural resources, yet assure that essential development needs are met, are not in effect in most areas.

Normalized development growth tends to be incremental and unrelated to natural processes of the site. Natural processes and environmental quality need to be considered in the planning phases of development because individual changes to the character of a site affect the entire system. While negative consequences of development are related to aggregate effects and thus usually the responsibility of the public sector, benefits of development are particular to the site and accrue to specific private sector interests. Past development has been characterized by "leap frogging" which results in inefficient land use and excess taxation on infrastructure, facilities and transportation. Urbanization develops primarily on open land areas with more intensive uses filling in the urban fabric.

At a larger scale, the use of open space in development, is related to improving water quality and limiting pollution. At various scales, vegetative areas are related to climatic effects which, in turn, affect temperature, humidity, precipitation and wind patterns. Vegetation also helps cleanse air of pollutants and the quality and quantity of stormwater runoff. Replacement of polluted air and its diffusion depends upon air movements over pollution-free areas. Intensive development warrents detailed open space planning in urbanized areas to assure that open space will be incorporated into the urban environment. Protection of sand and gravel deposits for future use may be linked into an open space system.

1. Water - The Hydrological Cycle

1.1. Importance and Realtionship to Other Systems

The quality of our environment, the adequacy and dependability of food supply, the production and distribution of energy, all depend upon water resources. Supply of water for human use is dominated by various constraints: it is widely varied according to regional characteristics, the season, fluctuations in demand, supply mechanisms, and quality differences. With increasing growth in urbanization patterns and associated water resource demands, water must be obtained from greater distances which encroaches upon extra-regional ecosystems. In addition, due to natural and cultural use cycles of water, the interrelated effects of development and unwise use are becoming more complex.

1.2. Water Resources in Society

One of the main problems in our society is the way in which scarce resources are allocated among alternative uses and users. Water, one of the earth's basic elements, plays a significant and dynamic role in determining the earth's capacity for life support. It is the single most important compound enabling life formation and in providing tools which have forged our environment.[9] At higher levels of impact, water forms a basis for social existence and settlement patterns for man, as well as other life forms which congregate for existence. As civilizations became more complex, it was often water which made possible man's technological and urbanization advancements.

One of the most obvious needs for water is for human consumption to support body functions. This use is actually a relatively small amount of

the total amount of water used. It is the various support activities such as showers, toilets, laundry, lawn watering and public use for activities of fire protection or street cleaning, which consume the larger amounts of water. All these uses combined, still limit the use of water for human activities, to about 4% of total runoff.[10] In recent years, industrial utilization of water has been great but the largest consumption of water has been for agricultural uses. Irrigation alone accounts for the use of about half of all fresh water available in the United States and nearly all of this is lost through evaporation and transpiration processes.[11]

With extended dependency on water resources, there is a greater concern involved in how, where and for what purpose they are developed and managed. Laws of nature regarding water are becoming better recognized and impacts of future decisions are more difficult to understand and foresee based on the complexity of factors in the use of water resources.

1.3. Watershed Mechanics

The area of land down which water runs to a particular stream, lake or other water body is called a watershed. There are many smaller sub-basin drainage areas within a larger watershed and a "drainage basin" is the term often used in referring to larger watershed areas. A watershed unit includes a combination of water and land features, the soil, vegetation, agricultural areas, urban areas, industry, people and animals; in other words, a watershed is an encompassing geographic, social and economic unit.

As a result of natural and man-constructed forces the surface of the earth is always changing. Land masses of the watershed which are

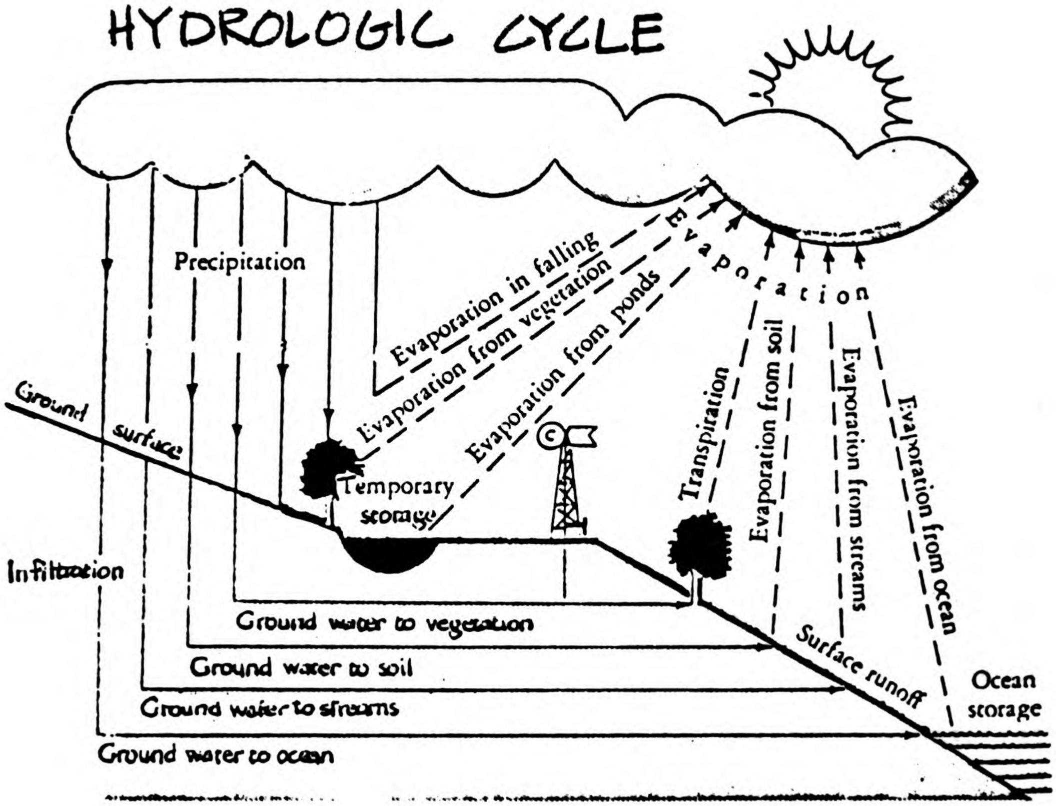
exposed on their surface, are acted upon by tides, ocean currents, winds and the movement of water through the hydrological cycle. Every unit of land, no matter how small, is part of a watershed area. Hence, the manner in which the land is managed will inevitably influence streamflow of associated land changes. The management of a watershed requires specific information pertaining to the conditions affecting plant, soil and water relationships in the area; both broad regional differences and local variations must be considered.

In order to appreciate the water resource of a watershed, its relationship to other small watershed areas and to regional watershed units, it is necessary to have a general understanding of the hydrologic cycle. Water is the product of the hydrologic cycle. A broad definition of hydrology has been given by the Transactions of the American Geophysical Union (1962):

> "Hydrology is the science that treats of the waters of the Earth, their occurrence, circulation and distribution, chemical and physical properties, and reaction with the environment, including their relation to living things. The domain of hydrology embraces the full life history of water of the Earth".

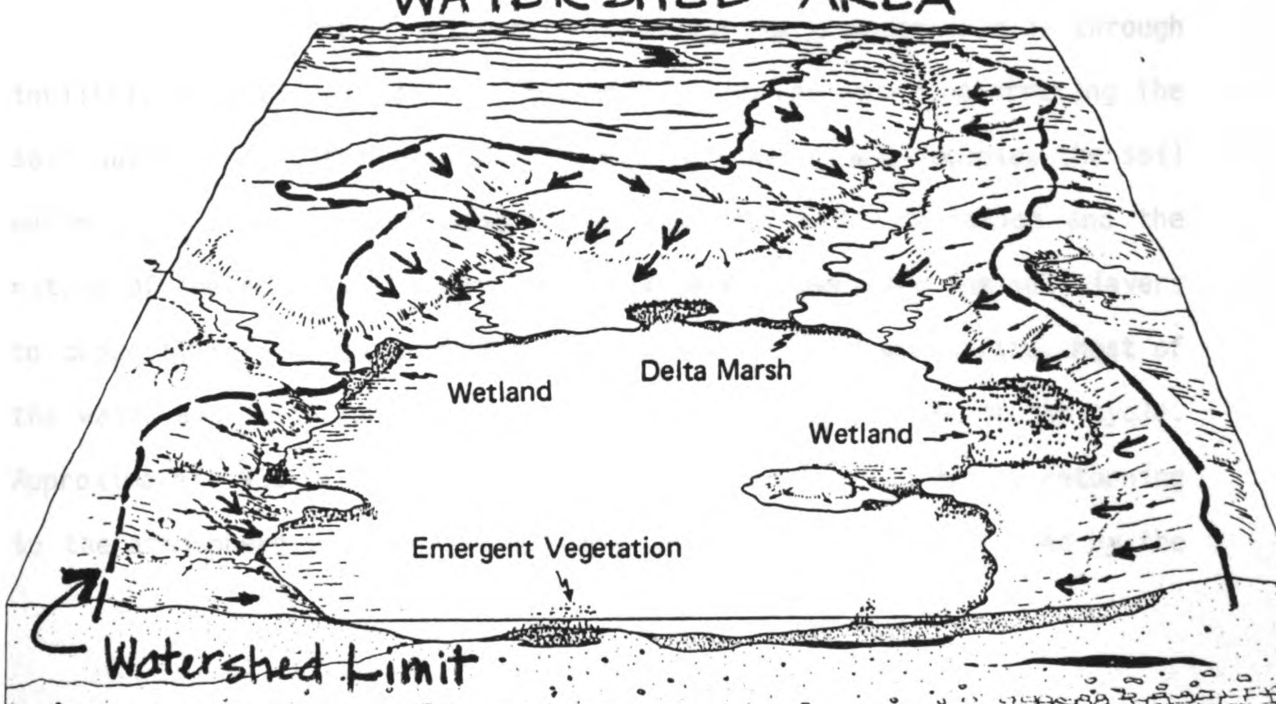
Of the earth's water, the oceans contain an estimated 97%. These water areas are continuously being evaporated by solar radiation striking their surface. As maritime air masses move over the land surface, condensation may give rise to some form of precipitation. This precipitation may then strike an object before reaching the ground and evaporate, transpire or be used by the object. This process is called interception.

HYDROLOGIC CYCLE



SOURCE: Fitzsimmons & Salama, "Man & Water"
Note.--Reprinted from U.S. Department of Interior.

WATERSHED AREA



SOURCE: Marsh, "Inland Lake Watershed Analysis"

Vegetation is usually the intercepting object. The quantity of water intercepted is difficult to measure but may be a significant portion of the total precipitation amount. Precipitation, in the form of rain, is intercepted more readily by broadleaf deciduous trees. In turn, coniferous vegetation is able to intercept a larger amount of precipitation in the form of snow.

Upon striking the ground, rainwater runs downslope to stream channels with some of the surface flow evaporating or entering the soil before it reaches these streams. This is particularly evident where the water is likely to be temporarily detained in surface depressions. This streamflow is the residual difference between precipitation and losses due to interception, transpiration, evaporation and seepage. Vegetation reduces surface runoff, promotes infiltration and offers obstructions in delaying the movement of water to stream channels along with retarding and/or lessening flood peaks while prolonging flow into the dryer season.

The most important pathway of water for man's sustenance is through infiltration into the soil.[12] That portion of the water penetrating the soil surface (infiltration) constitutes soil water and occupies the soil water belt. The rate of penetration depends on precipitation and the nature of the soil. Soil water moves downward, saturating the soil layers to capacity before it is available for flow to the lower strata. Most of the water available for vegetation occurs during this phase of the cycle. Approximately 95% of this water is absorbed by the plant roots, returning to the atmosphere via the transpiration process with 5% being used by the plant to manufacture food.[13] The water table level varies in response to these seasonal and multiple-year periods of excess or limited precipitation.

Below the water table, water percolates downward with a considerable horizontal component. The general direction of movement is toward sea level but most of the ground water returns to the land surface before reaching the ocean. Some of the water percolates into permeable bedrock strata. The more permeable formations are acquifers and are sources of ground water used for human activities. Typical acquifers include: sand, sandstone, gravel, conglomerate and cavernous limestone. Formations with relatively low permeability that do not permit water flow to any extent are termed aquicludes. These formations may be: clay, shale, slate and crystalline rocks.[14]

During the processes of the hydrologic cycle, water is put to many uses. It provides life-supporting substance that is required by land and water-based animals and plants, it maintains a life-supporting earth temperature range, and the recirculation helps maintain a level of quality. The use of water is not only critical to plant life but also to the generation of oxygen, maintenance of topsoil and protection of many other life forms as well. Man is one user of available water but other users are critical to man's survival.

Known underground and surface freshwater available to man is less than .05% of the world's total water content. This amounts to approximately 120,000 cubic miles with three-quarters of this freshwater supply held frozen in polar icecaps.[15] There are a number of means for increasing the water supply available to man; these include: weather

modification, reuse of water, saline water demineralization, reduction of reservoir evaporation loss, and transport of icebergs. Each of these methods has associated advantages and disadvantages with its use. Man's main influence in supplying water can best be exerted on reception and distribution of the precipitation that reaches land surface. Management of the land can insure absorption of clean water into the soil and control, to an extent, flow towards the oceans, storage and distribution factors.

Surface permeability (permeability equals water in inches divided by time in minutes), or infiltration, regulates the amount of precipitation which is converted to surface runoff. On a given slope angle and length, runoff estimates can be made on the basis of soil texture and plant cover. Differences in density and structure of plant cover affect runoff. The coefficient of runoff equals the fraction of rainfall that is not lost to infiltration; it is expressed in numbers between 0 and 1.0, 1.0 represents 100% runoff.

The ground water table generally follows the topographic configuration of the ground surface. A change in surface topography that is too abrupt to produce a corresponding change in the water table elevation may result in interception of the water table by the surface. In sandy areas, springs may form; in clay, there may be perennial surface dampness. This outflow of groundwater along a slope may lead to slope failure and erosion. Processes which contribute to this situation may be: 1) addition of water to clay-like material that produces a consistency change which reduces resistance of the material to deformational forces and changes the physical state from solid to plastic to liquid form, 2) poor water

pressure occurs when the weight pressure of groundwater upslope causes soil particles to be driven apart, reducing their interparticle binding strength. In combination with the plasticity factor, this reduces the capacity of the soil to maintain a slope, 3) sapping which is erosion of fine particles by seepage outflow which removes supportive materials.[16]

In a watershed, or drainage basin area, there occur first, second and third order streams. Order is determined by the number of major tributaries entering into a stream channel. First order streams have no tributaries; second order streams are the convergence of two first order streams; and third order streams are the convergence of two or more second order streams.

Floodplains are formed by the lateral erosion and deposition processes of the river in its channel. Water is supplied to a river system via precipitation in the form of overland flow or groundwater. River discharge is controlled by processes that supply water such as: rainfall, snowfall and snowmelt, comined with characteristics of the drainage basin, which include: size, shape, orientation, network and infiltration capacity.

1.4 Historical and Technical Aspects of Use and Control

> "The history of water resource management and history of the human race are inseparable". (W. Durant, "our Oriental Heritage", The Story of Civilization: Part I, 1935)

In Durant's opinion civilization was and continues to be conditioned by certain factors which are geologic, geographic and economic. Social organizations, law, economics and commerce all relate to our water resource.[17] A review of historical and institutional water development is characterized by certain periods of rapid development. Historically, early peoples were mostly hunters and gatherers and established their civilizations in river valley areas. As they learned to cultivate crops, they moved into the valleys for access to more dependable supplies of water and thus learned irrigation techniques to bring the water to their needs. These societies also learned to develop water-holding systems for dry periods and the use of rivers for transport. Eventually, water was put to greater uses by more elaborate means.

Two of man's major uses and modifications of the water cycle are represented by the septic tank (for disposal of unwanted material) and by the well (as a water source). The first piped water supply in the United States occurred in Boston in 1652. Between the years of 1652 and 1800, there were only 9 recorded water works in what is now considered the United States. Currently there are more than 45,000 works which supply billions of gallons daily to people of the U.S. and Canada.[18] It was not until the 20th century that wholesale changes of rivers began in concert with other dramatic changes occurring in the country during this period. Growth and development demanded larger industries, more power and more land for agriculture. Associated with these changes was the irrigation and use of lands previously without adequate water supplies to sustain development needs. With the construction of the Hoover Dam a new, unprecedented era began. Hoover Dam and its related system of reservoirs and aqueducts, made possible the development of civilization centers, industries and agriculture in environments that were not naturally suited for such use. Today, in both large and small countries, substantial amounts of the national economy are committed to the development of water supplies for major cities as these areas outgrow the geographical resources by which they were formed. Therefore, large volumes of water of both good quality and hydraulic control are saleable products and if held high in the river system, the potential energy is also saleable, in part, as hydro-electric power. As demands for water and power continue to grow, more land area will be pre-empted for water resource development with associated economic and social costs. Increasing investment at the study and design stage for water development projects can be justified based on these impacts.

Many communities located along streams have turned their reliance to groundwater resources due to the high cost of dam construction and questionable quality of the surface waters. Albuquerque, New Mexico, Tusca, Arizona, Miami, Florida, and Honolulu, Hawaii are among these cities.[19] World-wide groundwater use has been somewhat hap-hazard and not well matched by adequate development of research and exploration. Historically, this lack of research has been partially due to the costs and laborious process involved. Exploration processes include reliance on drilling boreholes, supplemented by surface geophysical methods of plotting the earth's local magnetic field, speed of propagation of shock waves from small explosions, local variations in gravity force and direct measurements of electrical resistance. Even with this process, rock formations are complex and waterbearing materials often have irregular lenses so that there is a need for approximate interpolation between measurements. In the past, locating water sources was a result of exploratory drilling processes done for oil, coal and mineral ores.

With the combination of rising rates of population, water consumption per person, domestic and industrial wastes for disposal, the need for water is outstripping geographic resources of the environment of major cities. As cities grow, water must be obtained from farther distances. Los Angeles currently supplies its water needs from areas 200 miles north and 250 miles east; New York taps water from 140 miles upstream.[20] Problems of water supply are reaching critical concern and involve levels of decision-making at a national governmental scale in many industrial countries. The needs of a growing human population have overwhelmed, if not completely eradicated, the natural ecosystem in many parts of the world. There is a limit to the number and extensiveness of these natural ecosystems which can be altered without interfering with the well being, and survival, of man.[21]

1.5 Natural Environmental Influences and Impacts

The care of a watershed involves the protection of the soil and of managing the water of smaller watershed units upstream with the aim of decreasing water erosion and preventing excessive floods along the stream. Classification of water quality depends upon the purpose for which it is to be used. The most important criteria of water quality for living organisms concerns the dissolved oxygen content, which is a function of temperature (the colder the water, the higher its capability of holding oxygen in solution). Acidity and alkalinity also have a critical bearing on the use to which water must be put. A pH term is used to express the acidity or alkalinity with a pH reading of 7.0 being a neutral solution.

Not all natural watersheds are in good condition. Some steep hilly areas have shallow soil and cannot support adequate vegetation cover.

These watersheds are easily damaged by erosion. A watershed area cannot avoid erosion if the trees or supporting vegetation are stripped from the hillsides. Tree crowns help minimize the force with which rain strikes the ground surface and forest litter prevents disturbance of surface soil by raindrop splash. An erosion condition may develop when grassy hillside areas are bared through abusive use by grazing animals, soil damage, loss by inappropriate agricultural practices or intensive development effects. The resultant erosion can change water quality of a stream and alter its fitness for use or as habitat for animal and vegetation communities. This has been the outcome on many watersheds throughout the world brought on by insensitive development practices and poor management.

The beneficial influence of a forest on the quality of water yield by a drainage basin has been recognized for a long time. The forest-soil or grassland-soil ecological complex must be present if purification of waste water is to be accomplished. Research also indicates that where water temperature is an important balancing factor of an ecological community, the cutting of forests should be carefully controlled near stream bottoms as it may increase normal temperature ranges and thus exceed optimum conditions for species' habitats. Trees also serve as protection for streamsource areas. Projecting features on the land serve to force approaching airstreams up to cooler altitudes, where water vapor condenses into precipitation. Because of this, these features are source areas for stream flow.

In a study done by Lull and Sopper (1969) on the influence of urbanization on forested watersheds, they conclude that: 1) urbanization may increase peak waterflow through partially forested watersheds by 1½

to 5 times the rate of discharge as compared to previous conditions; 2) during construction, sediment yields increased 5 to 10 times compared to those of protected watersheds; 3) annual potential evapotranspiration was reduced in the range of 19% to 57% under previous forested conditions; and 4) the annual volume of runoff was increased in the range of 15% to 41% as a result of urbanization effects.

In comparing runoff rates, the coefficient of runoff is the percentage of rainfall which runs off the surface. This runoff is expressed in decimal form. The remainder is that percentage of rainfall lost to soil penetration. The higher the coefficient, the greater the runoff. Runoff coefficients vary depending upon surface cover, soil texture and slope. In general, the runoff coefficient increases as land use intensity increases.

In light of experiences that have been recorded and the results, it is apparent that forest areas should neither be felled nor planted on a large scale without a study of the potential hydrological changes that may be expected. Research exists today that enables qualitative predictions to be made along with some quanitative evaluations. The use of good sense in the early stages of comprehensive planning involving land use changes will provide the necessary study that will reduce decisions based upon guesswork and thus save large sums of money later to correct inappropriate actions.

1.6. Development Influences and Impacts; Land Use and Pollution

All problems of land use concern water. In most instances the availability and seasonal distribution of water supply is the critical ingredient in land use decisions. The types of groups which can be found

around a water source determine the land use pattern of the area and are further influenced by the quality and quantity of water available.

As a watershed is developed, forests are cleared and replaced with more impervious surfaces that become depositories for urban-gengerated residue. Ultimately, these surfaces are rinsed by runoff and the residues carried to the lakes via streams, storm sewers and drains. This situation triggers aquatic changes by the addition of these materials.

The need for consistent watershed development discipline is evident. The achievement of this discipline is wrought with the political sensitivities of controlling land use and of overlapping political jurisdictions of natural watershed boundaries. Traditionally water has been a cheap commodity that was able to be collected, stored, purified and delivered for only a few cents per ton.[22] One of the advantages to the costs involved in water resource development is that it forces the more technically advanced communities to look critically at their use of water in formulating discipline and management policies.

Land use changes dramatically alter the runoff manner of a drainage basin. Major hydrological changes associated with urbanization are: 1) surface changes, 2) suppression of natural surface flows into subsurface conduits and 4) new, artificial flow systems.[23]

The majority of surface changes increase impervious areas, in turn increasing runoff volume and velocity (runoff coefficient). The more impervious an area, the more runoff occurs at a faster rate. "Pruning" of stream networks which alters lower order parts of a drainage system, causes major effects further down the drainage network. Mitigation of this problem may be accomplished via: the use of greenbelt areas, storm-sewer runoff routed temporarily to infiltration areas underground or held in surface retention ponds.

As cities outgrow their natural geographical facilities for water supply and waste disposal, it has proven easier to supplement input by transporting water a distance than to solve the disposal problem. As a result, major rivers have become open sewage systems. After a century of neglect of this steadily worsening problem, public attention in more developed countries has turned to the correction of misuse of these watercourses. Costs involved in solutions are so great as to become major financial burdens to municipalities, ranking third in expenditures (after education and highway construction).[24] Even with this high cost treatment, control of industrial effluent is inadequate. Industrial wastes, of increasing chemical complexity, present a far more intractable problem than domestic sewage. In particular, the salts of heavy metals, copper, lead, zinc, iron, chromium and cadmium, produce highly toxic sludges which are difficult to dispose of.

Modern agricultural practices involving the extensive use of fertilizers and concentrations of animal wastes (due to "factory farming" of animals involving intensive penfeeding), produce runoff problems for surface and groundwater also. The Royal Commission on the Pollution of the Environment gave the following summary of the pollution problem:

> "Pollution's main economic characteristic is that its costs are not usually borne by the pollutors, so that production is often pushed beyond the socially optimum point; there is inadequate incentive to allot sufficient resources to reducing pollution when certain producers and consumers benefit at the expense of the victims of the pollution."

Water is the most dynamic and major determinant of natural processes. If these processes are maintained in relative equilibrium, benefits will be accrued. Defense of these water-based priority areas, and restrictions to their use, can then be justified based on the work that these water processes perform. Priority water-based areas would include: flood water reservoirs, marshes, storage basins and surface water protection for purification.[25] By following the processes and methodology of this macro-design approach, detailed elements on a micro or municipal scale, would begin with an inter-related program for intrinsic form which would make a significant contribution to the larger context.

"Water is one of the earth's most abundant resources and a resource which can be placed at serious risk by the activities of the mineral industries".[26] Continued availability of pure water to meet the demands of a growing human population is one of the most vital problems society faces. Water is utilized in many stages of mining and mineral processing, dependent upon the type of mineral involved. Mining processes in which water is generally used include:[27]

a) Mining - slurry, dredging may result in silting

b) Cooling - crushers

c) Process Water - electric generating, benificiation, contact with raw materials

d) Transport Water - slurry

e) Miscellaneous Water - for dust control, vehicle and other washing, domestic and sanitary uses

Additional routes by which mining can influence water processes without actually using it include:

f) Pumped Mine Water - water influx due to rain or groundwater

g) Run-off - rain, snowfall

h) Percolation - via polluted water stored in sumps or tailings impoundments

i) Leaching - through low grade, metalliferous ores

j) Groundwater Interception - interception of aquifer due to excavation

k) Spillages - oils, toxic reagents

l) Aerial Pollutants - fallout of pollutants that affect surface waters

"Over the whole spectrum of mining, direct and immediate interface with human health is rare and the greatest impact is normally upon the acquatic ecosystem".[28] Whether or not a particular substance is a pollutant depends upon its nature, concentration in the effluent, total load discharge, nature of the receiving water and its capacity to absorb the waste loading imposed. Water pollution in mining is usually attributed to several pollutants. Possible combinations of pollutants are varied but the four major problems are:[29]

1) **Acid Mine Drainage** - predominently chemical; produced when sulphate reacts with air and water to form sulphuric acid.
2) **Eutrophication** - aging; may be toxic and nutrient rich
3) **Deoxygenation** - major consequence of pollution
4) **Heavy Metal Pollution** - sources vary but usually in discharges from coal and metal mines

There occurs a broad range of pollutants but they exist within relatively few groups. These groups are:

1) **Organic** - major non-mining problems (i.e.: sewage) but a small mining problem
2) **Oils** - commonly spilled; aesthetically unpleasing, inhibits re-oxygenation of water by forming a film, and may coat fish gills; if contaminants boiler feed water it may cause explosion
3) **Cyanides** - lethal to many fish even at low concentrations
4) **Acids and Alkalis** - changes pH value of water and can adversely affect fish and the acquatic ecosystem; may damage structures at higher acid levels
5) **Base Metals** - highly toxic when in excess; varies according to the type of metal
6) **Fluorides** - usually from waste water of fluorspar mining; toxicity seldom a problem in hard water but toxic in soft water
7) **Dissolved Solids** (Soluble Salts) - common in mine effluents; main source is dissolution from contact with rock; effects vary greatly according to the concentration
8) **Organic Reagents** - i.e.: frothers, collectors, depressants, many toxic but usually are not at sufficiently high levels in mine tailings
9) **Colour** - water discoloration by dissolved or suspended matter; the problem depends upon its cause
10) **Suspended Solids** - interfere with self-purification of water by diminishing light penetration
11) **Turbidity** - from non-saltable fraction of suspended solid load; effects on fish appear relatively small

12) **Thermal** - heated effluents can be extremely damaging; dissolved oxygen content of water decreases while oxygen-demanding biochemical reactions are sped up; lethal temperature for some fish is quite low

13) **Radioactivity** - acquatic flora and fauna absorb and concentrate radioactivity discharged effluents; effect of low doses on man are primarily genetic while no effects upon aquatic organisms appear to be recorded in respect to mining radioactivity

Control of water pollution may be accomplished through:

1) **Monitoring** - To: a. define objectives, b. select parameters to be measured, c. select sampling locations, d. sampling procedures, e. analysis

2) **Water Control** - a. preplanning, b. controlled mining techniques, c. erosion and infiltration control, d. handling of polluted water, e. regrading, f. revegetation, g. mine sealing

2. Land

2.1 Nature of Mineral Deposits; Their Origin and Use

The world-wide search and use of mineral deposits has had profound effect on the migration of peoples and subsequent settlement patterns. Understanding the formative process of deposits is the first approach to their discovery. Deposits reflect the geologic history of a region and the relationship of geographic features as they are determined by geologic influences. These characteristics are unrelated to political boundaries. Long term public and commercial planning must be based on the probability of geologic identification of resources in, as yet, undiscovered deposits and of technological development of extraction processes for presently unworkable deposits.

Most commercial deposits are found in or around valleys, terraces, fans of existing and pre-existent rivers and streams, in coastal plains and lake deposits, and in glacier-deposited areas. The value of a deposit is dependent upon its location, size and purity.[30] There are no general standards for determining the value of a deposit; it is necessary to study the local industry characteristics to find out what makes deposits valuable in that area.

For the operator, the commercial potential of a deposit depends upon:[31]

1) thickness and variability of overburden
2) extend of the deposit
3) physical properties of particle size, distribution, mineralogy and durability

4) accessibility of the deposit to roads, railroads and waterways

5) distance from the intended use point

6) availability of sufficient water supply

7) depth of the groundwater

8) government restrictions

Besides geologic factors, the size and permanence of markets, freight rates and truck weight limits will also determine the value of a deposit.

2.2 Landform Change Impacts; Soil Erosion and Sedimentation Control

Soil is transitional between the air, water, life on the surface and rock of the subsurface. Various soil aspects include:[32]

1) **Bearing Capacity** - the ability to support weight

2) **Erodibility and Stability** - the susceptibility to erosion and failure in sloping terrain

3) **Drainage** - the capacity to receive and transmit water

4) **Resource Value** - the economic worth

Sources of soil information are:

-The Soil Conservation Service - for detailed surveys and analyses by the U.S. Department of Agriculture

-Geologic Maps, Air Photos, Topographic Contour Maps with vegetation and drainage

-Field Sampling

Seventy-five percent of the root mass of plants is concentrated in the upper one foot of soil so vegetation is a vital soil stabilizer.[33] Plant roots bind together aggregates of soil particles thereby increasing resistance to erosion by runoff or displacement by mass movement.

Additionally, foilage and organic litter mitigate erosion (splash) power of raindrops.

Land is not merely soil but also the energy foundation flowing through a circuit of soils, plants and animals. When change occurs in one part of the circuit, other parts must adjust. Evolution is a series of self-induced changes, usually slow and local. Man's invention of tools has enabled changes of unprecedented violence, rapidity and scope.

Vegetation conveys much information about environmental conditions and may be viewed as a primary determinant in gauging ecological sensitivity and as an indicator of environmental constraints that have influenced previous land use. Informational sources include:

-U.S.G.A. maps (for general cover)

-Detailed cover maps used generally for timber production

-U.S. Forest Service Maps

-Local detailed surveys

-Aerial photos - black and white, infra-red and color

A slope is defined as: elevation (or rise) divided by distance (or run). Percent slope is the elevation in feet divided by the distance in feet multiplied by 100. The angle of repose of a slope is the maximum angle at which various soil and rock materials can be inclined before slope failure occurs (i.e., landslide). Site analyses are necessary to determine if a slope is active or susceptible to failure. Some reasons for slope failure include:[34]

1) Undercutting - by waves, streams or construction processes

2) Increased Groundwater Content - as along banks of a reservoir

3) Devegetation - particularly of forest cover

4) Spontaneous Liquidification - slopes comprising certain material types of marine origin which, under force of ground shock, may instantly transform from solid to liquid state

Erosion by surface runoff is an ongoing process on virtually every slope, to some extent. The rate of erosion equals velocity and volume of runoff. This rate is regulated by vegetative cover and slope incline. Slope classification is standardly defined as:

very steep	=	25^{o}
steep	=	15^{o} to 25^{o}
moderate	=	5^{o} to 15^{o}
gentle	=	5^{o}

Assessment of the potential for stream sedimentation, from a proposed construction site, can be determined from topographic maps and aerial photos. The basic slope analysis with determination of nearness of the site of a stream, identifies the most potentially severe problems. Also, there are seasonal variations in sediment yields; those idle or most active during winter-spring season are the most susceptible to severe erosion. Site design features such as settling ponds, check dams and construction schedules minimize site exposure during winter-spring and may help to avert high levels of stream sedimentation.

3. AIR

3.1 Quality Influences and Technical Background

Even though air pollution attributable to mining operations is no more than 1.4% of the total U.S. air pollutant load, the practical importance of a pollutant depends upon its nature, concentration and the point at which it is emitted.[35] Air pollution is defined as "the presence in the air of materials at concentrations sufficiently dense so as to effect health and property in a negative manner".[36] A study by deNever in 1977 reported that damage to health and property were proportional to pollutant concentration and type of pollution. Pollutants that are emitted at ground level, where they are easily inhaled, pose a greater danger than those elevated and dispersed when emitted. Air pollutants are classified into gaseous and particulate. With gaseous pollutants, of most concern in mining are CO and SO_3. With particulates, the most relevant to human health are airborne dusts within the respirable size range. Particulates are the most important and widespread air pollutants.

Sources of air pollution fall into two different groups, point and non-point. Point sources include: chimneys, vents, exhausts; non-point sources include: dispersed sources such as dumps, stockpiles and haul roads. As wind speed and turbulence increase, concentration of pollution downwind of the source decreases. Diffusion of the pollutants occurs more rapidly when an air plume is high above the ground. CO, released primarily from automobiles and NO_2, released from automobiles, industrial and institutional sources, are usually transported in plumes high off the ground and touch ground only after they have grown very large.

Vegetation can greatly improve urban air quality. Quantities of pollutants removed by vegetation are sufficient to lead to substantial improvements in their concentrations. The magnitude of improvements depend on the pollutant type, quantity of vegetation and length of time a plume is in contact with the ground surface.[37] Vegetation serves as a "sink" to remove particulate and gaseous pollutants in the atmosphere. Removal involved: 1) gaseous diffision, 2) impaction, and 3) sedimentation. Gaseous diffusion into the aqueous portion of vegetation leads to the removal of various pollutants at different rates dependent upon solubility and pressure of the gas in the atmosphere.[38] Other gaseous pollutants, CO in particular, are utilized in the respiration of soil micro-organisms which are physically removed from the atmosphere by impaction upon the vegetation structures. This process is referred to as "Dry Deposition".

Resistance in the air-vegetation layer (known as the turbulent boundary layer) is primarily a function of the canopy and structure of the vegetation. Surface roughness, stability and wind speed are aeromatic parameters that define turbulency (or diffusion velocity) in the boundary layer and the transport of materials through that layer.[39] Increases within stand parameters of canopy height, foliage density, canopy roughness and leaf area, will decrease the resistance within the canopy.

The magnitude of a surface sink is expressed as deposition velocity. Collection efficiency and area of a surface determine the deposition velocity of that surface. Efficiency depends on the size, shape, surface textures of particles and the plant surfaces. This collection efficiency varies with the vegetation species and size distribution of the particulate pollutants.[40] A study done by Schroch in 1980 indicates that in heavily vegetated suburbs of Chicago, monitored levels of SO_2 were significantly lower than air quality models had predicted. The difference was attributed to depostion of the SO_2 to vegetation surfaces. Dry deposition of both gaseous and particulate pollutants to the ground surface is an important process leading to reduced concentrations of certain atmospheric pollutants. Existing vegetation in urban areas reduces concentration of pollutants. With increased quantities of vegetation, these concentrations may be further reduced. Morphological characteristics which affect aeromatic parameters include: ground surface conditions (heat capacity and conductivity), vegetation biomass, height and canopy structure.

Air pollution, in the form of fugitive sources, is composed of gaseous and particulate emissions from industrial processes that escape to the atmosphere without passing through a primary exhaust system. Fugitive dust may be natural, agricultural or synthetic dust from non-industrial activities such as unpaved roads, urban streets, construction sites, parking lots and open spaces. Fugitive dust emissions are a function of soil type, wind speed, surface moisture, precipitation, vegetation cover and automobile traffic activity.[41] Recent studies indicate that stack-oriented control strategies, alone, are not sufficient to achieve the National Ambient Air Quality Standards (NAAQS). Present Environmental Protection Agency (E.P.A.) efforts are aimed towards controlling fugitive emissions and requiring the use of innovative technology.

A report by Rahn and Harrison in 1974 indicated 5% of total suspended particulates (T.S.P.) in the Chicago area were resuspended by street winds with 15% of these particulates being auto-initiated. At times, resuspension accounts for 40% of T.S.P., as determined by studies conducted at monitoring stations. Large particulates, due to their size, are of less importance because they quickly settle out of the atmosphere. Fine particles are of greatest concern because they tend to be suspended longer. Urban particulates are especially important due to their small size, toxic, carcinogenic nature and occurrence in highly populated areas. Aerial particulates are not as detrimental because of their tendency to be non-respirable and of natural origins.[42]

There are various types of soil movement due to wind surfaces; they include:

1) surface creep - rolling particles
2) saltation - jumping particles
3) suspension - lifted and carried particles; saltation is needed to produce suspension

Vegetation, becuase of its effects on surface roughness and soil moisture level, will reduce wind velocities over surfaces and increase the cohesive and adhesive forces that retard suspension.[43] To date, there has not been a study that has quantified the effect of urban vegetation on T.S.P., but most research in the area has mentioned that increased levels of vegetation have been effective in reducing the quantity of suspendable materials.

A study conducted by Chepil indicated that soil movement can be stopped by the cohesive forces of absorbed water film surrounding soil particles. Vegetation cover substantially increases ground surface moisture levels. Newman, et al, stated in their report that suspendable particles in an area would be decreased if more vegetation were present. Newman also states that impermeable city surfaces have dry, readily suspendable particles more than soil surfaces because of their drying characteristics. Soil surfaces, because of their association with large volumes of soil, are able to draw up water from sub-surface layers and stay moist longer than artificial surfaces. Vegetation reduces the energy incident upon the soil surface and thus reduces moisture loss by the soil surface. The vegetation canopy over an artificial surface will also reduce radiation flux toward the surface, prolonging wetness there.

Vegetation substantially affects the quantity of materials lofted to the air by wind. Wind speeds at the ground, which are necessary to suspend a particle, decrease with surface roughness. Only when surface materials are dry can saltation occur. Increases in the quantity of vegetation serve to increase surface roughness and moisture levels. In all cases vegetation, either as a barrier or coverage, decreases ground level wind speeds which contributes to a redution in soil movement at the surface.

3.2 Control Measures

Control measures are dependent upon containing and channeling emissions to defined points. Water, used to moisten minerals being processed, can be very effective in the control of dust. An effective dust suppression system required careful selection and positioning of spraying equipment to enable prewetting with water plus a wetting agent. Typical locations for suppression systems include: crushers, tip heads, drawpoints, screens and haul roads.

3.3 Relationship and Impact on Temperature

The urban heat island (UHI) is the climatic consequence of increased air temperature of the urban area relative to rural areas.[44] Characteristics of surface type and associated vertical and horizontal morphology, partially determine the heating and cooling of air that moves across urban areas. Urban surfaces maintain energy differently than rural surfaces, for reasons which include:[45]

-energy used for evaporation is less in urban areas than rural areas due to the smaller amount of transpiring surface area and reduced surface moisture from effective drainage systems

-as evaporation is reduced, there is an increased transfer of heat to the air and heat storage in the ground

-heat capacity and conductivity of urban surfaces is greater than rural energy storage components

Reports of vegetation cooling effects on the UHI are supported by examining the energy and mass exchange processes which occur above the urban surface. Both analytical and empirical studies have been conducted on vegetation and land use effects of the UHI, and there appears to be an associated effect between diminished UHI effects and increased quantities of vegetation surface.[46] With this result planned open space areas to protect future mineral deposits can result in positive climatic effects to nearby urbanized areas.

3.4. Relationship and Impact on Noise

The noise environment of a community is described as having two components:

1) persistent noise emission from an identifiable source

2) community noise, which includes all other noise

The noise level at any point is a function of: nature of the source; path the sound wave travels; and nature of the receiver. Along the path a sound wave travels, numerous propagation effects occur that include: retraction, geometric spreading, air and surface absorption and scattering (reflection and diffraction).[47]

The loss of sound pressure level (SPL) greater than that due to geometric spreading and air absorption, is referred to as "excess attenuation". Excess attenuation may occur due to reflection by a barrier (which may be in the form of tree stands), or scattering and ground absorption of the wave by vegetation and the ground surface. The effectiveness of vegetation in attenuating sound is increased when it is used in combination with a berm or other barrier form. An effective noise abatement program requires knowledge of different noise types, intensity levels, characteristics of the noise, time of day of occurrence and the activities or areas where noises are produced. Vegetation should be a component of any comprehensive noise abatement program but cannot be a sole substitute for other types of controls.[48] Abatement strategies that utilize vegetation and berms as bariers to noise are unique in that they deal with noise after it has left the source, thus affecting the propagation of noise. The main mechanism of attenuation by vegetation is the scattering, by the woody parts, and absorption by the ground surface. Porosity of the ground surface also determines absorption efficiency and this is another area where vegetation and open space areas can abate noise.[49]

There has not been any conclusive evidence of a substantial difference in attenuation characteristics between coniferous and deciduous vegetation types. According to a study done by Grey and Deneke in 1978, species did not differ greatly in their ability to reduce noise levels. Forest cover with large amounts of understory vegetation provides the greatest degree of noise reduction.[50]

In studies of vegetation strips and barrier effects, scattering can lead to excess attenuation due to a reflectance-like phenomenon called "edge effect": (Bjorsen, 1971). Functionally, the vegetation strip or stand resembles a barrier and very high attenuations will occur over relatively short distances. Bjoresen (1971), also reported an attenuation result from a 4 foot strip of vegetation equal to that of 100 feet of forest area.[51] It has been suggested that attenuations that are possible from thin vegetation barriers should not be underestimated.

Distance from the noise source to the vegetation barrier is also important in propagation. Maximum effects occur when source-to-barrier distance is short. This is due to the fact that the quantity of acoustic energy interacting with the barrier increases with decreasing distance from the source. The major problem with noise is usually as a nuisance or annoyance factor. Primary sources of noise problems in mining operations are: equipment, workshops, loading facilities and transportation traffice. Fundamental control techniques that can be incorporated into a noise abatement program include:

1) reduction of noise energy generated at the source
2) isolation of the source
3) increased attenuation or absorption between source and receiver (reduction at the source is usually simpler and less costly than other alternatives)

III. The Social Environment

Physical aspects of resource allocation and carrying capacity entail social consequences. The transitory quality of public attention to various issues is partially due to competing social problems but also reflects an ignorance of systemic connections between social and economic structures. An ecological approach to social evolution begins by assuming a reciprocal relationship between technology and environment rather than environmental determinism.[52] New conditions in the environment and technology which produce changes have social effects by the fact that these changes alter size and life conditions of a population.

Many cities have already outgrown their original local resources and have found it necessary, as in the extension of water supply, to go long distances for water derived from other drainage basins. If these transbasin diversions fall short of current or anticipated demand, major adjustments will need to be made to fulfill supply needs. These adjustments may include departure of population and industry from the area until a balance can be attained between supply and demand or an adjustment in the life style and consumption for non-essential uses.

According to Glacken (1970), the "man verses nature" concept has been outmoded in many cultures with acknowledgment that man is a part of the natural ecosystem and that his survival depends on integrating human demands within the ecosystem limitations. Further study by Helm and Peters (1975) points out that in accord with ecological principles, man is part of the ecosystem and is regulated and influenced by the same set of principles which regulate other living organisms. Man's failure to recognize this relationship has resulted in an endless series of problems, compounded upon one another, until the resulting situation seems to defy solution.

The final avenue of approach is to provide opportunity for an integrative endeavor of study within the context of an ecological ethic. It appears evident that the prevailing value system is the ultimate key in affecting the nature of resource management policy. It is at this primary point that new directions in resource use, understanding and respect need to be revised. This is a necessary beginning point on which to effect changes towards the well-being of the earth's ecosystem.

1. SOCIAL IMPACTS

"Men pay attention to what is their own: they care less for what is common" -- (Politics, Book II, Chapter 3, Aristotle). "When the time scale of environmental ruin is measured in generations, it is not easy for mortal man to recognize future threats or past degradations".[53] These quotes exhibit fundamental truth in that those in a commons have incentive to ignore the social impact of private behavior.

Urbanization is not only a physical phenomenon but is also a major process of social change that complicates resource management. Research by Peterson and Ross found that even prior to physical urbanization, the introduction of a water system to a small farming community initiated a change in attitudes by the introduction of "surburban" viewpoints with respect to land and water. Studies by Spaulding found that water use tends to increase with socioeconomic status. This knowledge provides the key to development plans for the commons. The social risks apparent in ecosystem disorganization are:

a) Direct Biological Threats

- -carcinogens and environmental toxins
- -disorganization fo current food systems
- -disorganization of future food systems
- -climate changes destroying habitats

b) Sociocultural Production Threats

- -unemployment
- -income reduction
- -decreased availability of public services

Societal values are an important key to resource use and reasons why people abuse resources. Current problems of pollution call attention to rules that regulate behavior with respect to the environment as it is held, used or enjoyed in common by groups. Problems arise when some members of the group change the common environment in a way that impinges on the rights of others. A major contribution to understanding societal values underlying resource abuse is that: the common resource is the responsibility of no one in particular. With this orientation, each individual uses the environment for personal ends, then discards it as abandoned property. Belief systems that involve this type of resource use include elements which are ecologically dysfunctional. Some of these are: [55]

1) That speculative land values are a legitimate way to windfall wealth
2) Government must help private enterprise but not control it
3) Growth is an absolute good
4) Property ownership defined as people doing as they please with their property
5) Government by judges being preferable to government by administrators (even though administrators may often be better equipped to handle complicated technical and environmental problems)

These notions of progress and growth lead to the depletion of our natural resources. If environmental problems are to be solved, the basic ideas of what constitutes progress need to be revised to reflect ecological values. Changes in societal values can either be induced by crisis or obsolescence. Obsolescence involves the erosion of a value, leading to its replacement. Individual decisions and public policy can also influence some behavioral phenomena. Over the years public policy has tended to encourage situations to happen; an example being the "Homestead Act" which encouraged people to move west. Newer policy directions have hinted at the idea of manipulating attitudes and resultant action to stay within environmental constraints. This is contrary to past attitudes of total manipulation of the environment to satisy human needs.

Social impacts take into account effect on individuals, organization and/or communities. A Social Impact Assessment (SIA) examines social relations and social activities. It determines how a proposed physical development affects the community's activities and interactions. The SIA process is a growing field of applied social science that is used to evaluate policy alternatives in terms of estimated consequences. The origin of SIA processes can be tied to Environmental Impact Statements and the 1969 National Environmental Protection Act (NEPA). Social impact evaluation still remains a relatively new field for many local governments. Understanding social impacts leads to better land use decisions and ocmmunication of the effects of such decisions. It is difficult to make definitive evaluation of social impacts, so much of the quanitative, and especially qualitative, determinations are based upon inference. Because of this, a cardinal rule that must be adopted is that assumptions, expectations and conclusions should be cross-checked for misleading biases. More objective processes for SIAs have been developed in recent years and can be applied to give situations when needed.

Communities are social systems and social impacts can be examined

in terms of systematic inputs, structures, activities and outputs. The inputs are resources of human, financial, material, natural or intellectual elements that are fed into structures. Activities, as processed through structures, produce outputs. These outputs determine the resulting quality-of-life conditions for a community. Various projects and policies impact communities by reducing or expanding the variable inputs of the process, by altering structures, or by increasing or decreasing activities. Due to these possible changes in the process, the outputs are altered and, subsequently, the impacts. Impacts of extraction operations on communities occur at various stages. Impacts may occur during land acquisition for mining operation in the displacement of other development and ancillary activity locations. During construction activities annoyance factors may impact the community. After cessation of mining activites, the post-operation land condition and future land use will impact the community.

Questions to ask during planning stages of mineral extraction projects in regard to social impacts are:

1) Is the proposed development significant enough to merit detailed evaluation or can a more intuitive evaluation suffice?
2) Who will be impacted by the development?
3) What is the geographic boundary of the study area?

Social impacts need to consider two primary levels of understanding. They are: the actual objects and how changes affect social activities and the perception of objects and associated effects of the changes. Relevant social effects from changes in the physicial environment, due to mining operation, involve many characteristics. Some of these characteristics are: perceived quality of the environment; personal safety, privacy and health; aesthetic and cultural values; population changes; employment changes; neighborhood disruptions; noise impacts; accessibility; recreation and leisure patterns and the effects on human activity; and commercial and residential activities.

Steps in conducting a social impact analysis should include:

1) collection of baseline data to profile current physical and social conditions
2) identifying physical changes that will occur with and without the development
3) estimating social impacts or differences between development or no development
4) evaluation of the significance of impact
5) identification of alternatives to mitigate negative impacts

In evaluating social impacts to a community there is a need to determine the ability of the community to adapt to or assimilate the changes, before working towards necessary mitigative measures. These mitigative measures most often refer to design, location or functional features of the proposed development.

Though the importance of social impact consideration is being recognized the lack of legal mandate to require an SIA, along with the absence of readily available analytical approaches and inadequate baseline data to detail current social needs, hinders efforts to incorporate social impact consideration into a project. Legal mandates usually initiate at the federal and state levels with local government rarely requiring impact considerations.

Quality community leadership and development goals are important catalysts to growth. Causes of community decline are usually attributed to a decline in natural resource conditions, and conservative or pessimistic viewpoints towards business in that area. These important community growth and quality-of-life elements need to be considered at the local government level to deal with future planning and current development of mineral extraction operations.

2. Management and Organization

As outlined in previous protions of this paper, the water resource system is the primary natural resource by which other resource systems are based. It then follows that the water resource system should be the organizational base upon which other systems are integrated and managed.

Water resource developments, in contrast to land programs, have traditionally been conceived and administered as individual projects rather than an overall program. A better method of planning involves the watershed as a unit closely interrelated to other watershed units. Land and air systems can then be incorporated into this management unit. Research, practical experience and observation have shown that management of land and water must be handled together for effectiveness and lasting benefits. Another problem in dealing with watershed resource decisions is the bureaucratic demarcation used in administration efforts. There is a need to link disjointed political, technical, biological and social systems in a dynamic inter-relationship. In this manner, communications research and implementation processes can be best utilized in watershed developments for local and regional benefit.

Watershed management has been defined as the administration and regulation of the aggregate resources of a drainage basin for the production of water and control of erosion, streamflow and floods (Kittredge). In a study sponsored by the International Council of Scientific Unions, it was determined that management is the most important factor in the development and protection of land and water resources. Man has not yet evolved a universal set of laws to govern watershed management. The real problem in water resource management is to determine and understand the relationship of different land use practices to water and, ultimately, to apply this knowledge to land management with the intent of restoring and maintaining favorable supplies.

A watershed protection program includes using each piece of land within its capability, in applying practices needed to prevent erosion and allow more water to seep into the soil. This includes the use of water flow retardation and disposal structures. Two major considerations in effective planning in the use of water resources involve: 1) the use of water and its protection and 2) recognition of man, the consumer, as a social being and the necessary weighing of effects in social and psychological contexts as well as economic benefits and costs. With these considerations in mind, trends in planning focus on water use to meet the growing set of demands while at the same time not degrading the quality and water utilization for economic gain.

There exist few examples of integrated land and water resource management efforts of a drainage basin as a unit. One outstanding example is the Tennessee Valley Authority (T.V.A.). T.V.A. is a social and engineering venture, that combines multiple land uses while accomplishing the restoration and quality management of a complete watershed area, improving navigation and flood control concerns.

In water use allocation, social processes intervene to determine what groups receive a water supply and where it will be supplied from. Partially because water is channeled away from its natural source for use, it tends to be taken for granted and given a low value as an economic good. With this perspective its consumption is uncontrolled, resulting in waste. Problems arise when conflicts develop between uses and users, their supply access and waste practices. It is at this point that individuals and groups turn to the courts or political alliances to achieve their needs. Equitable allocation is a key to resolving social processes governing conflicts and water functions; but this idea is more easily theorized than implemented. Equitable allocation must be understood in the context of competing and incommensurable utilizations. Often tradeoffs must be made between incompatible uses, but tradeoff does not imply commensurability. Thus, from fundamental concepts basic to social processes--conflict resolution, tradeoff and incommemsurability--one arrives at functions of water utilization for productive purposes and ecological maintenance and control. The basic relationship between social and economic structures is their dependence on water for production. This dependence is evidenced by the need for energy, the need for water to carry out agricultural production, and the uses of water by industry.

Distribution of resources is the critical concept establishing the relationship of social processes in defining authority, power and roles.[56] With this perspective social processes, through mechanisms of power pressure and conflict resolution, determine and are influenced by the spatial distribution of water. Other influences are its accessibility, ownership and use. These processes tend to mitigate for the status quo; consequently those who have more power tend to also have increased access to resources. Establishment of watershed policy encounters problems involving unity of social goals and objectives. Goals achieved by watershed programs depend partly on availability and acceptance of necessary resource management authorities and powers. Both goals and means are subject to restraints imposed by economic, social and political considerations.

3. Regulation

Prerequisite for effective regulation is a clear understanding of the basic reasons for exploitation. For populations that are economically valuable but possess low reproductive capacities, either one of these conditions may lead to extinction. The difference between private and public resource management is usually meaningless in determining how effectively a resource will be used or preserved. There is a need to look at specific incentives in allocating resources. Public or private owners and managers have similarly enforced property rights and regulations. Public structures place demand on private developments and private developments are, in turn, governed by public controls.

In establishing controls, coordination between regional, county and municipal agencies is important in contributing to the positive affects of these areas. Inter-agency coordination and conflicts between regulations should be minimized. Environmental quality of an area is tied to the fiscal health of the community and, for this investment, municipal government needs to play a large part.

Zoning is recognized by experts as the most useful and widespread legal measure available to local governments for the orderly development and transitional use of land. Zoning is defined as: "the legislative division of the community into areas, in which only certain designated cases are permitted, so that the community may develop in an orderly manner in accordance with a comprehensive plan".[57]

The courts have recognized two basic principles in determining the legal limits of police power in zoning cases; these are: 1) that police power must promote general health, safety and welfare of society by preventing land use activities threatening the well-being of others or by 2) requiring activities enhancing the social, economic and physical environment as determined by the government. The problem of wise urban development is how to organize, control and coordinate the process of urban growth to protect what is valued in the environmental, cultural and aesthetic characteristics of the land. This need should be accomplished while meeting the needs of the changing U.S. population for new housing, roads, parks, businesses, commercial and industrial facilities.

Local agencies recognize the importance of the mineral industry but controls are usually developed due to public controversies with insufficient planning beforehand. Control of mining sites varies from lease arrangements to outright ownership, and the responsibility for rehabilitation differs according to ownership form. Local government may be more strict than state or federal government but also be at least as stringent in ideas of progressive and integrated reclamation. Examples of reclamation standards may be: a) timing, b) site clearance, c) slope, d) topsoil removal, e) drainage, f) topsoil replacement, g) cover and planting, h) abandoned uses, i) operation termination, j) bond and k) insurance.

Efforts of protection vary from site to site and area to area. Examples of protection are: a) <u>Land Use Regulations</u>--these are used as protective devices for designating "resource conservation areas"; among this type of regulation is: zoning, which is only effective for sites that are to be developed in the near future; special extraction districts; overlay zones; map-identified deposits that are developed into existing use districts in which excavation is permitted by conditional use or special exception

b) State Action--in this form, protection aids in supporting local government in making unpopular decisions (policies and standards).

c) Development Code and Mineral Resource Protection--an example of this form is San Bernadino, California, where mining is allowed unless there are specific prohibitions, (this is contrary to the usual logic of conventional zoning where mining is prohibited unless otherwise stated)

d) Land Dedication--

e) Transfer of Development Rights--

f) Intergovernmental Coordination--

g) Public Acquisition--this form can be included under open space or industrial land packages

h) Land Banking--where the public purchases for resale later.

Present land use regulations neither recognize natural processes, the public good of these processes, nor allocate responsibility to the acts of landowner or developer. There still is not adequate information on the cost-benefit ratios of specific interventions to the natural processes.

CRITERIA FOR DECIDING WHETHER A SAND, GRAVEL, OR ROCK DEPOSIT WARRANTS PROTECTION

	Write It Off	Consider for Protection	Protection Desirable	Protection Highly Desirable (1000' × 2,000 × 20')	Protection Critical
Economic Value	Small or low-grade deposit.	Small deposits (less than 2,000 tons) located near use area or near processing plant.	Medium-sized deposit (5 million tons). Deposit made economical to mine by upgrading material. Large, low-grade deposit that might be economical to mine in the future.	Large deposit (7.5 million tons). Can be mined economically in near future by upgrading the material.	Very large deposit (10 million tons) of concrete quality sand.
Access	Only practical route to site is through a residential area. More than 15 miles from use area. No noise buffering can be provided between existing access road and adjacent uses.	Longer alternate access route can be built.	Within 10 miles of use area; alternate access route available.	Large deposit, presently beyond economical hauling distance to present use areas. Near highways; access can be provided.	Within 5 miles of use area, adjacent to highway with access for trucks; adequate noise buffering for access road.
Compatibility with Surroundings	Adjacent land use presently incompatible with mining (appreciable residential development within range of excessive noise, dust, blasting vibrations, etc.)	Scattered development within outer range of impacts of mining; owners may not object to mining.	Adjacent land suitable for development and within commuting distance of use area.	Imminent incompatible development on adjacent land.	No incompatible land uses existing or likely in the forseeable future (adjacent land in national forest, operator's ownership, agricultural land-use category, or with very steep topography, etc.).
Impact of Noise	Noise level in adjacent presently developed areas would clearly exceed standards if mining occurred.		Noise level in adjacent undeveloped areas would exceed standards for likely use, but use of these areas can be easily delayed or economical mitigation can be provided by barriers.		Noise at adjacent residential area less than 50 dB(A) due to distance or topographical barrier; berm can be constructed easily.
Impact of Blasting	Too close to existing subdivision.				Blasting not required; permanent open space between quarry and other uses; topographic barrier between quarry and other land uses; only occasional light blasting; blasting compatible with adjacent uses.

(CONTINUED)

	Write It Off	Consider for Protection	Protection Desirable	Protection Highly Desirable (1000' × 2,000 × 20')	Protection Critical
Impact of Truck Traffic	Only access is local road through residential area.	Slightly longer alternate route exists.	Alternate truck route can be built at reasonable expense; alternate transportation (conveyor or slurry pipeline) can be used past residential streets.		Adjacent to freeway with access to site.
Visual Impact	Mining would destroy or create.	Mining activity cannot be screened and would permanently alter landscape.	Some activity visible from residential areas, but no permanent deterioration of landscape.	Mining activity can be easily screened by berms and/or vegetation.	Activity screened by topography or vegetation, or appreciably reduced by distance.
Biological Impact	Major stand of oaks; rare and endangered plants or animals on site.	Site includes prime wildlife habitat that would be permanently removed by mining.		Minor or temporary loss of wildlife habitat.	No significant biological resources; rehabilitation of site would replace or create riparian wildlife habitat.
Impact of Flooding	Mining would cause erosion of adjacent property; could be prevented only at great expense.		Mining would create erosion hazard for roads, bridges, and utility lines; however, these structures could be strengthened at reasonable costs.		Mining would create flood control channel and would not damage adjacent land.

SOURCE: SAND AND GRAVEL RESOURCES: PROTECTION REGULATION, AND RECLAMATION. JOET T. WERTH

IV. Conclusion

During hearings before the Committee of Surface Mining for the State of California, mineral industry representatives stressed the need to conserve mineral resources for access when they would be required in the future. Major extraction problems occur with jurisdiction over land use at the local level and conflicting jurisdiction of several local authorities. Failure to identify significant mineral deposits in local areas, in advance of community growth, results in additional controversy on many issues, increased mineral supply costs and decreased access to these resources.

Increases in population and the standard of living, places increased demands upon the mineral industry to work at preserving future reserves and enhancing the incorporation of existing sites into urban areas. Controversies usually evolve regarding: attractive nuisance elements, unsightly views from the road, deep and stagnant water, and sheer walls. Mineral resource management problems are interdependent of the overall need for coordinated urban-resource problem solving. The lack of local policy and direction are major contributing factors to mineral resource management problems.

The process of rehabilitation should be an integral part of the excavation process. For optimum use of depleted lands, and to insure implementation, there must be coordinated intergovernmental effort and industrial association. Comprehensive resource management plans, relating to mineral extraction, are crucial to wise land and water use allocation for continued viability of the mineral industry that is necessary to urban development.

Management plans serve the purpose of: 1) providing data, amount, quality of earth resources and assessing market needs over time; 2) stating community goals in balancing the benefits of preserving and using sites against the need to use the same site for other uses; and 3) a basis to establish legal devices to control the use of potential sites against exploiting earth resources. To develop plans it is necessary to:

1) Identify Deposits. This is accomplished by understanding local geology (via mapping, sampling, testing and analysis) and through data necessary to back up boundary decisions for protection areas.

2) Utilize Sources of Information. These may include: the State Geological Survey; existing site operations; records of private and public groups; the U.S.D.A. Stabilization Conversation Service for maps, aerial photos, etc.; the Soil Conservation Service; mining operators; local and state highway departments; and the U.S. Army Corps of Engineers.

3) Estimating Demand. Demand can be estimated, approximately, by considering average annual per capita use in the region and the state of the economy.

4) Ranking of Deposits for Protection. Ranking needs to consider the producer's requirements and public interest factors (i.e.: large scale pits involve 20 to 40 years to excavate); a) if total local supply is limited, there should be an attempt to protect all reserves, b) it is better to preserve multiple sites, 10 or so miles apart, vs. one large site, c) alternative sites can be used to stimulate competition thus holding down prices.

Adequate landscape planning measures of individual extration sites will help to ease the problems of proximity of the industry to developing urban areas.

Considerations in landscape planning should include:

I. General Surveys. By gathering information on landscape characteristics, topography, ecology, hydrology, communications, facilities, boundaries, and mining plans.

II. Detailed Planning; to conceal surface excavations, processing plants and associated facilities. This can be accomplished through the use of vegetative screens, screening banks or berms, fencing, and decorative signage.

A major criteria in attractive and incorporated urban areas is the ratio of "open space to developed land". Most urban areas need an infusion of open space for microclimatic and regional biological balance. The overlooked utilization of open space can be found in depleted and future mining sites. These areas must be effectively perserved through designation and planned conversation. There is a need for a locally specific balance between conversion of mining sites to open space and development purposes. This is a responsibility that will remain primarily with local agencies and be further effective with inter- and intra-regional coordination.

end notes

END NOTES

[1]Landerman, N.J., Schwartz, S. and Tapp, D.R. Community Resources: The Development-Rehabilitation of Sand and Gravel Lands. (Pomona, CA: Department of Landscape Architecture, School of Environmental Design, California State Polytechnic University and Southern California Rock Products Assn., 1972), p. 11

[2] Barney, G.O., ed. Council on Environmental Quality, Department of State. The Global 200 Report to the President. (Washington, D.C.: U.S. Government Printing Office, 1981), p. 14

[3]Landerman, N.J., Schwartz, S. and Tapp, D.R. Community Resources: The Development-Rehabilitation of Sand and Gravel Lands. (Pomona, CA: Department of Landscape Architecture, School of Environmental Design, California, State Polytechnic University and Southn California Roc, Products Assn., 1972), p. 3

[4]Ibid., p. 6

[5]Werth, J.T. Sand and Gravel Resources: Protection, Regulation and Reclamation. (Planning Advisory Service Report Number 347, Chicago: American Planning Association, 1980), Chp. 3.

[6]Rummery, R.A. and Hones, K.M.W., eds. Management of Lands Affected by Mining. (Australia: Division of Land Resources Management, Commonwealth Scientific and Industrial Research Organization, 1979).

[7]Leopold, Aldo., A Sand County Almanac. (New York: Oxford University Press, 1966), p. 218

[8]Dunlap and Catton, Annual Review of Sociology. (1979), Chp. IV

[9]Fitzsimmons, S.J. and Salama, O. Man and Water: A Social Report (Boulder, CO: Westview Press, 1977), p. 223

[10]Ibid., p. 165

[11] Ibid., p. 165

[12]Pereira. Land Use and Water Resources. (Cambridge: The University Press, 1973), p. 1.

[13]Stevens. Physical and Cultural Characteristics of An Urbanizing Watershed. (Ph.D. Thesis, Michigan State University, Fisheries and Wildlife Dept., 1967), p. 50.

[14]Ibid., p. 51.

[15]Perira. Land Use and Water Resources. (Cambridge: The University Press, 1973), p.4.

[16]Marsh, W.M. and Borton, T.E. Inland Lake Watershed Analysis, A Planning and Mangement Approach. (Lansing, Michigan: Michigan Department of Natural Resources, Land Resource Programs Division, Inland Lakes Management Unit, 1976), p. 99.

[17]Garstka. Water Resources and the National Welfare. (Ft. Collins, CO: Water Resources Publications, 1978), p.1.

[18]Ibid., p. 449

[19]Ibid., p. 450.

[20]Pereira. Land Use and Water Resources. (Cambridge: The University Press, 1973), p. 10.

[21]Garska. Water Resources and the National Welfare. (Ft. Collins, CO: Water Resources Publications, 1978), p. 285.

[22]Pereira. Land Use and Water Resources. (Cambridge: The University Press, 1973), p. 37.

[23]Marsh, W.M. and Borton, T.E. Inland Lake Watershed Analysis, A Planning and Management Approach. (Lansing, Michigan: Michigan Department of Natural Resources, Land Resource Programs Division, Inland Lakes Management Unit, 1976), p. 101.

[24] Pereira. Land Use and Water Resources. (Cambridge: The University Press, 1973), p. 202.

[25] Down, L.G. and Stocks, J. Environmental Impact of Mining. (London: Applied Science Publishers, Ltd., 1977), p. 89.

[26] Ibid., p. 89

[27] Ibid., p. 89.

[28] Ibid., p. 101.

[29] Ibid., p. 101.

[30] Werth, J.T. Sand and Gravel Resources: Protection, Regulation and Reclamation. (Planning Association, 1980), Chp. 2, p.2.

[31] Ibid., Chp. 1, p. 3.

[32] Marsh, W.M. Environmental Analysis: For Land Use and Site Planning (1978), p. 56.

[33] Ibid., p. 90.

[34] Ibid., p.56.

[35] Down, C.G. and Stocks, J. Environmental Impact of Mining. (London: Applied Science Publishers, Ltd., 1977), p. 58.

[36] Flynn, J.E. Vegetation and Air Quality. (Dayton, Ohio: Dayton Climate Project, 1981).

[37] Ibid.,

[38] Ibid.,

[39]Ibid.,

[40]Ibid.,

[41]Flynn, J.E. Vegetation and Fugitive Sources. (Dayton, Ohio: Dayton Climate Project, 1981),

[42]Ibid.,

[43]Ibid.,

[44]Flynn, J.E. Vegetation and Urban Air Temperature. (Dayton, Ohio: Dayton Climate Project, 1981),

[45]Ibid.,

[46]Ibid.,

[47]Flynn, J.E. Vegetation and Urban Noise. (Dayton, Ohio: Dayton Climate Project, 1981),

[48]Ibid.,

[49]Ibid.,

[50]Ibid.,

[51]Ibid.,

[52]Duncan, O.D. Handbook of Modern Sociology. (Chicago: Rand McNally, 1964),

[53]Hardin, G. and Baden, J. Managing the Commons. (San Francisco, CA: W.H. Freeman and Co., 1977), Preface xii

[54]Schnaiberg, A. The Environment: From Surplus to Scarcity. (New York: Oxford, 1980), Chp. I.

[55]James, L.D., ed. Man and Water, The Social Sciences in Management of Water Resources. (Lexington, Kentucky: University Press of Kentucky, 1974, p. 186.

[56]Fitzsimmons, S.J. and Salama, O. Man and Water: A Social Report. (Boulder, CO: Westview Press, 1977), p. 221.

[57]Ibid., p. 113

appendix

SOURCE: MODEL MINERAL RESERVATION & MINE ZONING ORDINANCE

MODEL ZONING ORDINANCE

Section 1

Statement of Purpose

In order to protect the health, safety, and general welfare of the citizens of ______________ County, the ______________ County Board of Supervisors do hereby enact this ordinance to reserve and protect the mineral deposits of ____________ County and to provide methods for the regulation of mineral extraction.

This ordinance recognizes that minerals are fixed in location, are rare, and are nonrenewable in nature. In order to prevent noncompatible land uses from denying the benefits of these materials to the citizens of ___________ County, to protect mineral deposits near urban centers, to prevent unwise patterns of development, to assure proper reclamation of mining sites, and to provide the best economic growth opportunities and environmental management techniques available, this ordinance provides for the creation of ___________ _________ as an amendment to the ___________ County Zoning Ordinance.

Section 2

Definitions

(1) Mineral shall mean a naturally occurring element or combination of elements that occur in the earth in a solid state, but shall not include soil.

(2) Mining shall mean all or part of the processes involved in the extraction and processing of mineral materials.

(3) Operator shall mean any person or an agency either public or private, engaged or who has applied for a permit to engage in mining, whether individually, jointly, or through subsidiaries, agents, employees, or any person engaged in managing or controlling a mining operation.

(4) Structure shall mean any building, whether for human habitation or not.

(5) Board[3] shall mean the ____________ County Board of Adjustment.

(6) Waste shall mean all accumulation of waste mined material and overburden placed on the land surface, whether above or below water.

(7) Person shall mean an individual, partnership, cooperative, corporation, or agency, either public or private, or any persons, whether incorporated or not.

(8) Reclamation Plan shall mean the operator's proposal for the reclamation of the project site which must be approved by the board under this ordinance prior to the issuance of the mining permit.

(9) Mining Permit shall mean the mining special exception permit[4], whether on a regular or temporary basis, which is required by Section ________ of Ordinance ______________. It does not replace or otherwise eliminate the need to apply for state mining permits such as are required under Chapter 144.85 of the Wisconsin Statutes.

Section 3

Mineral Reservation Districts

(1) NAME: The name of this district shall be the Mineral Reservation District of ______________ County.

(2) PURPOSE: The purpose of this district is to protect the lands in ____________ County which contain known mineral resources which are potentially valuable for commercial extraction. The location of the district shall be based upon geological surveys and consideration of the following factors:

(a) Location of past and present mining and land areas held for future extraction by operators;

(b) The presence, location, extent, and quality of potentially valuable mineral deposits both known and inferred.

(c) Availability of potential mineral-bearing land and feasibility of extraction of the mineral.

(d) Any regional, county, and municipal comprehensive plans.

(e) Potential for effective multisequential use which would result in the optimum benefit to the operator, residents of adjacent districts, and the residents of __________ County.

(f) Development and reclamation potential of the land to enhance the possibility of physically attractive surroundings compatible with adjacent areas.

(g) The quality of life of the residents in and around areas which contain potential mineral deposits.

(h) Maximization of the short- and long-term benefits of mineral extraction.

(3) PERMITTED USES

(a) Agricultural uses, including farm structures and single-family residences up to two units per farm.

(b) Forestry.

(4) SPECIAL EXCEPTIONS

(a) NONMINING

(1) Nonstructural conservancy uses[5], such as:

(a) Utilities such as telephone, telegraph, and power transmission lines;

(b) Hunting, fishing, preservation of scenic, historic, and scientific areas, wildlife preserves;

(c) Hiking trails and bridle paths;

(d) Accessory uses;

(e) Public and private parks, picnic areas, golf courses, and similar uses;

(f) Any other use which the board finds is similar in nature and purpose to the nonstructural conservancy uses herein listed.

(2) Any use that is allowed as a permitted use or special exception in any district which abuts the Mineral Reservation District[6] provided that the Board of Adjustment finds that:

(a) The use is clearly necessary to community development and that this need outweighs potential conflict with mineral conservation and/or mining; <u>and</u>

(b) The decision to establish the use has taken into account the possibility that it may need to cease in favor of mining at a future time which could be before the natural expiration of such use; <u>and</u>

(c) The use is subject to special conditions designed to eliminate or minimize conflict with future mineral extraction activities on the same or nearby sites.

(d) Such other standards as the board may find necessary to fulfill the purposes of nonmining special exceptions in mineral reservation districts.

(b) MINING: Mineral extraction operations on a regular or temporary basis.[7]

(5) APPLICATION FOR AND DECISION ON NONMINING SPECIAL EXCEPTIONS

(a) The board shall require an application for a nonmining special exception permit. Such application shall contain such information, consistent with the terms of this ordinance, as may be necessary to enable the board to determine the effect of the nonmining special exception on mineral extraction.

(b) The board shall review the application for completeness, accuracy, and consistency in meeting the standards of this section contained in part 4-a-1 which relate to nonstructural conservancy uses and part 4-a-2 which relate to nonmining special exception standards. Notice shall be given and a public hearing shall be held consistent with the terms of this ordinance.

(c) The board shall approve, approve conditionally, or deny the application for a nonmining special exception permit, consistent with the terms of this ordinance.

(d) The board may cause the following conditions to be attached in writing to the nonmining special exception permit:

   (1) Conditions as to the nature of structural improvements (including paving) designed to facilitate the removal of the improvements at minimum cost in the event the structures must later be eliminated to allow a change of use to mining.

   (2) The condition that the applicant has registered a notice with the ______________ County Register of Deeds and filed the notice in such a manner as to be accessible to all persons researching the property title to that parcel stating that the parcel has valuable mineral deposits which may require extraction and that if the extraction occurs, such extraction may cause interference with the use and enjoyment of the property. Proof of such notice shall be required of the applicant.

   (3) Such other conditions as the board may find necessary to fulfill the purposes of nonmining special exceptions in mineral reservation districts.

(e) A violation of any conditions attached to the nonmining special exception permit shall be considered a violation of this ordinance, and subject to the penalty provisions listed in this ordinance.

(f) Any conditions attached to the nonmining special exception permit shall continue to apply to heirs, assigns, transferees, or successors in interest to the application for such permit.

Section 4

Special Exceptions Relating to Mineral Deposits

(1) In order to assure that mineral deposits are protected from noncompatible adjacent land uses and that mineral extraction operations are properly controlled, while at the same time assuring the maximum amount of flexibility in dealing with mineral deposits whose location is not precisely described, the following amendments are made to the text of the agricultural, forestry, or conservancy [8] district of ____________ County:

(a) Mineral extraction shall be a special exception in such district and persons wishing to establish such use shall apply for a mining special exception permit on a regular or temporary basis.[9]

(b) In such districts, the board shall inquire as to the existence of mineral deposits on or near all sites on which other special exception permits are requested.

Section 5

Application for a Regular and Temporary Mining Special Exception Permit

I. The application for a regular mining special exception permit shall be accompanied by information which shall include the following;

(1) The names and addresses of the applicant, operator, and principal officers, and resident agent of the business if other than a single proprietor.

(2) A legal description and map and/or aerial photograph of the tract or tracts of land to be involved and affected by the proposed operation, which may be supplied by the board.

(3) The map and/or aerial photograph and accompanying materials shall indicate:

(a) Boundaries of the affected and adjacent lands;

(b) Surface drainage of the affected land;

(c) Location and names of all streams, roads, railroads, utility lines, and pipelines on or immediately adjacent to the area;

(d) Location of all structures within one thousand feet of the outer perimeter of the area, present owners and occupants of such structures, and purposes for which each structure is used;

(e) Names of the owners of the affected and adjacent lands;

(f) Proposed location, areal extent, and depth of intended mine excavation;

(g) Proposed location of the mine, waste dumps, tailing ponds, sediment basins, stockpiles, structures, roads, railroad lines, utilities or other permanent or temporary facilities used in mining as defined in Section 2;

(h) Estimated depth to groundwater.

(4) A description of the mining and processing equipment to be used;

(5) A description of measures to be taken to control noise and vibrations from the operation;

(6) A description of the anticipated hours of operation;

(7) A description of measures to be taken to screen the operation from view;

(8) Proposed primary travel routes to be used to transport the mined material to processing plants or markets away from the property;

(9) A description of the plans for topsoil storage;

(10) A reclamation plan which shall include:

(a) A map or plan and description of the proposed reclamation including grading, final slope angles, highwall reduction, benching and terracing of slopes, slope stabilization and revegetation where applicable, and erosion control, and alternative future land uses;

(b) Description of topsoil stripping and conservation during storage and replacement;

(c) Plan and description of anticipated final topography, water impoundments, and artificial lakes on the property;

(d) Description of plans for disposition of surface structures, roads, and related facilities after cessation of mining;

(e) A plan for disposal or treatment of any harmful or toxic materials found in any formations penetrated by the mining operation or produced during the processing of minerals on the affected land, and of chemicals or materials used during the mining or processing operations;

(f) The estimated cost of reclamation for the total project;

(11) A statement in writing and adequate evidence to indicate the duration of the lease in years;

(12) A timetable of the commencement, duration, and cessation of mining operations;

(13) Any and all mining permits held by the applicant within the state;

(14) Such other information as may be necessary to determine the nature of the operation and the effect of the surrounding area, including the mining reclamation plan;

(15) The signature of the applicant and date of signature;

(16) The application shall be accompanied by a fee of ___________ for each acre of surface area to be disturbed, but the total fee shall not be less than $35.00.

The application for a temporary mining special exception permit shall be accompanied by information which shall include the following:

(1) The names and addresses of the applicant, operator, and principal officers and resident agent of the business if other than a single proprietor.

(2) A legal description of the land involved.

(3) As may be required by the board, a map and/or aerial photograph of the land with any of all of the information as listed in I-3-a,b,c,d,e,f,g, of this section, relating to requirements for maps and/or aerial photographs for regular mining special exception permits.

(4) As may be required by the board, any or all of the information listed in part I-4,5,6,7,8,9,10,11,12,13 of this section, relating to requirements for information for regular mining special exception permits.

(5) The signature of the applicant and date of signature.

(6) The application shall be accompanied by a fee of ________ for each acre of surface area to be disturbed, but the total fee shall not be less than_____.

III. The board may vote to waive or modify any requirements for information requested under the terms of this Section.

IV. Unless the board votes to waive or modify any requirements of this Section, the application shall not be accepted or deemed to be accepted unless all the information required by this section is supplied by the applicant. In the case of an incomplete application, the review and decision on the application shall not commence and no regular or temporary mining special exception shall be issued.

Section 6

Review and Decision on the Application for a Regular and Temporary Mining Special Exception Permit

A special exception permit for mineral extraction shall be approved by the board of adjustment if found to comply with the following requirements:

(1) Upon receipt of the application and supporting information, the board shall:

(a) Review the application for completeness and accuracy. To accomplish this purpose or to assist in the enforcement of the ordinance, the board may request assistance from other governmental agencies or any educational institution.

(b) For a regular mining special exception permit application, hold a public hearing within 30 days at such time and place as established by the board with notice of the hearing published as a Class 2 notice under Chapter 985 of the Wisconsin Statutes. Notice of the time, place, and purpose of such public hearing shall also be sent to the applicant, the county clerk, and the town board members of the affected town. If the proposed special exception is within one-fourth mile of any other jurisdiction, the clerk of that governmental unit shall also be notified. All owners of land, as determined by owners of record in the current tax description records, within 300 feet of the proposed site shall also be notified.

(c) The public hearing may be recessed for a reasonable amount of time, as determined by the board, if the board feels that additional information or study is needed. The hearing shall be conducted and a record of the proceedings shall be made according to procedures as the board shall prescribe.

(d) For a temporary special exception permit application, the board may require a public hearing as described under (b) and (c).

(2) The board shall approve an application for a regular mining special exception permit when the application, in addition to all other requirements, meets the following standards listed below:

(a) That the establishment, maintenance, or operation of the special exception shall not endanger the public health, safety, or general welfare;

(b) That the establishment, maintenance, or operation of the special exception will not substantially affect the existing use of adjacent property, and will not have a substantially adverse effect on the long-term future use of the adjacent property;

(c) That adequate utilities, access roads, drainage, traffic plans, and other site improvements have been, are, or will be provided;

(d) That the special exception shall conform to all governmental regulations pertaining to the activity itself;

(e) That the mining operation shall conform to applicable air and water quality standards;

(f) That the noise, vibration, and dust levels at the property lines be within the levels determined by the board;

(g) That an undeveloped buffer zone, commencing not less than 20 feet from the property line of the mining site or such other distance as the board finds necessary for the protection and safety of adjacent property from mining, with a stable angle of slope repose shall be provided along property lines;

(h) Where deemed practicable and necessary by the board, an earth bank or vegetative screen shall be erected and/or maintained to screen the mining operation from view from any residential district located within one-half mile of the operation;

(i) Where deemed necessary by the board, each mining operation shall be enclosed by at least a single-strang barbed-wire fence, maintained at all times, with warning signs spaced no more than 200 feet apart to indicate the presence of a mining area.

(j) That an application shall not be of a speculative nature, nor shall the mining cause harm to adjacent property;

(k) Such other standards that will permit the board to evaluate and decide on a regular mining special exception permit.

(3) The board shall grant, grant with conditions attached, or deny the application for a regular mining special exception permit within a reasonable time after the public hearing. Prior to granting, granting with conditions attached, or denying the regular mining special exception, the board shall make findings of fact based upon the evidence presented that the standards of this ordinance will or will not be met.

(a) Upon approval of the application, the board shall notify the applicant in writing of the decision and where applicable establish the amount of bond necessary to assure reclamation of the affected land according to the reclamation plan. Upon receipt of the established bond from the applicant, the board shall issue a regular special exception mining permit for an initial term of not more than five years. The applicant shall commence significant development of mining operations within two years of the date of issuance of such permit. At the written request of the board the applicant shall submit proof in writing of the significant development of mining operations. A violation of the terms of the regular mining special exception permit may result in a forfeiture, a fine, or suit by the county according to the terms of this ordinance.

(b) The board may approve the regular mining special exception permit with conditions attached to the permit in writing. Such conditions may cover such subjects as control of operations, bonding and surety mechanisms, periods of operation, access, and any other standard or requirement listed under the terms of this ordinance. A violation of the conditions attached to this permit shall be a violation of this ordinance and shall be subject to the penalty provisions contained in this ordinance. Any conditions attached to the regular mining special exception permit shall continue to apply to heirs, assigns, transferees, or successors in interest to the application for such permit.

(c) Upon disapproval of the application, the board shall notify the applicant in writing stating the reasons for disapproval as well as the necessary action, if any, that the applicant may take to complete the application in an acceptable form. No application which has been denied, in whole or in part, may be resubmitted for six months from the date of denial, except for new evidence, change of conditions, or such other reason as the board may accept.

(4) The board may approve an application for a temporary mining special exception permit for a term not to exceed six months.

(a) The board may subject the granting of the temporary mining special permit to any or all of the standards listed in part 2 of this section, relating to the standards for a decision on a regular mining special exception permit.

(b) The board shall grant, grant with conditions attached, or deny the application for the temporary mining special exception permit within a reasonable time after any public hearing the board may hold. Prior to granting, granting with conditions attached, or denying the temporary mining special exception, the board shall make findings of fact based upon the evidence presented that the standards will or will not be met.

(1) Upon approval of the application, the board shall notify the applicant in writing of the decision and where applicable establish the amount of bond necessary to assure reclamation of the affected land according to any reclamation plan. Upon receipt of the established bond from the applicant, the board shall issue a temporary mining special exception permit. A violation of the terms of the temporary mining special exception permit may result in a forfeiture, a fine, or suit by the county according to the terms of this ordinance.

(2) The board may approve the temporary mining special exception permit with conditions attached to the permit in writing. Such conditions may cover such subjects as control of operations, bonding and surety mechanisms, periods of operation, access, and any other standard or requirement listed under the terms of this ordinance. A violation of the conditions attached to this permit shall be a violation of this ordinance and shall be subject to the penalty provisions contained in this ordinance. Any conditions attached to the temporary mining special exception permit shall continue to apply to heirs, assigns, transferees, or successors in

interest to the application for such permit.

(3) Upon disapproval of the application, the board shall notify the applicant in writing stating the reasons for disapproval as well as the necessary action, if any, that the applicant may take to complete the application in an acceptable form. No application which has been denied, in whole or in part, may be resubmitted for six months from the date of denial, except for new evidence, change of conditions, or such other reason as the board may accept.

(c) The board may extend the effectiveness of a temporary mining permit for an additional six-month period upon request of the operator, subject to the provisions of public notice and hearing contained in part 1-b,c of this section, relating to publication requirements.

Section 7

Bonding and Other Security Mechanisms[10]

(1) Prior to the issuance of a mining special exception permit, the operator, if required by the board, shall deposit with the board a bond conditioned on faithful performance of all the requirements of this ordinance and all the rules of the board. The bond shall be in an amount and of a kind to be determined by the board. In lieu of a bond, the operator may deposit cash, government securities, or land of equivalent value with the board.

(2) The board shall establish the length of the bonding period, which may be less than the permit period, and the amount of the bond necessary to cover the cost of the reclamation of all areas disturbed by the mineral extraction operation during the bonding period, less that amount of bond that the operator has deposited with the appropriate governmental agency as security for the particular mining operation.

(3) Any operator who obtains a mining permit from the board for two or more project sites within this jurisdiction may elect, at the time the second or any subsequent site is approved, to post a single bond in lieu of separate bonds on each site. Any single bond so posted shall be in an amount equal to the estimated cost of reclaiming all sites the operator has under each of his mining permits issued in ____________ County less that amount deposited for the particular sites with the appropriate governmental agencies. When an operator elects to post a single bond in lieu of separate bonds previously posted on individual sites, the separate bonds shall not be released until the new bond has been accepted by the board of adjustment.

(4) At the termination of each bonding period, the board of adjustment shall review the bond amount on mining and reclamation progress and shall either maintain the existing bond, return all or a portion of the existing bond, or request the operator to increase the amount of the bond.

(5) The operator may file with the board a request for release of bond at such time as the operator feels that all reclamation has been satisfactorily completed or is in progress in accordance with the approved reclamation plan on any or all of the affected lands. Such request for release of bond shall include the name and address of the operator, the permit number, a legal description of the area, and a final reclamation report on the area for which the release of bond is requested. The final reclamation report shall contain the following information:

(a) Name and address of the operator, permit number, and legal description of the land;

(b) A map and/or aerial photograph which may be supplied by the board, on which the operator shall indicate the final contours, slope angles of the affected land, surface water drainage and ponds, and the locations of any remaining structures and roads;

(c) A description of reclamation activities leading to completion of the approved reclamation requirements including: topsoil disposition and thickness, revegetation practices, disposition of waste dumps, tailing ponds, and surface structures, haulage and access roads, sediment control practices, and maximum depth of artificial lakes or ponds;

(d) Operators of all underground mineral extraction operations shall also submit a complete plan of all entries, workings, and levels as well as a description of the sloping and ground support methods at the cessation of operations;

(e) For underground mining operations, a description of the stability of lands overlaying the underground workings and a description of methods to be used for sealing all shafts, adits, inclines, and other mine entries;

(f) Such other pertinent information and maps as may be required to evaluate the completion of reclamation and the advisability of returning the operator's bond.

Final release of the bond shall not occur until the operator files a final reclamation plan under the terms of this ordinance.

(6) Upon receipt of a request for release of the bond, the board shall:

(a) Inspect the designated lands;

(b) Publish, following a class 2 notice under Chapter 985 of the Wisconsin Statutes, notice that the release of bond application is pending and specify a 30-day period for filing of complaints with the board against the release of bond;

(c) Publish, following a class 2 notice under Chapter 985 of the Wisconsin Statutes, notice of a public hearing at such time and place as the board determines to consider the request for release of bond and make a determination on the validity of complaints. The notice required in part 6(b) of this section and this subsection may be published at the same time, but in all cases the public hearing shall be held at least 30 days after the notice required in part 6(b) of this section;

(d) If the reclamation is found to be satisfactory and all valid complaints have been satisfied, the board shall release the appropriate amount of bond 30 days after the public hearing.

(e) If the reclamation is found to be unsatisfactory, so notify the operator by registered mail setting forth the reasons for denial of release of bond and the corrective action necessary for release of bond.

(7) Nothing in this section shall be construed to infringe upon the board's authority to take appropriate action on bonds, including forfeiture of all or part of the bond for cause. Forfeiture shall not be approved by the board unless there has been publication of notice and a public hearing held consistent with the terms of this ordinance.

(8) The mining operator shall maintain a public liability insurance policy issued by an insurance company authorized to do business in the state of Wisconsin which affords personal injury and property damage protection for any individual and for adjacent property for the term of the permit or permit renewal. The total amount of the insurance shall be determined by the board, but shall be not less than 50,000 dollars.

(9) Each operator shall notify the board of cessation of all mining activity at the project site no later than 60 days before operations are to cease. Such notice shall indicate the operator's name, address, and permit number.

(10) The requirements of this section shall apply to the successor in interest to the operator upon the sale or transfer of assets of the mining operation.

Section 8

Existing Mining Operations and Expansion of Mining Activities

(1) Any operator producing mineral materials from a mining operation at the date of enactment of this ordinance shall not need a regular or temporary mining special exception permit to continue mining.

(2) Upon the enactment of this ordinance, the board shall, by resolution, define the criteria for expansion of mining operations so that the applicant knows what an expansion of mining operations constitutes at the time the application for a mining permit is filed for a new mine.

(3) Any operator who holds any mining permit issued under the terms of this ordinance or who operates a pre-existing mine under part 1 of this section shall apply for a regular or temporary mining special exception permit if:

(a) the amount of mineral materials produced on an annual basis increases substantially; or

(b) the amount of waste materials produced on an annual basis in the mineral extraction process increases substantially; or

(c) the mining and processing equipment used in the operation changes substantially; or

(d) the normal hours of operation increase substantially; or

(e) the amount of noise, vibration, and dust from the operation increases substantially; or

(f) the extent of the area of the mining operation increases beyond the limits of land designated or held for that purpose at the time of adoption of this ordinance; or

(g) any other substantial increase in the mining or method of operations at the mining site, as determined by the formal decision of the board.

(4) The board, when considering the application for a regular or temporary mining special exception permit, as required by this section, shall consider the effect of the total mining operation, including reclama-

Section 9

Change, Renewal, and Transfer of Mining Special Exception Permits

(1) An operator holding a mining special exception permit may at any time apply to the board for amendment, cancellation, renewal, transfer, or change in a regular or temporary mining special exception permit or reclamation plan, provided that:

(a) This section shall not include an expansion of a mining operation which is subject to another section of this ordinance.

(b) This section shall not include a removal of mined land from the areal extent of the approved permit, which is subject to another section of this ordinance.

(c) This section shall not include a release of a bond or other security mechanism, which is subject to another section of this ordinance.

(d) This section shall not include the renewal of a temporary mining special exception permit, which is subject to another section of this ordinance.

(2) The application for the amendment, cancellation, or change shall be submitted to the board which shall approve, approve conditionally, or

deny the application subject to the following standards:

(a) The operator shall identify the tract of land and shall supply the permit number of the project to be removed from the project site or to be affected by any change in the mining operation or reclamation plan;

(b) If the application is to change a permit for a tract of land which has had no mining operations conducted upon it, the board shall ascertain by inspection that no mining has occurred. After so finding, the board shall order the release of any bond or security instrument and shall amend the mining special exception permit to reflect the removal of the unmined land from the project site;

(c) Such other standards consistent with the terms of this ordinance which provide for proper amendment, cancellation, and change to the permit.

(3) A regular mining special exception permit shall be renewed at the end of the permit term for successive five-year terms after public hearing and notice so long as the operator continues to produce mineral materials from the property, conforms to the approved reclamation plan, and conforms to the provision of this ordinance and is within the timetable of operations as established by Section 5-I-12 of this ordinance.

(4) No operator shall assign, sell, lease, or transfer in any manner any rights granted under a regular or temporary mining special exception permit until the succeeding operator has complied with all the requirements of this ordinance, including all requirements of the reclamation plan and the filing of a bond of like amount with the board. Upon compliance with the requirements of this ordinance, the board shall release the first operator from the requirements of this ordinance, including any bond, and transfer the permit to the successor operator.

(5) Any application granted with conditions attached under the terms of this section shall have the conditions attached in writing to the document of approval. Such conditions may cover any standard or requirement listed in this ordinance. A violation of the conditions shall constitute a violation of this ordinance, subject to penalties listed in this ordinance.

Section 10

Inspections

(1) Upon issuance of a regular or temporary mining special exception permit, the board or its approved agents may inspect the project site to determine compliance with the requiments of this ordinance. Inspections may also include the required records of a mining operation.

(2) Such inspection shall be at reasonable times with notice provided to the operator.

Section 11

Penalties

(1) Whenever the board finds a violation of this ordinance at a mining operation within ________________ County, including unapproved deviation from the reclamation plan, it shall be recorded and the board shall send the operator by registered mail an order specifying the nature of the violation, time of violation, and corrective steps necessary to achieve compliance with this ordinance.

(2) The board shall cancel the mining special exception permit held by a mining operator who fails to comply with the order within 30 days after the order is served unless the operator named therein, withinin

10 days after notice, requests in writing a hearing before the board. Failure to show just cause for the continued violation and lack of compliance with the order shall result in permit cancellation and immediate cessation of all mining activities on the affected property.

(3) Any person, firm, corporation, cooperative, operator, or any other group of persons convicted in a court of law of engaging in a mining operation without a valid permit from this jurisdiction shall be required to forfeit not less than __________ nor more than __________ per day for each and every day the operation is found to be in violation of this ordinance.

(4) Compliance with the terms of this ordinance may also be enforced by injunctional order at the suit of the county.

Section 12

Suitability for Subdivision

(1) Whenever an application for a subdivision, as defined by __________ of the __________ ordinance of __________ County, is made in the Mineral Reservation District to the ______________, the ______________ shall inquire as to the location of mineral deposits on or near the proposed site of the subdivision.

(2) For the purposes of protecting lands with known mineral deposits which are potentially valuable for extraction of mineral deposits, the ______________ may disapprove the site of the proposed subdivision on the grounds of unsuitability of the lands for subdivision under Chapter 236.45(1) of the Wisconsin Statutes.

(3) The ______________ in applying the provisions of this section shall make findings of fact after a public hearing upon which it bases the conclusion that such subdivision site is not suitable for that subdivision.

NOTES

1. 266 Wis. 475, 63 N.W. 2d 697 (1954).

2. 272 Wis. 1, 74 N.W. 2d 70 (1956). For a listing of cases from other jurisdictions, see "Prohibiting or Regulating Removal or Exploitation of Oil and Gas, Minerals, Soil or Other Natural Products within Municipal Limits," 10 ALR 3d 1226.

3. Throughout this ordinance, the planning and zoning committee of the county board of supervisors may be substituted for the board of adjustment. In Wisconsin, at the county level, the appeals board is known as the board of adjustment. In most other jurisdictions this unit will be known as the board of appeals.

4. Throughout this ordinance, a conditional use may be substituted for the special exception.

5. These uses are taken from the model shoreland protection ordinance of the Wisconsin Department of Natural Resources (1967). For additional permitted uses, including those related to water-centered activities, consult that document.

6. It is the intent of this ordinance that structural uses in the Mineral Reservation District be those conditional uses or special exceptions allowed in adjacent districts, with additional requirements designed to assure compatibility with mineral extraction. If there is more than one district adjacent to the proposed Mineral Reservation District, one should be selected to provide the basis for structural uses in the Mineral Reservation District.

7. The process for decision and review on mining special exception permits begins later in the ordinance.

8. These districts are only suggested. Another example might be open space. If the county does not wish to identify specific districts with this additional special exception language, the county might use words similar to "districts in which nonstructural conservancy uses are permitted uses" or "districts in which commercial developments are subject to special exceptions." The purpose behind naming these districts is to allow only nonintensive development in areas of known mineral deposits.

9. See note 7.

10. This ordinance does not speak to other issues of bonding, such as apportionment of the amount between several jurisdictions if the operator defaults, or performance standard bonding. These issues would have to be decided upon at the time the bond was required.

SOURCE: MODEL MINERAL RESERVATION AND MINE ZONING ORDINANCE.
J. PRESTON, E. STRAUSS AND T. FRIZ.

glossary

GLOSSARY

Accelerated erosion — The increased removal of the land surface that occurs as a result of man's activities.

Annual plant — A plant that completes its life cycle and dies in one year or less.

Available water-holding capacity (soils) — The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil. Commonly defined as the difference between the percentage of soil water at field capacity and the percentage at wilting point. This difference multiplied by the bulk density and divided by 100 gives a value in surface inches of water per inch depth of soil

Berm — A raised and elongated area of earth intended to direct the flow of water, screen headlight glare, or redirect out-of-control vehicles.

Borrow pit — The excavation resulting from the extraction of borrow.

Broadcast seeding — Scattering seed on the surface of the soil. Contrast with drill seeding, which places the seed in rows in the soil.

Brush matting — (1) A matting of branches placed on badly eroded land to conserve moisture and reduce erosion while trees or other vegetative cover are being established. (2) A matting of mesh wire and brush used to retard streambank erosion.

Channel — A natural stream that conveys water; a ditch or channel excavated for the flow of water.

Channel stabilization — Erosion prevention and stabilization of velocity distribution in a channel using jetties, drops, revetments, vegetation, and other measures.

Check dam — A small dam constructed in a gully or other small watercourse to decrease the stream flow velocity, minimize channel scour, and promote deposition of sediment.

Chute — A high-velocity, open channel for conveying water to a lower level without erosion.

SOURCE: MICHIGAN SOIL EROSION AND SEDIMENTATION CONTROL GUIDEBOOK, AND EROSION CONTROL ON HIGHWAY CONSTRUCTION.

Clay (soils) — (1) A mineral soil separate consisting of particles less than 0.002 mm in equivalent diameter. (2) A soil textural class. (3) (Engineering) A fine-grained soil that has a high plasticity index in relation to the liquid limits.

Contour — The shape of a land surface as expressed by contour lines.

Contour ditch — A ditch laid out approximately on the contour.

Contour grading plan — A drawing showing an arrangement of contours intended to integrate construction and topography, improve appearance, retard erosion, and improve drainage.

Contour line — (1) An imaginary line on the surface of the earth connecting points of the same elevation. (2) A line drawn on a map connecting points of the same elevation.

Cut and fill — A process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.

Debris guard — A screen or grate at the intake of a channel, drainage, or pump structure for the purpose of stopping debris.

Deposition — The accumulation of material dropped because of a slackening movement of the transporting agent (water or wind).

Desilting area — An area of grass, shrubs, or other vegetation used for inducing deposition of silt and other debris from flowing water, located above a stock tank, pond, field, or other area needing protection from sediment accumulation.

Detention dam — A dam constructed for the purpose of temporary storage of stream flow or surface runoff and for releasing the stored water at controlled rates.

Dike — A berm of earth or other material constructed to confine or control surface water in an established drainage system.

Diversion — A channel constructed across the slope for the purpose of intercepting surface runoff; changing the accustomed course of all or part of a stream. (*See* **Terrace**)

Drainage — (1) The removal of excess surface water or ground water from land by means of surface of subsurface drains. (2) Soil characteristics that affect natural drainage.

Drop inlet spillway — An overfall structure in which the water drops through a vertical riser connected to a discharge conduit.

Earth change — A man-made change in the natural cover or topography of land, including cut and fill activities, which may result in or contribute to soil erosion or sedimentation of the waters of the State. Earth change, as used in this guidebook, shall not apply to the practice of plowing and tilling soil for the purpose of crop production.

Easement (construction, drainage, planting, slope) — A right to use or control the property of another for designated highway purposes.

> **Construction easement** — An easement to permit the full development of the construction prism.
>
> **Drainage easement** — An easement for the directing the flow of water.
>
> **Planting easement** — An easement for reshaping roadside areas and establishing, maintaining, and controlling plant growth thereon.
>
> **Slope easement** — An easement for cuts or fills.

Emergency spillway — A spillway used to carry runoff exceeding a given design flood.

Engineer (resident, design, project) — A person trained in the science and profession of engineering.

Erodible (geology and soils) — Susceptible to erosion.

Erosion — The wearing away of land by the action of wind, water, gravity, or a combination thereof.

Erosive — Refers to wind or water having sufficient velocity to cause erosion. Not to be confused with erodible as a quality of soil.

Grade — (1) The slope of a road, channel, or natural ground. (2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction, like paving or laying a conduit. (3) To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation.

Graded stream — A stream in which, over a period of years, the slope is delicately adjusted to provide, with available discharge and with prevailing channel characteristics, just the velocity required for transportation of the load (of sediment) supplied from the drainage basin. The graded profile is a slope of transportation. It is a phenomenon in which the element of time has a restricted connotation.

Gradient — The rate of regular or graded ascent or descent.

Grassed waterway — A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from a site.

Gravel — A mass of pebbles.

Gravel envelope — Selected aggregate placed around the screened-pipe section of well casing or a subsurface drain to facilitate the entry of water into the well or drain.

Gravel filter — Graded sand and gravel aggregate placed around a drain or well screen to prevent the movement of fine materials from the aquifer into the drain or well.

Ground cover — Herbaceous vegetation and low-growing woody plants that form an earth cover.

Ground water — Subsurface water in the zone of saturation.

Growing season — The time during which a plant is periodically producing growth. This period will vary depending on the climate and is usually specified in the contract. It reflects climatic conditions and normal growth periods for the area in which the work is to be accomplished.

Grubbing — The process of removing roots, stumps, and low-growing vegetation.

Hardpan — A hardened soil layer in the lower A or in the B horizon caused by cementation of soil particles with organic matter or with materials such as silica, sesquioxides, or calcium carbonate. The hardness does not change appreciably with changes in moisture content, and pieces of the hard layer do not slake in water.

Haul road — a temporary road, generally unimproved, used to transport material to and from highway construction, borrow areas, and waste areas.

Heaving — The partial lifting of plants out of the ground, frequently breaking their roots, as a result of freezing and thawing of the surface soil during the winter.

Impoundment — Generally, an artifical collection or storage of water, as a reservoir, pit, dugout, sump, etc. (*See* **Reservoir**)

Infiltration — The flow of a liquid into a substance through pores or other openings, connoting flow into a soil in contradistinction to "percolation," which connotes flow through a porous substance.

Inlet (hydraulics) — (1) A surface connection to a closed drain. (2) A structure at the diversion end of a conduit. (3) The upstream end of any structure through which water may flow.

Interception channel — A channel excavated at the top of earth cuts, at the foot of slopes, or at other critical places to intercept surface flow. Syn., interception ditch.

Interceptor drain — A surface or subsurface drain, or a combination of both, designed and installed to intercept flowing water.

Invert — The lowest part of the internal cross section of a lined channel or conduit.

Landscape architect — A person trained in the art and science of arranging land and objects upon it for human use and enjoyment.

Landslide — The failure of a slope in which the movement of the soil mass takes place along an interior surface or sliding.

Lining (hydraulics) — A protective covering over all or part of the perimeter of a reservoir or a conduit to prevent seepage losses, withstand pressure, resist erosion, and reduce friction or otherwise improve conditions of flow.

Mulch — A natural or artifical layer of material placed on exposed earth to provide more desirable moisture and temperature relationships for plant growth. It is also used to control the occurrence of unwanted vegetation.

Outfall — The point where water flows from a conduit, stream, or drain.

Overfall — An abrupt change in stream channel elevation; the part of a dam or weir over which the water flows.

Peat — An accumulation of partially decomposed and compressed plant debris in bogs and marshes.

Percolation, soil water — The downward movement of water through soil, especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

Perennial plant — A plant that normally lives for three or more years.

Permanent erosion control measure — A control measure that is essential and will be maintained after project completion.

Permeability — The capacity for transmitting a fluid. It is measured by the rate at which a fluid of standard viscosity can move through material in a given interval of time under a given hydraulic gradient.

Planting season — The period of the year when planting and/or transplanting is considered advisable from the standpoint of successful establishment and good horticultural practices.

Revetment — A facing of stone or other material, either permanent or temporary, placed along the edge of a stream to stabilize the bank and protect it from the erosive action of the stream.

Right-of-way — A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Rill erosion — An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently cultivated soils.

Riprap — Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water; also applied to brush or pole mattresses, or brush and stone, or other similar materials used for soil erosion control.

Rounding, slope — The modeling or contouring of slopes to provide a curvilinear transition between several planes; e.g., tops, bottoms, and ends of cuts and fills.

Runoff (hydraulics) — That portion of the precipitation on a drainage area that is discharged from the area in stream channels. Types include surface runoff, ground-water runoff, or seepage.

Sand — (1) A soil particle between 0.05 and 2.0 mm in diameter. (2) Any one of five soil separates; very coarse sand, coarse sand, medium sand, fine sand, and very fine sand. (3) A soil textural class.

Scarify — To abrade, scratch, or modify the surface; for example, to scratch the impervious seed coat of hard seed, or to break the surface of the soil with a narrow-bladed implement.

Scour — To abrade and wear away. Used to describe the wearing away of terrace or diversion channels or stream banks.

Sediment — Solid particulate matter, mineral or organic, that has been deposited in water, is in suspension in water, is being transported, or has been removed from its site of origin by the processes of soil erosion.

Sedimentation — The action or process of depositing particles of waterborne or windborne soil, rock, or other materials.

Seedbed — The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Seepage — (1) Water escaping through or emerging from the ground along an extensive line or surface as contrasted with a spring where the water emerges from a localized spot. (2) The process by which water percolates through the soil. (3) (Percolation) The slow movement of gravitational water through the soil.

Settling basin — An enlargement in the channel of a stream to permit the settling of debris carried in suspension.

Sheet erosion — The removal of a fairly uniform layer of soil from the land surface by runoff water.

Sheet flow — Water, usually storm runoff, flowing in a thin layer over the ground surface. Syn., overland flow.

Side slope (engineering) — The slope of the sides of a canal, dam, or embankment. It is customary to name the horizontal distance first, as 1.5 : 1, or, frequently, 1½ : 1, meaning a horizontal distance of 1.5 feet to 1 foot vertical.

Silt — (1) A soil separate consisting of particles between 0.05 and 0.002 mm in equivalent diameter. (2) A soil textural class.

Slope — The degree of deviation of a surface from the horizontal, usually expressed in percentages or degrees.

Slope characteristics — Slopes may be characterized as concave (decrease in steepness in lower portion), uniform, or convex (increase in steepness at base). Erosion is strongly affected by shape, ranked in order of increasing erodibility from concave to uniform to convex.

Slope drains — Permanent or temporary devices that are used to carry water down cut or embankment slopes.

Sod — A closely knit ground cover growth, primarily of grasses.

Soil — The loose surface material of the earth in which plants grow.

Soil organic matter — The organic fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population. Commonly determined as the amount of organic material contained in a soil sample passed through a 2 mm sieve.

Soil survey — A general term for the systematic examination of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes.

Spoilbank (waste) — A pile of soil, subsoil, rock, or other material excavated from a drainage ditch, pond, or other cut.

Sprigging — The planting of a portion of the stem and root of grass.

Stabilized grade — The slope of a channel at which neither erosion nor deposition occurs.

Stilling basin — An open structure or excavation at the foot of an overfall, chute, drop, or spillway to reduce the energy of the descending stream.

Subsoil — The stratum of material beneath the surface soil.

Surface soil — The uppermost part of the soil, ordinarily moved in tillage, or its equivalent in uncultivated soils, ranging in depth from about 5 to 8 inches. Frequently designated as the plow layer, the Ap layer, or the Ap horizon.

Temporary erosion control measures — Those control measures which are essential and will have served their purpose until permanent erosion control is effected.

Terrace — An embankment or combination of an embankment and channel constructed across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope. Terraces or terrace systems may be classified by their alignment, gradient, outlet, and cross section. Alignment is parallel or non-parallel. Grade may be level, uniformly graded, or variably graded. Gradient is often incorporated to permit paralleling the terraces. Outlets may be soil infiltration only, vegetated waterways, tile outlets, or combinations of these. Cross sections may be narrow base, broad base, bench, steep backslope, flat channel, or channel.

Toe — The terminal edge or edges of a structure.

Topography — The configuration of the earth's surface, including the shape and position of its natural and man-made features.

Topsoil — The upper layer of soil, containing organic matter and suited for plant survival and growth.

Transpiration — The process by which water vapor is released to the atmosphere by the foliage or other parts of a living plant.

Watershed area — All land and water within the confines of a drainage divide or a water problem area, consisting in whole or in part of land needing drainage or irrigation.

Wind erosion — The detachment and transportation of soil by wind.

bibliography

BIBLIOGRAPHY

Barney, G.O., ed. Council on Environmental Quality, Department of State. The Global 2000 Report to the President. Washington, D.C.: U.S. Government Printing Office, 1981.

Bauer, Anthony. Shaping the Land--Conference Proceedings. East Lansing, Michigan: Michigan State University, 1982.

________. Associate Professor, Michigan State University, Department of Landscape Architecture and Urban Planning, East Lansing, Michigan. Interview July 13, 1983.

Beckett, Jackson, Raeder, Inc. Michigan Soil Erosion and Sedimentation Control Guidebook. Lansing, Michigan: Division of Land Resource Programs, Department of Natural Resources, 1976.

Coughlin, Robert E. Criteria For Open Space System Planning. Philadelphia, Pennsylvania: Regional Science Research Institute, 1975.

Christensen, K. Social Impacts of Land Development. Washington, D.C.: The Urban Institute, 1976.

Down, C.G. and Stocks, J. Environmental Impact of Mining. London: Applied Science Publishers, Ltd., 1977.

Duncun, O.D. "Social Organization and the Ecosystem" in Faris, Handbook of Modern Sociology. Chicago: Rand McNally, 1964.

Dunlap and Catton, "Environmental Sociology" in Annual Review of Sociology. 5(1979): 243-273.

Environmental Development Agency. Open Space Element. San Diego, California: Open Space Task Force, 1973.

Finsterbusch, K. Understanding Social Impacts. Beverly Hills, CA: Sage Publications Inc., 1980.

Fitzsimmons, S.J. and Salama, O. Man and Water: A Social Report. Boulder, Colorado: Westview Press, 1977.

Firey, W. Man, Mind and Land. Glencoe: Free Press of Glencoe, Illinois, 1960.

________. Social Aspects to Land Use Planning in the Country-City Fringe: The Case of Flint, Michigan. East Lansing: Michigan State College, Agricultural Experiment Station, Section of Sociology and Anthropology, 1946.

Flynn, J.E. Vegetation and Air Quality. Dayton, Ohio: Dayton Climate Project, 1981.

_______. Vegetation and Fugitive Sources. Dayton, Ohio: Dayton Climate Project, 1981.

_______. Vegetation and Urban Air Temperature. Dayton, Ohio: Dayton Climate Project, 1981.

_______. Vegetation and Urban Noise. Dayton, Ohio: Dayton Climate Project, 1981.

Garstka, W.U. Water Resources and the National Welfare. Fort Collins, Colorado: Water Resources Publications, 1979.

Hardin, G. and Baden, J. Managing the Commons. San Francisco, California: W.H. Freeman and Co., 1977.

Helfman, E.S. Rivers and Watersheds in America's Future. New York: David McKay Co., Inc., 1975.

Holton, H.N., Stiltner, G.L., Henson, W.H. and Lopez, N.C. USDAHL-74 Revised Model of Watershed Hydrology. Washington, D.C.: Agricultural Research Service, United States Department of Agriculture, 1975.

Hood, E.J. Watershed Organizations--Impact on Water Quality An Analysis of Selected Michigan Watershed Councils. (Ph.D. Dissertation, Michigan State University, Department of Resource Development, 1976.

Humphrey and Buttel. Environment, Energy and Society. Belmont, California: Wadsworth, 1982.

Humphreys, C.R. Watershed Management Reference, Vol. 5. East Lansing, Michigan: Michigan State University.

James, L.D., ed. Man and Water, The Social Sciences in Management of Water Resources. Lexington, Kentucky: University Press of Kentucky, 1974.

Keyes, Dale L. Land Development and the Natural Environment. Washington, D.C.: The Urban Institute, 1976.

Landerman, N.J., Schwartz, S. and Tapp, D.R. Community Resource: The Development-Rehabilitation of Sand and Gravel Lands. Pomona, California: Department of Landscape Architecture, School of Environmental Design, California State Polytechnic University and Southern California Rock Products Assn., 1972.

Leopold, Aldo. "Part IV--The Upshot" in A Sand County Almanac, A. Leopold. New York: Oxford University Press, 1966.

Levin, M.R., Rose, J.G. and Slavet, J.S. New Approaches to State Land Use Policies. Lexington: Lexington Books, D.C. Heath and Company, 1974.

Little, C.E. Challenge of the Land. New York: Open Space Action Institute, Pergamon Press, 1968.

Mann, R.L. A Visual Approach to Regional Planning. Cornell University, Ithaca, New York: Center for Urban Development Research, 1973.

Marsh, W.M. Environmental Analysis: For Land Use and Site Planning, 1978.

Marsh, W.M. and Borton, T.E. Inland Lake Watershed Analysis, A Planning and Management Approach. Lansing, Michigan: Michigan Department of Natural Resources, Land Resource Programs Division, Inland Lakes Management Unit, 1976.

Morrison, Denton, Professor, Michigan State University, Department of Sociology, East Lansing, Michigan. Interview July 5 and 12, 1983.

Morrison, Hornback and Warner, "The Environmental Movement: Some Preliminary Observations and Predictions" in Burch, Creek and Taylor (eds.), Social Behavior, Natural Resources and the Environment, New York: Harper, 1972.

Pereira, H.C. Land Use and Water Resources. Cambridge, Mass.: The University Press, 1973.

Reilly, W.K., ed. The Use of Land: A Citizen's Guide to Urban Growth. New York: Thomas Y. Crowell Co., 1973.

Ripley, E., Redman, R. and Maxwell, J. Environmental Impact of Mining in Canada. Kingston, Ontario: Centre for Resource Studies, Queen's University, 1978.

Rummery, R.A. and Howes, K.M.W., eds. Management of Lands Affected by Mining. Australia: Division of Land Resources Management, Commonwealth Scientific and Industrial Research Organization, 1979.

Schnaiberg, A. The Environment: From Surplus to Scarcity. New York: Oxford, 1980.

Smalley, G.W. Some Criteria for Determining Unit Area Control in Watershed Management on Municipal and Industrial Watersheds in the Southern Appalachians, (M.S. Thesis, Michigan State University, Department of Forestry, 1956.

So, F., Stollman, I., Beal, F. and Arnold, D, eds. The Practice of Local Government Planning. Washington, D.C.: International City Management Association, 1979.

Stevens, H.K. Physical and Cultural Characteristics of An Urbanizing Watershed (Ph.D. Thesis, Michigan State University, Fisheries and Wildlife Department, 1967).

Thomas, W.L., Jr., ed. Man's Role in Changing the Face of the Earth--International Symposium. Chicago: The University of Chicago Press, 1956.

Tolley, G.S. and Riggs, F.E., eds. Economics of Watershed Planning. Ames, Iowa: The Iowa State University Press, 1961.

Walker, T., Carpenter, P. and Lamphear, F. Plants in the Landscape. San Francisco: W.H. Freeman and Company, 1975.

Wallace, D.A., ed. Metropolitan Open Space and Natural Processes. Philadelphia, Pennsylvania: University of Pennsylvania, 1970.