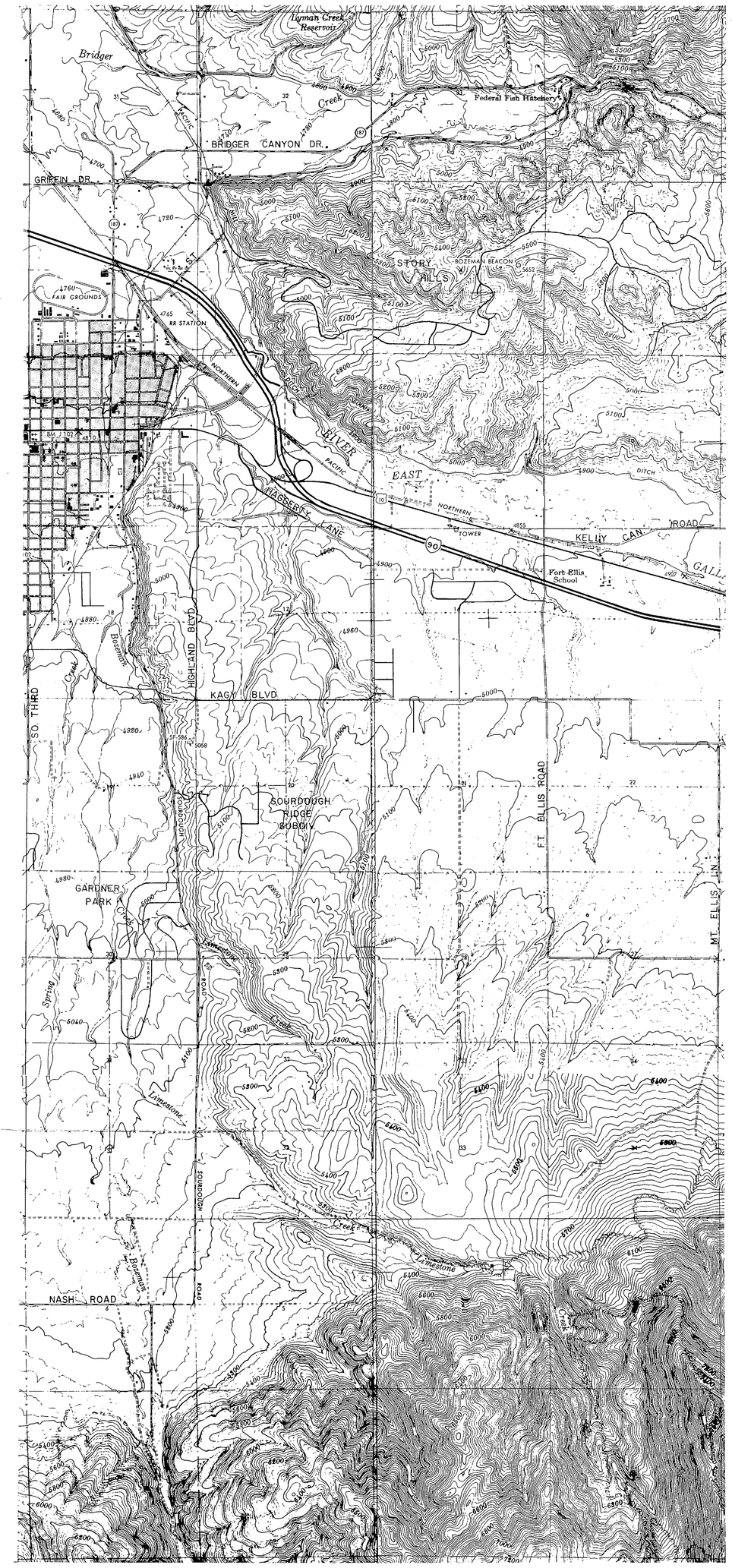
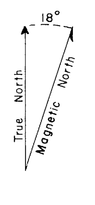
PLATE 1 GENERAL GEOLOGY

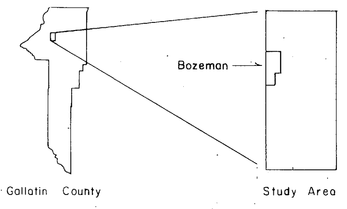
Southeast Margin of the Gallatin Valley



Base Map from U.S. Coast and Geodetic Survey
Upper Missouri River Basin Survey, 1947 & 1948
Map Numbers 87, 88, 97, & 98

Plates Drawn By Earl E Griffith MSU-1982





SCALE 1:24000

.5 0 1 KILOMETER

.5 0 1 MILE

6000 4000 2000 0 2000 4000 6000 FEET

CONTOUR INTERVAL 20 FEET

EXPLANATION

(Boundaries are approximate; statements are general; specific evaluations require on-site investigation.)

Hls — HOLOCENE - MANMADE DEPOSIT (DUMP): Uncompacted, poorly consolidated, solid-waste materials at sites generally in the floodplains of Bozeman Creek and the East Gallatin River; thickness varies from 2 to 10(+?) feet; may undergo differential settling; are occasionally flooded and contribute erosion materials when adjacent to stream banks; contribute to ground-water pollution.

HOLOCENE - MANMADE DEPOSIT (FILL): Unconsolidated, uncompacted deposits in abandoned gravel pits or low areas consisting of excavation material, demolition rubble, and construction waste; thickness from 2 to over 25 feet; possible differential settling from mixed materials and placement by end-dumping; erodible when placed in stream channel and may contribute to surface and ground water pollution.

Hls — HOLOCENE LANDSLIDE: Very recent (within 15 years) small scale slope failures from 2 to 6(+) acres in the Story Hills; materials include surfacial soil, unconsolidated Tertiary rocks and overturned and fractured Cretaceous bedrock; dip slope attitude; relatively shallow depth < 25 feet(?); ground water apparently confined by impervious layer; very high probability of natural reactivation.

Hrs — HOLOCENE ROCKSLIDE: Area in Bridger Canyon where active downslope movement of large masses of fractured and overturned Madison, Amsden and Big Snowy rocks resulted in road closure; events are generally unpredictable and extremely hazardous; such slope failure will continue until the natural angle of repose is reached or the slide toe is artificially and adequately weighted to stop movement,

Qya — QUATERNARY YOUNG ALLUVIUM: Unconsolidated interbedded clay, silt, sand, and gravel along stream channels; characterized by low relief, overbank flooding, water ponding, lateral channel migration and a very high ground-water table; ground-water yields of 10 to 60 gpm at depths of 45 to 200 feet.

Qls — QUATERNARY LANDSLIDE: Unconsolidated, unstratified, heterogeneous mixture of soil and Tertiary (Bozeman Group) materials; characterized by hummocky topography, steep slopes, active creep, and springs; shallow to ground water; deeply weathered; ground water yields of 25 gpm at sites near the toe.

Qf — QUATERNARY FAN: Younger, unconsolidated deposits of coarse and fine-grained materials derived from older Qac deposits; ground water potential good in stringers and lenses of gravel, and poor in the silt and clay fractions; 10(+) gpm at depths of 100 feet or more.

Qac — QUATERNARY ALLUVIUM AND COLLUVIUM: Unconsolidated deposits of mixed silt, sand, pebbles, cobbles, and boulders; associated with mountain front erosion and gravity transport; ground-water potential appears adequate with yields from 6 to 90 gpm at depths of 25 to 260 feet; overlain by deep deposits of silty loam soils on the Mount Ellis Fan surface.

Tb — TERTIARY BOZEMAN GROUP (UPPER HALF): Poorly stratified, variously consolidated tuffaceous siltstone, claystone, sandstone and conglomerate; rock units are vertically and laterally discontinuous; ground water appears adequate for single family dwellings, but may be marginal for larger withdrawls; potential for ground-water development in the Story Hills is further limited by the topography and small size of the recharge area; yields of 10 to 15 gpm at depths of 125 to 225 feet are noted on the north part of the Mount Ellis Fan.

Ta — TERTIARY - IGNEOUS ROCKS: Andesitic dike in Tb on the southeast flank of the Story Hills.

Kc — CRETACEOUS - LIVINGSTON GROUP, COKEDALE FORMATION: Andesitic siltstone and sandstone with claystone, tuff, bentonite and coal; lower part carbonaceous with some thin coal beds; local ground-water potential unknown; possible contamination from sulfide mineral constituents; bentonite layer impermeable to fluids and may act as a glide plane for landslides.

Ke — CRETACEOUS - EAGLE FORMATION: Well bedded sandstone and siltstone with intercalated coal and shale in the upper part; massive indurated, crossbedded sandstone with intercalated coal, siltstone and shale in lower part; units overturned and dip to the northwest; local ground-water potential unknown; water quality may be affected by sulfides.

Kcg — CRETACEOUS - COLORADO GROUP: Lower to mid-Cretaceous marine sand and shale; basal sandstone locally and quartzite, with lignite and betonite layers near the top, grading into calcareous, arkosic, and glauconitic sandstones and shales in the upper part; found locally east of Bridger Creek-Bear Canyon fault in Story Hills; permeability limited by bentonite layer; uncertain ground-water potential, but sand units would provide best yeilds and quality; possible contamination from sulfides.

Kk — CRETACEOUS - KOOTENAI FORMATION: Red and green sandstone, mudstone and fresh water fossiliferous limestone; basal chert pebble conglomerate; salt and pepper sandstone and purple shale at the top; ground-water potential unknown within study area, but sufficient domestic yeilds of iron impaired water obtained in the Bear Canyon area to the southeast

Jm — JURASSIC - MORRISON FORMATION: Variegated shale, siltstone, mudstone, limestone, and massive quartzose sandstone; black shale near the top; generally covered; ground-water potential unknown, but presumably limited by fine fractions.

Je — JURASSIC - ELLIS GROUP: Cliff-forming calcareous, glauconitic sandstone with abundant fossil trash at top; olive-gray shale, bluish-gray limestone and cliff-forming oolitic limestone in middle unit; and an olive-gray shale, fossiliferous argillaceous limestone and multicolored siltstone in the lower part; units truncated by Bridger Creek-Bear Canyon fault in Sec. 34, T.1 S., R.6 E.; ground-water potential unknown.

IPq — PENNSYLVANIAN - QUADRANT QUARTZITE: Pale yellow to white pure quartz sandstone or quartzite, locally calcareous; some thin dolomitic beds in the middle; interbedded thin quartz sandstone and light-gray dolomite in the lower part; relatively resistant to weathering in quartz units; ground-water potential unknown, but yeilds could prove adequate in fractured and jointed portions of the sandstone fraction.

MPa — PENNSYLVANIAN - MISSISSIPPIAN, AMSDEN FORMATION: Dolomitic, calcareous sandstone and siltstone in uppper part; argillaceous limestone in middle part; massive sandstone and red calcareous siltstone and limestone in lower part (generally concealed); limited competency in the fine-grained fractions; ground-water potential probably limited because of low permeability.

Mbs — MISSISSIPPIAN - BIG SNOWY GROUP: Red siltstone, with purple and cream colored dolomite; basal dolomite and dolomite or limestone breccia; exposed as a result of Bridger Canyon Rockslide; ground-water potential unknown.

Mmc — MISSISSIPPIAN - MISSION CANYON FORMATION: Massive cliff-forming, gray, fossiliferous limestone and colomite with chert or black silty shale at base; ground-water potential best in fracture zones or at fault intersections.

Mm — **Mlp** — MISSISSIPPIAN - LODGEPOLE FORMATION: Thin to medium bedded cliff-forming fossiliferous limestone and dolomite with chert or black silty shale at base; ground-water potential best in fracture zones or at fault intersections.

Dtf — DEVONIAN - THREE FORKS SHALE: Black and olive-gray shale with thin beds of dolomite in upper part; olive-gray and reddish-brown, calcareous, fossiliferous shale in lower part; mostly concealed; ground-water potential unknown, but probably limited due to shale fractions.

Dj — DEVONIAN - JEFFERSON DOLOMITE: Massive, cliff-forming, olive-gray, fetid dolomite in upper part and brownish-gray limestone and dolomite in lower part; limited ground-water potential at fractured zones; possible in high porosity dolomite; water quality may be affected by oil and hydrogen sulfide contamination.

Ob — ORDOVICIAN - BIGHORN DOLOMITE: Massive, cliff-forming mottled yellow and gray dolomite; found in the southern part of the study area; ground-water potential unknown.

Cs — CAMBRIAN - SNOWY RANGE FORMATION: Upper gray-green fissile shale, with interbedded yellow calcareous siltstone and sandstone; middle fine-grained, thin-bedded, dense limestone and limestone pebble conglomerate with interbedded green shale. Columnar limestone at base; mostly concealed; ground-water potential unknown, but probably low.

Cp — CAMBRIAN - PILGRIM LIMESTONE: Massive cliff forming, oölitic, mottled, dolomitic limestone with flat and edgewise pebble conglomerate; interbedded green shale and glauconitic limestone; ground-water potential low; adequate domestic quantities possible near upper contact or in fractures.

Cps — CAMBRIAN - PARK SHALE: Green and maroon fissile shale with thin beds of argillaceous limestone, siltstone and sandstone; mostly concealed; ground-water potential unknown; adequate quantities possible in sand units.

Cm — CAMBRIAN - MEAGHER LIMESTONE: Thin-bedded, silty, medium to dark gray dense limestone and yellowish-gray dolomite; locally dolomitic; low ground-water potential.

Cw — CAMBRIAN - WOLSEY SHALE: Greenish-gray calcareous, micaceous shale and mudstone with thin beds of limestone, mostly concealed; very low ground-water potential.

Cf — CAMBRIAN - FLATHEAD QUARTZITE: Red, pale orange and white sandstone; locally quartzitic; conglomeratic in lower part locally; ground-water potential unknown, but possible at lower contact with Precambrian igneous rocks.

pCg — PRECAMBRIAN ROCKS: Gneiss, Schist and granite pegmatite dikes locally; ground-water potential very low except in fractures.

LEGEND

Contact ————————?
Dashed where approximately located; dotted where concealed.

Normal Fault ——— U ——— D ———?
Dashed where approximately located; dotted where concealed; U, upthrown side; D, downthrown side; queried where doubtful.

Thrust Fault - Overturned Units ——————?
Sawteeth on side of upper plate; dashed where approximately located; dotted where concealed; queried where doubtful.

25 — Strike and dip of beds.

70 — Strike and dip of overturned beds.

Qls — Landslide

Toe — Landslide location; headscarp and extent of toe dashed where approximate.

Geology modified after: McMannis, 1955
Roberts, 1964
Glancy, 1966