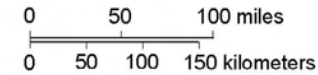
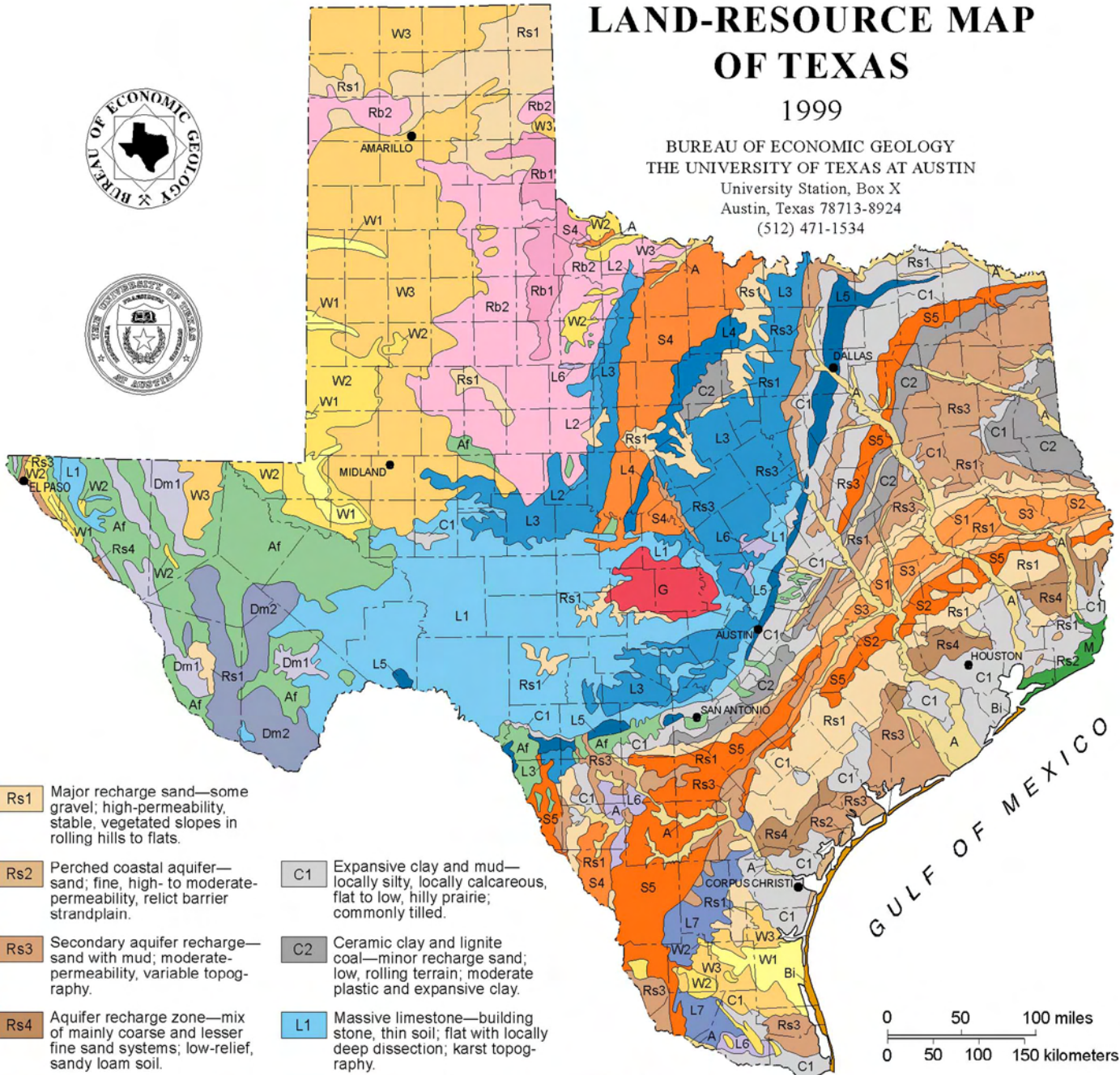


LAND-RESOURCE MAP OF TEXAS

1999

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| <p>Rs1 Major recharge sand—some gravel; high-permeability, stable, vegetated slopes in rolling hills to flats.</p> <p>Rs2 Perched coastal aquifer—sand; fine, high- to moderate-permeability, relict barrier strandplain.</p> <p>Rs3 Secondary aquifer recharge—sand with mud; moderate-permeability, variable topography.</p> <p>Rs4 Aquifer recharge zone—mix of mainly coarse and lesser fine sand systems; low-relief, sandy loam soil.</p> <p>S1 Greensand—ironstone—steep slopes and rolling hills; local hard beds; iron ore; road base; soil conditioner.</p> <p>S2 Tuffaceous sand and mud—rolling, steep badlands; expansive clay; bentonite; uranium; fuller's earth.</p> <p>S3 Sand and mud—lignite and bentonite; expansive clay; moderately rolling; poor strength; low permeability.</p> <p>S4 Sandstone and shale—locally thin coal and limestone; poor soil; subdued stair-step topography.</p> <p>S5 Sand and mud (undifferentiated)—cuesta-swale topography; colluvial, deep sand and clay loam.</p> <p>G Weathered granite and schist—hard fractured rock and loose granitic sand; locally minor aquifers.</p> | <p>C1 Expansive clay and mud—locally silty, locally calcareous, flat to low, hilly prairie; commonly tilled.</p> <p>C2 Ceramic clay and lignite coal—minor recharge sand; low, rolling terrain; moderate plastic and expansive clay.</p> <p>L1 Massive limestone—building stone, thin soil; flat with locally deep dissection; karst topography.</p> <p>L2 Thin-bedded limestone—crushed stone; locally poor aquifers; fractured, resistant local ledges.</p> <p>L3 Hard limestone and marl—stair-step topography; stable slopes; thin clay soils; local seeps and minor springs.</p> <p>L4 Thick limestone and shale—building and crushed stone; thin, stony, clay loam soils; minor sandstone beds.</p> <p>L5 Chalk—potential cement material; high slope stability; black, expansive soils; rolling prairie.</p> <p>L6 Caliche—bedrock and alluvium, cemented irregularly by calcite; road-base material.</p> <p>L7 Karstic caliche-cemented sand—sink holes and collapse lows; hummocky terrain.</p> | <p>Rb1 Gypsiferous red bed with dolomite—rolling to steep slopes; collapse lows; plastic and expansive clay.</p> <p>Rb2 Dissected red bed—mud and sand; local badlands with steep slopes; thin loam soils; not productive.</p> <p>Dm1 Desert mountain terrain (sedimentary rock)—steep, variable rock types; loose surface rock.</p> <p>Dm2 Desert mountain and canyon land (volcanic rock)—rugged; many box canyons; lava and explosive debris.</p> <p>A Flood-prone valley and terrace—alluvium of sand and mud; sparse gravel; stream channels, flats, and coastal marshes.</p> <p>Af Alluvial fan—Trans-Pecos: active cover; Rio Grande: relict chert gravel; Balcones Escarpment: calcareous detritus.</p> | <p>W1 Sand dune and blowout—mobile or stabilized by vegetation; locally deflated hollows and flats.</p> <p>W2 Windblown sand—strong relict grain of leveled dunes, blowouts, playas; flat to low, rolling terrain.</p> <p>W3 Loose surficial sand and silt (loess)—playas; flat to low, rolling, grassy prairie and scrub brush.</p> <p>M Wetlands—fresh, brackish, and saltwater marsh and swamp—coastal and deltaic.</p> <p>Bi Barrier island—sand and shell, beach, fore- and back-island dunes, back-island and tidal flats, marshes, and washovers.</p> |
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Land Resources of Texas

The fundamental physical and biological properties of Texas lands that are represented on this map collectively define basic land-resource categories: regions of groundwater recharge, lands containing economic mineral resources, areas containing land-surface materials having economically important physical properties, regions exhibiting distinctive land forms, areas influenced by dynamic physical processes, and areas dominated by biological factors. One or more of these categories define a land-resource unit, differentiated on this map by color and labeled by alphanumeric abbreviations. Each of the generalized map units commonly represents more than one land-resource unit.

Groundwater Recharge Units. Surficial recharge sands and gravels (map units Rs1 through Rs4) are among the most economically important of the Texas land resources. Aquifers supply nearly 60 percent of the total fresh-water demand of the state, and they are the sole source of water in numerous areas of Texas. Recharge areas are generally underlain by uncemented or loosely cemented sand or mixed sand and gravel. Surface waters can, however, recharge aquifers by passing through virtually any type of bedrock or surficial sediments that have permeability (for example, map units G, L7, and others not specifically designated as recharge sands on this map) sufficient to enable water to flow into aquifers.

Groundwater movement and storage in the recharge sediments and aquifers occur within open spaces (porosity) between the sediment grains and can compose as much as 25 percent of the sediment volume. The degree to which these open spaces are interconnected (to allow subsurface water flow) determines the permeability of the recharge and aquifer material. The map differentiates between recharge units on the basis of sediment grain size (gravel, sand, and clay), permeability, and topography (for example, rolling hills, barrier islands, and low-relief terrains).

Mineral-Resource Units. Because Texas produces a large, diverse array of mineral resources, particularly nonmetallic minerals, it has historically been ranked among the top five states in total annual yield of mineral commodities. Mineral-resource units depicted on the map (map units S1 through S5, G, C1 and C2, Rb1, and L1 through L7) include regions where known significant resources or potential deposits exist. For example, major quarries in hard limestone (map unit L1), sandstone (map unit S4), and granite (map unit G) in Central and East Texas provide building, dimension, and facing stone for commercial and residential structures. Crushed limestone, sandstone, and other rock and sediment types furnish hard-rock aggregates in road bases. Recharge sands also

host large deposits of uranium in the Karnes City area of South Texas. Caliche (map unit L6) and greensand-ironstone (map unit S1) are locally common road bases. Iron ore has also been mined from greensand-ironstone in northeast Texas. Cement plants on and near chalk bedrock (map unit L5) extend from San Antonio to Dallas, and areas depicted by map units C2 and Rb1 have yielded bituminous coal, ceramic clay, and gypsum in North-Central Texas.

Physical-Property Units. Physical-property units determine the suitability of an area's physical characteristics for various uses by humans. The physical characteristics of substrate material or soil are the most important, and land properties that impose engineering limits on construction are among the most significant of the map units. These limits include slope stability, foundation strength, excavation potential, compressibility, plasticity, corrosion potential, and infiltration capacity, among others.

The recharge sand units (map units Rs1 through Rs4) exhibit excellent engineering properties for building. They include high foundation strength, low corrosion potential, low compressibility, low expansion (shrink-swell) potential, moderate slope stability, and ease of excavation. Limestone, sandstone, and granite (map units L1 through L5, S1, S5, and G) share many of these desirable characteristics.

In contrast, land-resource units that have a high clay content are typically unsuitable as a construction base. Clays and shales (map units C1, C2, S2, S3, and Rb1) erode easily, forming lowlands; compose weak foundation and construction materials; and have expansive and corrosive properties that damage roads and foundations. Clay-dominated units, however, commonly well suited for solid-waste disposal, are sources of industrial clays and constitute prime agricultural lands.

Land-Form Units. For certain land-resource areas in Texas, topographic relief and land-surface configuration control land use. Unlike other land-resource units, however, few generalizations can be made about physical properties of the land-form units because of their statewide diversity. Substrate materials range from very hard to soft, topography ranges from flat prairie and coastal lands to rugged mountain terrain, and agricultural suitability ranges from poor rangeland with sparse vegetation to highly productive farmland. Mountain, canyon, and desert vistas (map units Dm1, Dm2, and Af) in Trans-Pecos Texas, badland red-bed terrains (map units Rb1 and Rb2) in North-Central Texas and the Panhandle, the limestone-supported Hill Country of Central Texas (map units L1 and L3), and dune fields and barrier islands of coastal Texas are but a few examples of land-form units that have created prime recreational attractions in the state.

Dynamic-Process Units. Land-resource units in which dynamic physical processes (for example, flooding and wind erosion) are paramount greatly affect the natural suitability of many areas of the state for human activities. In some areas, these processes are continuous; in other regions, the processes occur periodically, rapidly, and sometimes with intensity. The periodicity and intensity of these processes and resultant land-surface changes strongly affect human ability to use land and water resources in the affected areas.

The land-resource units that are grouped under dynamic processes are stream, coastal, and eolian (wind) deposits: flood-prone valleys and terraces (map unit A), areas susceptible to hurricane-surge flooding (map unit Bi and other coastal units), sand dunes and blowouts (map unit W1), and windblown sands (map unit W2). Other units that are less influenced by dynamic processes include limestone terrains susceptible to sinkhole development (map unit L7) and mountainous terrains where rock and mud slides may occur (map units Dm1 and Dm2). Primary dynamic-process units are restricted to the Texas Coastal Zone, West Texas, and the Panhandle.

The nutrient-rich soils in stream and river valleys that are subject to periodic flooding are best used for agriculture in rural areas and for greenbelts in urban settings. River terraces require thoughtful commercial development because they remain possible flood zones during infrequent, but major, flooding events. Topographically low areas along the coastal zone, such as barrier islands, are susceptible to storm-surge flooding and shoreline erosion. Mobile sand dunes and blowouts, involving generally continuous dynamic processes, are components of lands that are commonly left undeveloped as scenic park lands. Mountainous areas subject to rock and mud slides are remotely inhabited, and they are also prime scenic lands.

Biological-Resource Units. Only one biological-resource unit is represented on this map—wetlands (map unit M). This land-resource unit includes fresh-, brackish-, and saltwater marshes in coastal and deltaic settings that can be mapped as separate units on a larger scale map. Swamps and riparian lands, also generalized, are included in the wetlands unit. Numerous other coastal marshes and swamps cannot be shown at this scale. In the coastal bay areas, many other biological units can be identified on the basis of benthic populations. Seagrasses and oyster reefs are examples.

For more details about the information summarized on this map, please consult the Bureau's 1:500,000-scale map and the text that accompanies the publication *Land Resources of Texas*.

—Text by E. G. Wermund

Bureau of Economic Geology

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