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Ecological Impacts of Mining

Mining is necessary for the maintenance of the built environment and contributes to a healthy economy, yet the environmental impacts of mining are controversial. We must meet the challenge of reducing and mitigating these impacts in order to conserve scarce biological resources and make mining more acceptable to the public. This newsletter discusses aspects of the ecology of mining, identifies some poorly-known impacts, and recommends how problems can be addressed. We focus on the area between the Hudson River and the Massachusetts and Connecticut borders, but much of our discussion is applicable to large areas of eastern New York (and, ecologically but not legally, to southwestern New England as well).

The Hudson Valley has large deposits that have been mined since European settlement. Sand and gravel, clay, schist and gneiss, limestone, and marble are currently the most important mineral resources in the region (iron ore, "bluestone" sandstone, conglomerate, roofing slate, and peat were mined formerly). We depend on these non-renewable resources for construction of roads, buildings, and other purposes, but their extraction from the earth results in damage to local ecosystems. Sand and gravel are mined from glacial outwash deposits which often contain "kettle holes" and groundwater seeps. The Threatened Blanding's turtle lives in kettle wetlands. The Endangered bog turtle and many rare plants occur in groundwater-fed wet meadows at the edges of limy gravel banks. Clay for brickmaking comes from limy glacial lake deposits which often support wet meadows with rare plants. Limestone for cement manufacture is mined from ridges which also may support rare plants. Aggregate is produced from hard metamorphic rocks including schist, gneiss, and marble. Schist and gneiss ledges sometimes contain dens of the Threatened timber rattlesnake, and marble knolls often have rare plants.

All mining can cause siltation into wetlands and streams, dust pollution, visual disturbance, noise pollution, excess traffic, and road damage. Many of these problems can be alleviated by careful design, operation, monitoring, and remediation, but too often the potential and actual impacts are overlooked by mine planners and operators and by local and state regulators. The state law requires that all sites mined since 1975 be reclaimed to their former condition or to otherwise productive land after mining has ceased; but in southeastern New York, much land still goes unreclaimed. Reclamation may involve grading, returning stored topsoil, and planting.

GLACIAL OUTWASH

In this region, sand and gravel are taken from glacial outwash deposits which were left in lowland areas by meltwater streams during the most recent deglaciation (ca 10,000 years ago). The Harlem Valley and the corridors of Wappinger Creek, Sprout Creek - Fishkill Creek, and the Wallkill River contain some of the most extensive outwash deposits in the Hudson Valley. Sand and gravel are mined in open pits by large excavating equipment. Demand for different products, and complex distribution of different grades of gravel and sand in an outwash deposit, may necessitate shifting patterns of excavation in soil mines. Materials are often but not always washed, sorted, and crushed in processing plants on site.

Pink earth lichen on sand.

Outwash deposits often contain high-yield groundwater aquifers. Because of the permeability of coarse-textured subsoils, outwash deposits can be valuable sites for groundwater recharge. We suspect that soil mining increases the susceptibility of the underlying aquifer to contamination. For example, reduction of the thickness of subsoil above the water table would reduce the capacity to immobilize phosphorus. If phosphorus-enriched groundwater emerges in seeps and wetlands, it could lead to eutrophication and degradation of those habitats. In addition, heavy equipment used in mining is a potential source of petroleum contaminants.

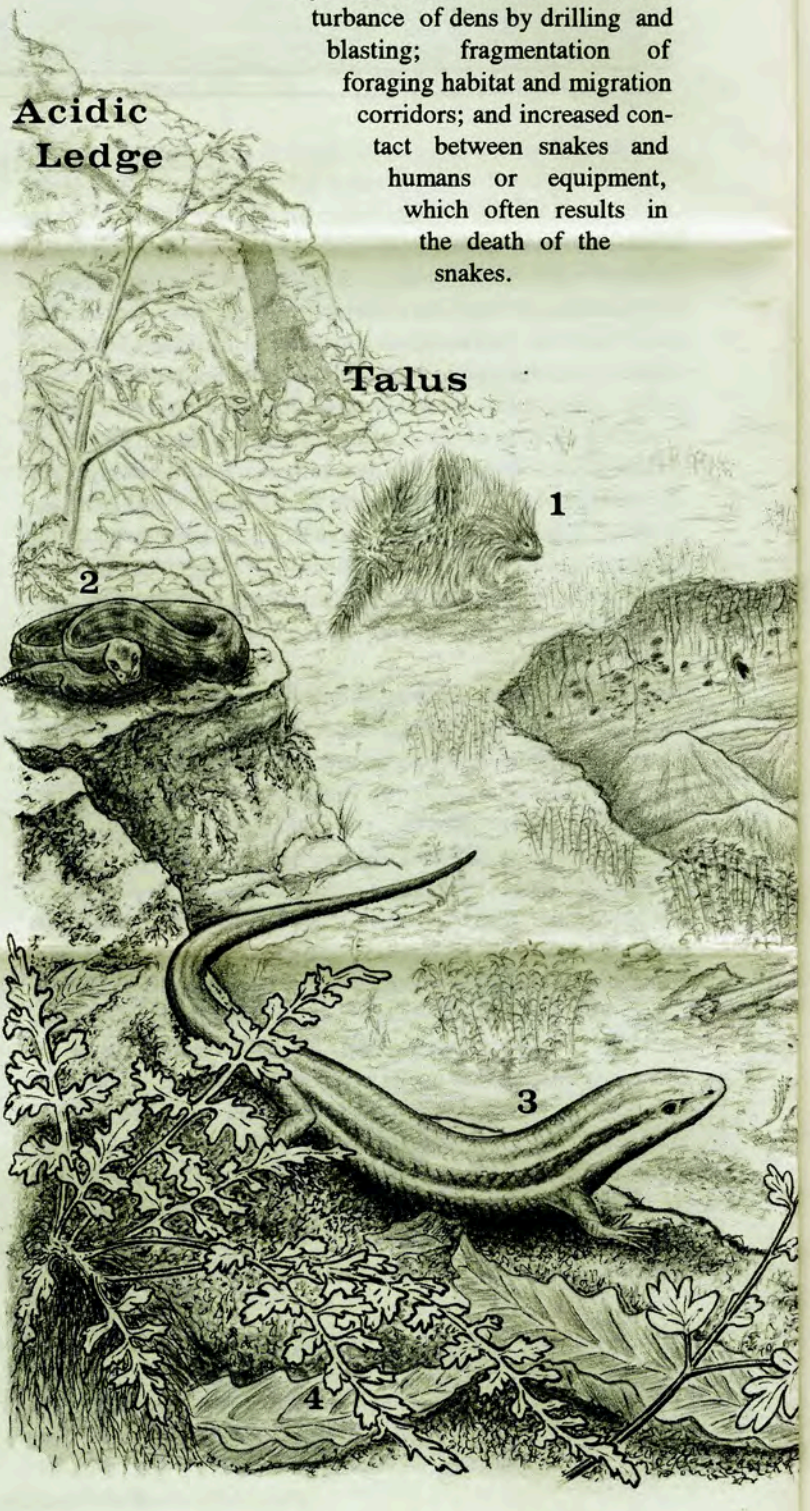
Some outwash areas have special attributes that combine to provide habitats for rare species. In the spring, rapid warming of well-drained outwash soils is favorable to species of southern or coastal affinities, such as Fowler's toad, box turtle, and hognose snake. Springs may be common. Groundwater-fed wet meadows on limy outwash are habitat for the Endangered bog turtle and numerous rare plant species. Kettle holes formed by the melting of buried, residual, glacial ice blocks often contain wetlands suitable for the Threatened Blanding's turtle. Habitat loss and degradation in general are major factors in the decline of populations of both bog and Blanding's turtles. Soil mining can disrupt groundwater hydrology, expose surface water and groundwater to contamination, and harm or destroy valuable wetlands and rare habitats.

ACIDIC ROCK

Highly metamorphosed, hard, acidic rocks such as schist, gneiss, and granite are prominent in the Taconic range and in the Hudson Highlands. Many of these mountains are relatively wild because the thin soils and steep terrain are poorly suited to agriculture, logging, construction, and other human uses. These rocks are drilled, blasted, and then crushed and sorted to produce aggregate for road building, concrete, and other construction uses.

Gneiss and schist ledge and talus (accumulation of loose rock) habitats provide shelter for many species of animals, notably snakes and small mammals, which use deep fissures in ledges and the spaces between talus blocks. Some gneiss and schist hillsides in the Hudson Valley contain winter dens of the timber rattlesnake, a Threatened species in New York. Other inhabitants include the copperhead, black racer, black rat snake and five-lined skink. The porcupine, an uncommon but possibly increasing mammal, makes dens in large fissures in ledge and talus. The Endangered eastern woodrat was formerly reported from cliff and talus habitats on the Connecticut side of Schagticoke Mountain and was still found in the 1970s-80s in the Hudson Highlands west of the Hudson River.

Rattlesnake dens are on steep, rocky, thinly wooded slopes with a southeast, south, or southwest exposure such that the rocks used by snakes for basking warm quickly in spring and fall. Rattlesnakes require a plentiful supply of small mammal prey and a permanent source of water nearby. They may travel 2-6 km from the den seeking prey and water. Killing and collecting of snakes and road mortality have been blamed for the steep decline in rattlesnake populations in recent decades. Although habitat loss from mining may not have been a major factor in past declines, any further loss of individuals or habitats is critical now that the population is so small. Therefore, den surveys should be conducted at any proposed hard rock mine site with potential for rattlesnake use (i.e., on or adjoining sunny ledges or talus). Mining can affect rattlesnakes by: destruction of den sites; disturbance of dens by drilling and blasting; fragmentation of foraging habitat and migration corridors; and increased contact between snakes and humans or equipment, which often results in the death of the snakes.



MARBLE AND LIMESTONE KNOLLS

Marble knolls that emerge through the outwash of the Harlem Valley floor have ledges, talus, and limy sand formed from weathering marble. This type of marble is mined primarily for aggregate.

These highly calcareous habitats support many species of rare plants, including side-oats grama, Bicknell sedge, yellow wild flax, Carolina whitlow-grass, and large twayblade. Carolina whitlow-grass is detectable for less than a month in spring, thus assessments of the biological value of marble knolls depend on informed and thorough botanical surveys. Northern saw-whet owl is a possible nesting bird in the groves of dense and tall eastern red cedar on some marble knolls. Seepage-fed fens on the sides or at the base of marble hills can support bog turtle and rare plants such as Indian paintbrush. Nellie Hill, a new Nature Conservancy preserve in the Town of Dover, has at least nine species of state-listed rare plants, one of which grows nowhere else in New York. Other richly diverse knolls, and many as yet unsurveyed, are unprotected.

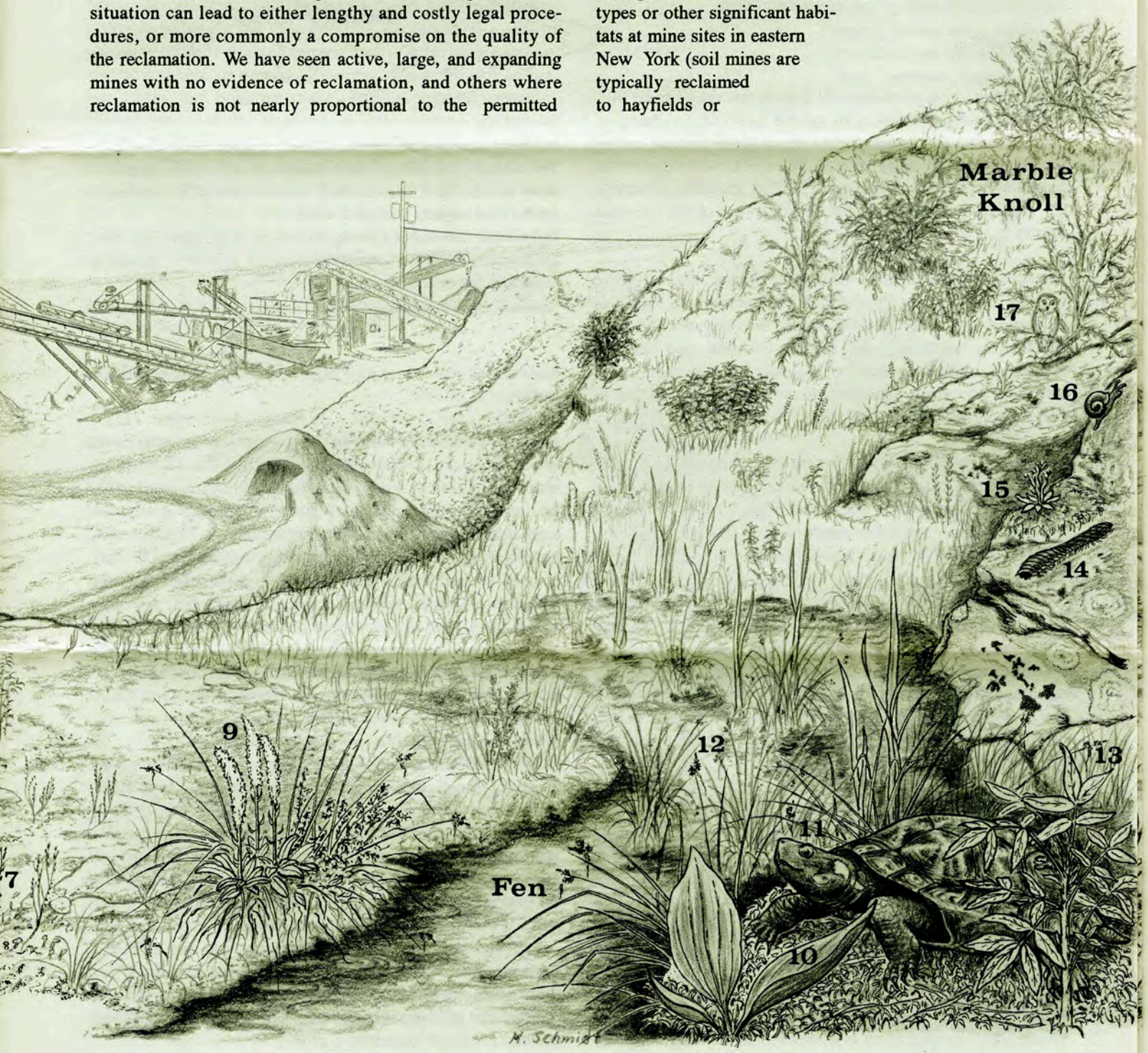
STATE AND LOCAL REGULATIONS

A 1991 amendment to the New York Mined Land Reclamation Law transferred to the state the entire regulatory authority for mining and reclamation. Any mine from which 1000 tons or more per year are removed for commercial or municipal use must obtain a mining permit (called a Mined Land Reclamation Permit) from the Department of Environmental Conservation (DEC). Local governments can directly regulate only smaller mines. There are several ways, however, in which local governments may influence the siting, operation, and reclamation of state-regulated mines. Local zoning ordinances and special use permit authority can specify permissible land uses, and access to and use of local roads by trucks. Local governments may help enforce DEC mining permit conditions, including reclamation requirements. They may also review and comment on permit applications to the DEC and make recommendations for permit conditions.

1 Porcupine, 85 cm
2 Timber rattlesnake, 125 cm
3 Five-lined skink, 15 cm
4 Mountain spleenwort (*Asplenium montanum*), 15 cm
5 Pale corydalis (*Corydalis sempervirens*), 50 cm
6 Bank swallow, 13 cm
7 Orange-grass (*Hypericum gentianoides*), 20 cm
8 Pink earth lichen (*Baeomyces roseus*), 8 mm
9 Blazing-star (*Chamaelirium luteum*), 50 cm
10 Grass-of-Parnassus (*Parnassia glauca*), 7 cm
11 Bog turtle, 9 cm
12 Yellow sedge (*Carex flava*), 50 cm
13 Shrubby cinquefoil (*Potentilla fruticosa*), 70 cm
14 Anise millipede 3 cm
15 Carolina whitlow-grass (*Draba reptans*), 10 cm
16 Land snail, 2 cm
17 Saw-whet owl, 17 cm

A mining permit may be issued by the DEC for up to five years (maximum). Prior to issuance of the permit, the mine operator must place a bond with the state equal to the estimated cost to the state for reclaiming the site if the mine operator defaults. At the end of the permit period, the operator may apply for a renewal. DEC regulators say they prefer to see reclamation carried out concurrently with mining, and they may require some reclamation before renewing a permit. But in practice the agency does not usually insist on substantial concurrent reclamation. Furthermore, while there are mine operators who default on reclamation, the state often has difficulty obtaining a transfer of the bond if the mine operator doesn't cooperate. This situation can lead to either lengthy and costly legal procedures, or more commonly a compromise on the quality of the reclamation. We have seen active, large, and expanding mines with no evidence of reclamation, and others where reclamation is not nearly proportional to the permitted expansion. Although the DEC is authorized to retain the bond for two years after completion of reclamation, while assessing the effectiveness of reclamation measures, the bond is often released soon after the DEC's initial inspection of the site. Even two years is scarcely enough time to evaluate the success of revegetation or the capability of a reclaimed area to withstand the rigors of normal but not necessarily annual natural events, such as severe storms or extended droughts.

There have been some attempts to restore or create wetlands, but we know of no attempts to restore unusual wetland types or other significant habitats at mine sites in eastern New York (soil mines are typically reclaimed to hayfields or



recreational lakes). The DEC does not monitor reclamation sites once the bond has been released, so there are no long-term data on the success of reclamation efforts. If prime farmland soils are removed during mining, the regulations require restoration of the land to prime agricultural standards after mining. We have been unable to find quantitative data indicating that such reclamation restores land to pre-mining levels of agricultural productivity. Despite shortcomings in the provisions and enforcement of the current mining and reclamation law, it nonetheless offers an opportunity for carefully designed and well-documented experimental restoration of valuable natural habitats, such as rattlesnake dens, Blanding's turtle wetlands, intermittent woodland pools, and prime agricultural land.

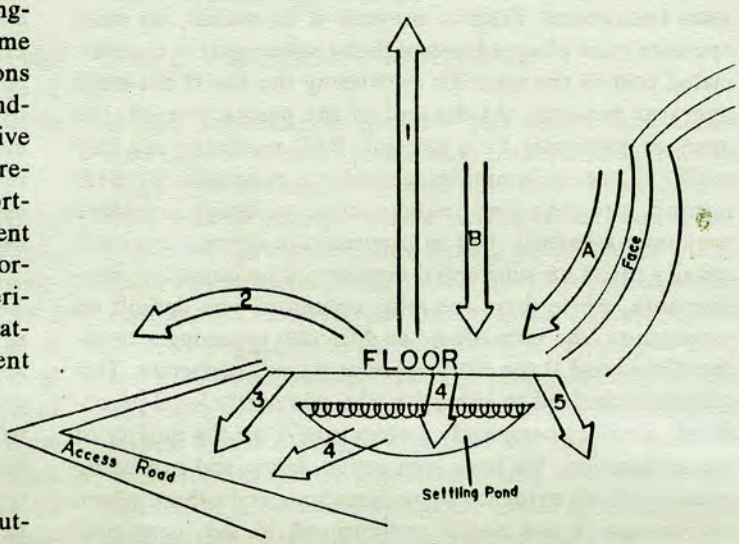
DISCUSSION

Mining has ecological impacts which can range from outright habitat destruction to subtle hydrologic changes. Environmental impact studies are seldom carried out by biologists qualified to recognize or evaluate significant habitats or rare species; hence, neither the mine operator, the regulators, or the public are made aware of the potential loss of biological diversity.

Erosion control on mine sites is often lax, and siltation barriers are often poorly installed and maintained. Rain and snowmelt wash fine mineral matter into streams and wetlands. Fine sediments clog stream bottoms, and smother fish eggs, aquatic insects, and plants. Soil particles also introduce excess nitrogen and phosphorus that contribute to the eutrophication of wetlands and waterways.

Heavy equipment in mines stirs up large amounts of dust in dry weather. Dust deposits can reduce photosynthesis, raise leaf temperatures, alter water exchange, increase susceptibility to disease, and cause direct toxicity to vascular plants, mosses and lichens. Noise from drilling, blasting, transporting, and sorting materials can disturb wildlife and humans. Animals vary in their sensitivity to noise and visual disturbance, but many species avoid noisy areas and some large birds are especially sensitive. Broad, heavily vegetated buffer zones can help to protect sensitive biological resources from siltation, nutrient input, dust and noise, but the state-mandated wetland buffer zone of 100 feet is inadequate in cases of steep terrain, erodible soils, or highly sensitive organisms and habitats.

Many of the environmental costs of mining could be avoided or minimized if: 1) careful biological studies are carried out by qualified scientists early in mine planning to identify rare species or significant habitats; 2) the mining project is then designed to avoid the most valuable habitats and minimize disturbance of other areas; 3) erosion, siltation, and dust control measures are rigorously implemented, monitored and maintained throughout the life of the mine; 4) the reclamation project is designed to restore (or create where appropriate) significant habitats and productive farm soils; and 5) reclamation is monitored in the long term to understand successes and failures, and to inform future reclamation efforts.



Potential fates of fine soil material at a hypothetical soil mine. The ecological impacts of dust from roadways, quarries and other sources have been studied, but we know of no research on the dust impacts from soil mines.
Inflows: A. Downslope (gravity, runoff); B. Deposition from air.
Outflows: 1. Airborne; 2. On trucks, etc.; 3. Runoff; 4. Dredging of settling pond; 5. Infiltration.

Industries that have solved their own environmental problems have earned the respect of the public. The mining industry has taken some steps in this direction and further action could produce benefits quickly. Citizens' groups are a potential source of ideas for improvement. These groups, however, will fare better if they focus on constructive criticism. State and local agencies should strive for consistency in review of permit applications and enforcement. All operating mines should be subject to frequent inspections for permit compliance. If necessary, mine permit fees should be increased to cover monitoring costs. Permit fees and reclamation bonds should also cover the costs of longterm monitoring and analysis of reclamation efforts.

Many people are aware of the importance of maintaining the diversity of native plants and animals, protecting high quality open space and clean water, and conserving non-renewable resources. Although it may be more costly to mining companies in the short term to design and operate mines in accordance with sound environmental practices, in the end such practices will make proposals for new mines and for permit renewals more palatable to an increasingly concerned public. The costs of mitigation and effective reclamation must be accepted as part of business. When these costs are accurately reflected in the costs of mineral products, it will encourage conservation and more efficient use and re-use of materials.

The scene on the previous pages is a composite of actual habitats and biota in the towns of Dover, Amenia and Northeast, although no one site necessarily has all the habitats and species shown. Permeable outwash soils occasionally have an impermeable layer that could support a perched wetland such as the fen in the drawing.

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Hudsonia needs a binocular dissecting microscope for herbarium work. We are also seeking donations of office and field equipment, and natural history/ecology books and journals for Hudsonia's library.

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Celebrate with us: Ten years of non-advocacy, scientific information about the environment of the Hudson Valley and neighboring regions; 160 projects in the public interest; and reports that have provided the factual basis for forward-looking land use decisions, negotiated settlements between economic interests and citizens' groups, and conservation of native biological diversity.

Hudsonia specializes in field science in the service of wise use and management of the environment. Our field personnel have 10-25+ years of experience in the Northeast. We have specialists who can identify a mayfly, a sedge, or a lichen, because these obscure organisms can provide information about environmental quality and improve our capability to harmonize economic activities and conservation. Hudsonia also conducts economic analysis, cultural resource surveys, and pure research.

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We are planning future issues of *News from Hudsonia* on environmental archeology of the Hudson, marine mammals, water-chestnut, and the ecology of woodland pools.

1992 Natural History Courses

MOSSES, Jerry C. Jenkins, 2 May.
BUTTERFLIES, Spider Barbour, 16 May.
MINNOWS, Robert E. Schmidt, 30 May.
LICHENS, Robert Dirig, 13 June.
ADULT DRAGONFLIES & DAMSELFLIES, Ken Soltesz, 11 July
WETLAND DELINEATION, Gretchen Stevens, 8 August.
MACROFUNGI, Bill Bakaitis, 5 September.

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