

---

# Integrating Geoscience with Sustainable Land-Use Management

**Position Statement.** To ensure sustainable land management practices that meet the present and future needs of humans and the ecosystems on which they depend, The Geological Society of America (GSA) advocates the use of comprehensive geoscientific information in land-use planning and decision making. The geosciences provide a unique contribution to land-use issues because they address the origin and character of materials at or near Earth's surface and the varied natural and human-induced (anthropogenic) processes that have modified or redistributed these materials over time. Geoscientific information is critical to appropriately address a number of issues related to land-use, such as natural hazards (e.g., landslides, earthquakes, floods, or droughts), natural resources (e.g., energy, water, soils and mineral resources), environmental issues (e.g., climate change and pollution), and anthropogenic hazards (e.g., land-based waste disposal).

**Purpose.** This position statement (1) summarizes the consensus view of GSA regarding the integration of geoscience into the land management decision-making process; (2) provides information to raise awareness among policy makers and land managers of the vital contributions geoscientists make toward crafting and implementing well-thought out policies for sustainable land use as well as evaluating their short- and long-term consequences; 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 affords humanity with places to build communities and associated infrastructure, generates most of humanity's food resources, serves as a major carbon sink, and provides the mineral and soil resources vital to society. The land surface also provides both aesthetic satisfaction and recreational value.
- Groundwater, lakes, and rivers provide water for domestic, municipal, industrial, and agricultural uses. Lakes and rivers also provide water for transportation, recreation, and ecosystem habitats.
- Air quality is determined by interactions between activities on Earth's surface and the atmosphere.

Water, air, and land resources are inherently linked through the integration of hydrologic and biogeochemical cycles and processes. These resources must be sustained for society's 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 are wide-ranging and include, but are not limited to, agriculture, ranching, logging, mining, river management (including building dams and levees and water diversion and storage), groundwater withdrawals, waste disposal, and urban/suburban development. Such practices affect hydrologic and biogeochemical cycles and processes, as well as the structure of fundamental ecosystems. Changes in these highly dynamic processes and structures affect all living things and can diminish the availability of resources for future generations.

Land resources, and our ability to manage and protect them, are also affected by climate change. For example, a rise in sea level could result in the displacement of millions of people from coastal regions. Increasing temperatures have thawed permafrost in arctic regions, affecting wildlife and infrastructure and diminishing the suitability of these lands for human habitat. Climate change also affects the water cycle, including the amount, type, and seasonal and spatial distribution of precipitation, as well as the magnitude and duration of extreme events. These changes have the potential to increase the risk of extreme flooding, drought, and wildfires, alter groundwater recharge and discharge patterns and availability, and adversely affect both managed and natural ecosystems.

Human activities continually interact with Earth's natural processes; expanding populations, pollution, and anthropogenic hazards impact 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, and vulnerability of materials at or near Earth's surface upon which life depends. Geoscientists are also uniquely qualified to distinguish between natural and anthropogenic processes that alter and redistribute natural resources. In short, the geosciences provide an understanding of potential short- and long-term that result from past, present, and future land-use practices. This geoscientific information must be integrated with land-use planning so that various, often conflicting, land-use scenarios are evaluated on the basis of conservation, protection of human and ecologic health and safety, and 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 resources that sustain communities; (2) include measures to mitigate and avoid over-allocation of resources; and (3) consider the needs and resource values of the wider community and future populations to conserve natural resources and avoid widespread disruption of and damage to natural systems that may be difficult, expensive, or even impossible to restore. Geoscience, with its interdisciplinary, comprehensive, multi-scale, and long-term consideration of changes to the landscape, is critical to science-based land-use decision making. Without careful planning and integrated resource management, inappropriate land-use practices may proceed on an unsustainable course.

Scientific understanding, based on the best available geological, hydrological, ecological, and biogeochemical information on the long-term effects of land-use change on the environment, is essential for improving land-resource management. Geoscientific studies and data can aid decision makers in industry and government in as they evaluate the location, extent, and availability of present and future soil, water, mineral, and energy resources. Geoscientific studies and data also enable decision makers to concurrently optimize resource utilization while minimizing adverse environmental impacts.

Finally, as the human population grows, demand for land resources will increase, as will the need for science-based land-management decisions to support future populations in a sustainable manner. Geoscience can significantly and uniquely contribute to improved understanding of the potential long-term consequences associated with past and future land uses and natural hazards, and can provide evaluation strategies for the mitigation of detrimental changes.

#### RECOMMENDATIONS

- Geoscientific knowledge significantly improves the technical basis for land-use planning and therefore should be used to enhance the strength and integrity of decisions regarding land use.
- Government agencies at local, state, national, and international levels must integrate geoscientific information with land-use planning to effectively address such issues as natural hazards (e.g., earthquakes, floods, droughts, landslides, subsidence, and erosion), natural resources (e.g., energy, water, soils, and mineral resources), environmental issues (e.g., climate change and pollution), and anthropogenic hazards (e.g., sites for industrial and waste facilities).
- Strong and growing public investment in geoscientific research is needed to improve the scientific basis for land-use decisions. Reliable geoscientific information must be readily accessible to policy makers, private developers, land managers, and community groups so as to reduce potential risk and liability in areas of known natural or anthropogenic hazards.
- Improvements in the public's ability to make informed land-use decisions regarding, for example, construction of housing developments close to fault zones, in flood-prone areas, or along eroding coasts, are contingent upon increased investment in geoscientific education.

#### ABOUT THE GEOLOGICAL SOCIETY OF AMERICA

The Geological Society of America, founded in 1888, is a scientific society with over 21,000 members from academia, government, and industry in more than 90 countries. Through its meetings, publications, and programs, GSA enhances the professional growth of its members and promotes the geosciences in the service of humankind. 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 the GSA or this position statement should be directed to GSA's Director for Geoscience Policy, Dr. Craig M. Schiffries, at +1-202-669-0466 or [cschiffries@geosociety.org](mailto:cschiffries@geosociety.org).

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

To facilitate implementation of the goals of this position statement, GSA recommends the following actions to increase the participation of geoscientists in land-use policy decisions at all levels of government, with private companies, and with the public.

- We should seek opportunities to communicate the value of integrating geoscience with sustainable land management to international, national, state, and local legislative bodies and 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, and broadcast media to promote the value of science in addressing critical land-use issues. Members who participate in land-use planning are encouraged to share their experiences at GSA meetings and with GSA's Director for Geoscience Policy) in Washington, D.C. Local examples of how geoscience contributions to a land-use planning or decision-making effort are essential to this effort. We must clearly communicate with decision makers that the lack of geoscientific information has resulted in costly adverse land-use activities and increased the devastating consequences of natural disasters.
- We should seek opportunities to effectively convey to community groups the value of integrating geoscience with sustainable land management. The public must be able to respond in an informed manner to decisions about land use that affect their community and property. GSA and GSA members must, therefore, work to meet the public's growing need for education concerning the value of geoscientific information in land-use planning. Again, it is beneficial to provide GSA's Director for Geoscience Policy with local examples of how geoscientific information has either contributed to land-use planning efforts or how its lack resulted in costly adverse land-use activities or increased the devastating consequences of a natural disaster.
- Considerable expertise and resources are available to members through GSA's Geology and Public Policy Committee (GPPC), Geology and Society Division, and Director for Geoscience Policy to help GSA members create talking points on common land-use problems and participate in land-use decisions by becoming members of relevant decision-making bodies. It is important that GSA and its members identify legislation that affects land use and alert the GPPC, the Geology and Society Division, and GSA's Associated Societies so they can help improve the scientific basis for land-management decisions as well as bring this Position Statement to the attention of lawmakers.
- GSA should raise awareness of land-use issues by publishing articles on the links between geoscience and land-use planning and management decisions, as well as articles that point toward the successful integration of geoscience with sustainable land management.
- GSA should encourage interaction among geoscientists at all levels who work with land management issues or are interested in incorporating geoscience into land-use decision making. GSA should sponsor symposiums 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 policy.