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# Integrating Geoscience with Sustainable Land-Use Management

**Position Statement.** To ensure sustainable land-management practices that meet present and future needs of people and the natural systems on which they depend, the Geological Society of America (GSA) advocates use of comprehensive earth-science information in land-use planning and decision making. The geosciences address the origin, character, and interconnection of natural resources, as well as the natural and human-induced processes that affect these resources. Earth-science information is critical to addressing natural and human-induced hazards, such as landslides, earthquakes, subsidence and sinkholes, floods, or droughts; natural resource availability, such as energy, water, soils and mineral resources; and environmental issues, such as soil erosion, surface water quantity and quality, groundwater supply and contamination, and wetland destruction. Therefore, earth science should be incorporated into all land and natural resources management decisions to enhance their integrity and sustainability.

**Purpose.** This position statement: (1) summarizes the consensus view of GSA regarding integration of geoscience into land-use management; (2) provides information to policy makers and land managers showing the vital contributions geoscientists can make to strong and effective policies for sustainable land use; and (3) encourages geoscientists to participate in land-use decision making at local, regional, state, and national levels.

## RATIONALE

Earth's land, water, and air are indispensable natural resources. Land generates most of humanity's food, provides the aggregate, mineral, and soil resources vital to society, and serves as a major carbon sink through photosynthesis and mineral weathering. The land surface also provides both natural beauty and recreational value and affects the quality and amount of water delivered to streams and aquifers.

Groundwater, lakes, and rivers provide water for domestic, municipal, industrial, and agricultural uses. Lakes and rivers provide water for transportation, power generation, recreation, and natural habitats. Coastal waters provide important food resources and ecosystems for marine life, and coastal environments, such as dunes and marshes, protect communities from storm surges and tides.

Air quality is determined by interactions between natural and human activities on Earth's surface and the atmosphere; for example, some land uses, such as agriculture or construction, may generate large amounts of dust and smoke that travel great distances on global wind currents.

Thus, water, air, and land resources are closely linked through complex cycles and earth processes. These resources must be sustained for future generations and the health of the planet.

Land-use practices affect Earth's vital resources and the ecosystems supported by these resources. Land-use practices include agriculture, ranching, logging, mining, river management (such as dams, reservoirs, levees, and canals for water diversion and storage), groundwater withdrawals, groundwater recharge, waste disposal, and urban/suburban development. These practices affect hydrologic and biogeochemical cycles and processes, as well as the structure of fundamental ecosystems, such as wetlands, streams, estuaries and bays, shorelines, and forests. Changes in these highly dynamic processes can affect the integrity and future availability of natural resources.

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Land resources, and our ability to manage and protect them, also affect Earth's climate. For example, land-management decisions that promote urban sprawl will result in more paved surfaces generating urban heat islands, which influence precipitation patterns around cities. Hotter cities use more electricity for air conditioning, increasing fossil fuel use for power generation. Likewise, urban sprawl and highway construction require more fossil fuel consumption for transportation and increase greenhouse gas emissions. The impact of sprawl is amplified by the deforestation and land clearing that accompany it. As more people migrate to cities worldwide, large-scale urban land-use management will become increasingly important.

Human activities continually interact with Earth's natural processes. Expanding populations are increasingly impacting Earth's systems at all levels. Because natural and anthropogenic changes to land resources are diverse, land-management decisions are inherently multifaceted and interdisciplinary. Geoscience provides a unique contribution to land-use issues because geoscientists address the origin, character, distribution, availability, vulnerability, and connectivity of natural resources. In short, the geosciences provide an understanding of potential short- and long-term effects of past, present, and future land-use practices on other natural resources. Earth-science information must be integrated with land-use planning so that land-use management options are evaluated on the basis of conservation, protection of human and ecologic health and safety, and sustainable socioeconomic growth.

#### **PUBLIC POLICY ASPECTS OF INTEGRATING GEOSCIENCE WITH LAND-USE DECISION MAKING**

Land-use planning and management decisions should (1) reflect a comprehensive understanding of the potential impacts on natural resources that sustain communities; (2) include measures to avoid over-allocation, chronic depletion, and/or degradation of natural resources; and (3) consider the needs of future populations to conserve natural resources and avoid damage to natural systems that may be difficult, expensive, or even impossible to restore. Geoscience, with its interdisciplinary, multi-scale, and long-term scientific considerations, is a critical component of effective management of land and associated natural resources for sustained uses. Earth-science studies and data also help decision makers optimize resource use while minimizing unacceptable environmental impacts. Finally, as human population grows, demand for land and associated natural resources will increase, as will the need for more science to inform land management decisions in a sustainable manner and develop strategies for mitigating unacceptable and irreversible changes.

#### **RECOMMENDATIONS**

Earth science should be incorporated into all relevant land and natural resources management decisions.

Government agencies at local, state, national, and international levels should integrate earth-science information into land-use planning to effectively address natural and human-induced hazards, natural resource availability, and environmental issues.

Public investments in earth-science research should be maintained or increased to improve the scientific basis for land-use decisions. Reliable earth-science data and information should be readily accessible to policy makers, private developers, land managers, individuals, and community groups to reduce potential risk and liability in areas of natural or anthropogenic hazards.

Easy-to-comprehend earth-science information should be readily accessible to enable the public to understand land-use decision making, especially in areas such as fault zones, floodplains, steep slopes, eroding coastlines, and hydro-geologically sensitive settings susceptible to groundwater degradation.

#### **ABOUT THE GEOLOGICAL SOCIETY OF AMERICA**

The Geological Society of America, founded in 1888, is a scientific society with more than 26,000 members from academia, government, and industry in more than 100 countries. Through its meetings, publications, and programs, GSA enhances the professional growth of its members and promotes the geosciences in the service of humankind. Headquartered in Boulder, Colorado, USA, GSA encourages cooperative research among earth, life, planetary, and social scientists, fosters public dialogue on geoscience issues, and supports all levels of earth science education. Inquiries about GSA or this position statement should be directed to GSA's Director for Geoscience Policy, Kasey White, at +1-202-669-0466 or [kwhite@geosociety.org](mailto:kwhite@geosociety.org).

## OPPORTUNITIES FOR GSA AND ITS MEMBERS TO HELP IMPLEMENT RECOMMENDATIONS

To improve implementation of the goals of this position statement, GSA recommends the following actions.

- GSA members should seek opportunities to communicate the value of integrating geoscience with sustainable natural resources management to governing bodies at all levels, government agencies, private developers, economic development corporations, professional land-use planners, chambers of commerce, and other local decision makers.
- GSA members are encouraged to work with print, electronic, social, and broadcast media to promote the value of science in addressing critical land-use issues.
- GSA members who participate in land-use and associated natural resources planning are encouraged to share their experiences at GSA meetings and with GSA's Director for Geoscience Policy. Local examples of geoscience contributions to land-use planning are essential to this effort.
- GSA members must clearly communicate with decision makers that a lack of earth-science information has often resulted in costly adverse land-use activities, worsened the consequences of natural disasters, and allowed for needless human-induced disasters.
- GSA members should identify legislation that affects land use and alert GSA's Geology and Public Policy Committee, the Geology and Society Division, and GSA's Associated Societies so they can help improve the scientific basis for land-management decisions and bring this Position Statement to the attention of lawmakers.
- GSA should raise awareness of land-use issues by publishing articles in popular outlets on the links between geoscience, land-use planning, and sustainable resource management decisions.
- GSA should encourage interaction among geoscientists at all levels who work with land and natural resources management issues or are interested in incorporating geoscience into land-use decision making.
- GSA should sponsor symposia or town-hall meetings, particularly at the GSA sectional or annual meetings, that bring together geoscientists from land management agencies, the U.S. Geological Survey, universities, and private industry to share ideas about how geoscience has been and can be successfully integrated into land use and natural resources policies.