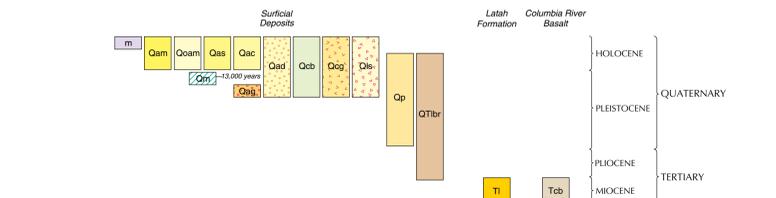


SURFICIAL GEOLOGIC MAP OF THE JULIAETTA QUADRANGLE, NEZ PERCE COUNTY, IDAHO

Kurt L. Othberg, Roy M. Breckenridge, and Daniel W. Weisz
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CORRELATION OF MAP UNITS



INTRODUCTION

The surficial geologic map of the Juliaetta quadrangle identifies earth materials on the surface and in the shallow subsurface. It is intended for those interested in the area's natural resources, urban and rural growth, and private and public land development. The information relates to assessing diverse conditions and activities, such as slope stability, construction design, sewage drainage, solid waste disposal, and ground-water use and recharge.

The geology was intensively investigated during a one-year period. Natural and artificial exposures of the geology were examined and selectively sampled. In addition to field investigations, aerial photographs were studied to aid in identifying boundaries between map units through photogeologic mapping of landforms. In most areas map-unit boundaries (contacts) are approximate and were drawn by outlining well-defined landforms. It is rare that contacts between two units can be seen in the field without excavation operations which are beyond the purpose and scope of this map. The contacts are inferred where landforms are poorly defined and where lithologic characteristics grade from one map unit into another. The precision of a contact with respect to actual topography also depends on the accuracy and scale of the topographic base. Details depicted at this scale, therefore, provide an overview of the area's geology. Further intensive analyses at specific locations should be arranged through independent geotechnical specialists.

The prominent feature on the map is the Potlatch River valley which drains mountains north of the quadrangle and dissects this portion of the Columbia Plateau. The canyons of the river and its tributaries expose the plateau's Miocene basalt flows of the Columbia River Basalt Group and the underlying granitic and metamorphic basement rocks. During the Miocene, the basalt flows filled ancestral stream valleys eroded into the basement rocks. The flows created volcanic embayments that now form the eastern edge of the Columbia Plateau where the relatively flat region meets the mountains. Sediments of the Latah Formation are interbedded with the basalt flows, and landslide deposits occur where major sedimentary interbeds are exposed along the valley sides. Loess that forms the characteristic rolling hills of the Palouse is generally thinning from east to west, and in the east side of the quadrangle a weathered and slightly eroded basalt plateau surface is mantled with thin, discontinuous loess. In the late Pleistocene, multiple Lake Missoula Floods inundated the Clearwater River valley, locally depositing silt, sand, and ice-rattled pebbles and cobbles in the lower elevations of the canyons.

The bedrock geology of this area is mapped by Garwood and others (1999) and Lewis and others (2001) and shows details of the basement rocks and the Miocene basalt flows and sediments. The bedrock maps' cross sections are especially useful for interpreting subsurface conditions suitable for siting water wells and assessing the extent and limits of ground water.

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

- m Made ground (Holocene)**—Large-scale artificial fills composed of excavated, transported, and employed construction materials of highly varying composition, but typically derived from local sources.
- Qam Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Clearwater River that are actively being formed on a seasonal or annual basis. Two grain-size suites are typically present: Well-sorted and rounded sandy gravel of river bars and islands, and coarse sand forming thin shoreline deposits. The gravel includes clasts of basaltic, granitic, and metamorphic rocks. Mainstream alluvium is called riverwash-saunders in the soil survey (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).
- Qoam Older alluvium of mainstreams (Holocene)**—Fine- to coarse-grained bedded sand and silt/sand overlying river channel gravel. These alluvial deposits form one or more levels of old point bars and flood-plain deposits that are younger than the Lake Missoula Floods backwater deposits, but older than alluvium of the present river. Surface heights above present mean water level range from 17 to 45 feet. Relative heights and soil characteristics suggest a late Holocene age, and the lower of these surfaces may have been inundated by the highest seasonal flood waters before the stream flows were controlled by Dworshak dam. The sand overlying channel gravel is several feet thick. Soils developed in older mainstream alluvium include the Lapwai, Bridgewater, and Uhlberg soil series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).
- Qas Alluvium of side streams (Holocene)**—Channel and flood-plain deposits of the Potlatch River and other tributaries of the Clearwater River. Primarily coarse channel gravel deposited during high-energy stream flows. Subrounded to rounded pebbles, cobbles, and boulders of basalt in a sand matrix. Moderately stratified and sorted. Silty coarse sand overbank deposits occur along margins of the flood plain. Includes intercalated colluvium and debris-flow deposits from steep side slopes. Soils developed in side-stream alluvium include the Lapwai, Bridgewater, Joseph, and Tomball series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999) and Aquic Xerofluvents (Barker, 1981).
- Qac Alluvium and colluvium (Holocene)**—Stream, slope-wash, and gravity deposits. Stream deposits typically are thin and intertongued with laterally thickening deposits of slope wash and colluvium derived from local loess deposits and weathered basalt. Soils developed in these deposits include the Latah series (Barker, 1981; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).
- Qad Alluvial-fan and debris-flow deposits (Holocene and Pleistocene)**—Primarily crudely bedded, poorly sorted brown muddy gravel shed from canyon slopes of basalt colluvium. Gravel is composed of subangular and angular pebbles, cobbles, and boulders of basalt in a matrix of granules, sand, silt, and clay. May include beds of silt and sand derived from reworked loess, Mazama ash, and Lake Missoula Flood backwater deposits. Thickness varies, but typically ranges from 6-50 feet. Fans composed of alluvium and debris-flow deposits commonly occur in canyon bottoms below steep debris-flow chutes (see Symbols).
- Qcl Landslide deposits (Holocene and Pleistocene)**—Poorly sorted and poorly stratified angular basalt cobbles and boulders mixed with silt and clay. Landslide deposits include debris slides as well as blocks of basalt, sedimentary interbeds, and pre-Miocene rocks that have been rotated and moved laterally. Debris slides mainly composed of unstratified, unsorted gravel rubble in a clayey matrix. In addition to the landslide deposit, the unit may include the landslide scarp and the headwall (steep area adjacent to and below the landslide scarp from which material broke away (see Symbols). The headwall area may include talus formed after landslide movement. Localized landslides in canyons is controlled by the presence of sedimentary interbeds, the hydrogeologic regime, and the occurrence of basalt overlying clay-rich weathered basement rocks. The largest landslides occur where canyon-cutting has exposed landslide-prone sediments in topography. Slope failures have occurred where the fine-grained sedimentary interbeds and weathered basement rocks are saturated by ground water moving toward the valleys. This relationship is so prevalent that the major sedimentary interbeds may be traced by locating landslide deposits along the valley sides. The landslides range in age from ancient, relatively stable features, to those that have been active within the past few years. The factors that cause landslides have been prevalent in the region for thousands of years. The frequency of landsliding may have been greater in the Pleistocene. Today, initiation and reactivation of landslides is closely tied to unusual climatic events and land-use changes. Even small landslide activity on the upper parts of canyon slopes can transform into high energy debris flows that endanger roads, buildings, and people below (see Debris-flow chute under Symbols). Landslide debris is highly unstable when modified through natural variations in precipitation, artificial cuts, fills, and changes to surface drainage and ground water.
- Qcb Colluvium from basalt (Holocene and Pleistocene)**—Primarily poorly sorted brown muddy gravel composed of angular and subangular pebbles, cobbles, and boulders of basalt in a matrix of silt and clay. Emplaced by gravity movements on steep-sided canyons and gullies cut into Columbia River basalt. Includes outcrops of basalt that are common on steep, dry, southerly aspects where colluvium is thinner and the more erosion-resistant basalt flows form laterally traceable ledges. More gently sloping areas are mantled with thin loess (typically 1-5 feet thick), especially near boundaries with loess (Qp, and QTbr). Distribution and thickness of colluvium is dependent on slope aspect, upper and lower slope position, basalt and sediment stratigraphy, and association with landslides. Colluvium is thin and associated with many basalt outcrops on dry, southerly facing slopes, and may exhibit patterned-ground features (see Symbols). Colluvium is thicker on north- and east-facing slopes, and is associated with landslides (Qcl) and debris-flow chutes (see Symbols), especially where more moisture is retained and where sedimentary interbeds are present. Areas of thicker colluvium have fewer outcrops of basalt, and the surface may have a patterned ground of crescent-shaped lobes of colluvium, probably relics of Pleistocene solifluction. Unit includes landslides too small to map separately, and talus below cliffs and ledges of basalt. Colluvium typically increases in thickness toward the base of slopes where it intertongues with alluvium in valley bottoms. May include all of valley-bottom sediment where streams have little discharge or are ephemeral. Soils developed in basalt colluvium include the Bluegum, Flybow, Gwin, Ketterback, Keuterville, Klickson, and Livinville series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).
- Qcg Colluvium from granitic and metamorphic rocks (Holocene and Pleistocene)**—Primarily poorly sorted muddy gravel composed of angular and subangular pebbles, cobbles, and boulders in a matrix of sand, silt, and clay. Emplaced by gravity movements in the canyons of Fine Creek and the Middle Potlatch River where there are outcrops of pre-Tertiary granitic rocks and quartzite. Includes local debris-flow deposits and isolated rock outcrops. Includes colluvium and debris-flow deposits from the upslope basalt section, and areas of thin loess (typically less than 5 feet). Grades laterally, as slope gradients decrease, into areas where thin loess and clayey saprolite mantle bedrock. Distribution and thickness of colluvium depend on slope, aspect, upper and lower slope position, and association with landslide deposits. Colluvium typically increases in thickness toward the base of slopes and may intertongue with alluvium in valley bottoms. Soils developed in the colluvium include the Bluegum, Flybow, Gwin, Ketterback, and Keuterville series (Barker, 1981; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).
- Qc Lake Missoula Floods backwater deposits (Pleistocene)**—Rhythmites deposited when backwaters from Lake Missoula Floods inundated the valleys of the Clearwater River and the lower Potlatch River. Primarily alternating thin beds of gray sand and pale brown silt. Cross-bedded, dark-gray, basalt-rich granule sand and coarse sand may be present at the base. Includes cut and fill structures and sandy clastic dikes. Similar depositional environment, sedimentology, and age as Lake Missoula Floods rhythmites of eastern Washington (Smith, 1993; Waitt, 1980, 1985). Commonly reworked into sandy, silty colluvium. Found locally up to 1,200 feet in elevation, the approximate maximum flood level. Mapped as a pattern where sandy, silty rhythmites mantle lower canyon slopes of basalt colluvium (Qcb), deposits of debris flows and alluvial fans (Qad), and Pleistocene alluvium (Qc).

Downstream at Lewiston in the Snake River valley, Lake Missoula Floods backwater deposits overlie Bonneville Flood gravel. In the Clearwater River drainage, Bonneville Flood deposits have not been recognized. Lake Missoula Floods temporarily reversed the course of the Clearwater and Potlatch rivers within the area of backwater inundation (see Flow direction in Symbols). Soils developed in Lake Missoula Floods deposits include the Chard and Uhlberg series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qad Alluvial gravel (Pleistocene)—Well-rounded pebble and cobble gravel of remnant point bar approximately 60 feet above the Clearwater River. Gravel poorly exposed owing to mantle of Lake Missoula Floods backwater sediments (Qm). Intertongues with colluvium and debris-flow deposits at toe of canyon slopes. The gravel was deposited by the ancestral Clearwater River prior to the latest Lake Missoula Floods and may have formed during periodic greater discharges of the river during the Wisconsin glaciation. Soils mapped in areas of Pleistocene alluvial gravel include the Uhlberg series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Op Palouse Formation (Holocene and Pleistocene)—Silty and clayey loess of the Palouse hills that are prevalent in adjoining quadrangles to the west where the Palouse Formation blankets Miocene basalt flows of the eastern Columbia Plateau and forms hills of loess up to 200 feet thick (Othberg and others, 2001a, 2001b). In the Palouse hills, many layers of loess represent periods of rapid deposition from air-borne dust transported into the Palouse from the Pasco basin. Buried soils mark the tops of most depositional units, which form complex surface and subsurface patterns that are discontinuous and difficult to map. Thicker loess includes middle- to early-Pleistocene deposits that are locally exposed through erosion or in artificial cuts. Where loess is thin, it is mostly Holocene and late Pleistocene in age. Previous usage mostly restricted the Palouse Formation to the Pleistocene (see Newcomb, 1961; Kerber, 1966; Richmond and others, 1965; Ringe, 1968; Griggs, 1973; Foley, 1982; Schuster and others, 1997). Holocene loess, however, was included in the Palouse Formation by Hooper and Webster (1982) and Hooper and others (1985). Along boundaries between Palouse hills and canyon slopes, thick loess gradually thins into a patterned ground formed in basalt colluvium (Qcb) at the upper surface of basalt units (see Symbols). The soils developed in the Palouse Formation form a pattern that reflects the complex interaction of erosion and deposition of loess throughout the Quaternary. The Palouse Formation eastward and grades into loess mantling basalt residuum (QTbr). Soils developed in the Palouse Formation include the Nafi, Palouse, and Thutina series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

QTbr Loess mantling basalt residuum (Quaternary and Tertiary)—Thin Quaternary loess mantling Tertiary residuum on remnant surfaces of the basalt plateau. Loess 1-6 feet thick mantles basalt that is spheroidally weathered and locally forms a zone of thoroughly decomposed clayey saprolite. Most weathered spheroids have indurated cores of basalt that grade outward into yellowish and reddish sand, silt, and clay. The basalt residuum is laterally discontinuous, probably as a result of erosion of the Miocene land surface, so that near drainages and canyon rims fresh basalt is often near or at the present surface. The weathering of the basalt probably can be attributed to the eastward increase in precipitation and to the Miocene age of this remnant basalt surface. Includes gravelly basalt colluvium on local steeper slopes where stream incision has exposed the local deposits of this alluvium (see Symbols). The loess in this unit includes the Larkin, Nafi, Palouse, Southwick, and Thutina series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Note: The following units are shown only in cross section:

LATAH FORMATION
The Latah Formation rocks were deposited along the margins of and within the Columbia basin during middle- to late-Miocene time. The Latah Formation comprises the sedimentary interbeds within the Columbia River Basalt Group. Their presence represents time intervals between eruptions of lava when sediments accumulated in lakes, streams, and local basins.

T1 Latah Formation sedimentary interbeds (Miocene)—Bedded silt, clay, and minor sand. The distribution of sedimentary interbeds controls the location of most landslides in the area (Qcl). Ground water moving into and within the basalt and interbed sections can saturate the silts and clays and cause landsliding. Unstable slopes commonly occur where valley incision has exposed interbeds in steep-sided canyons.

COLUMBIA RIVER BASALT GROUP
Tcb Columbia River Basalt, Undifferentiated (Miocene)—Comprises flows of the Saddle Mountains, Wanapan, Grande Ronde, and Imnaha Basalts of the Columbia River Basalt Group.

- ### SYMBOLS
- Contact: Line showing the approximate boundary between one map unit and another. The apparent ground surface is 80 feet at this scale (1:24,000).
 - Landslide scarp and headwall: Ticks show top of scarp.
 - Debris-flow chute in canyons. High-energy, short duration floods and debris flows may occur in these chutes in response to severe climatic conditions, such as thunderstorms and rain-on-snow events. Debris flows can also be triggered by landslides. These events are historically infrequent, dependent on weather, with a recurrence cycle on the order of years to decades. The most prominent debris-flow chutes are shown on the map, but any step-gradient valley sides and canyon bottoms have the potential for these catastrophic events. Thin and discontinuous alluvial-fan and debris-flow deposits (Qad) may be present, but are not mappable at this scale.
 - Flow direction of Lake Missoula Floods backwater inundation.
 - Patterned ground associated with the weathered, differentially eroded surface of basalt. Pattern consists of regularly spaced, subround fracture system in basalt with silty mounds between fractures. Silty mounds give way to fractured basalt downslope, but thicker upslope where they gradually obscure the fracture pattern and merge with loess deposits or weathered basalt. Probably formed by stripping of loess from the basalt surface through Pleistocene periglacial processes. Original patterned-ground features destroyed by field plowing in many locations.

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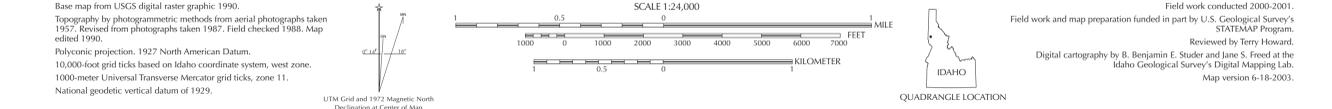
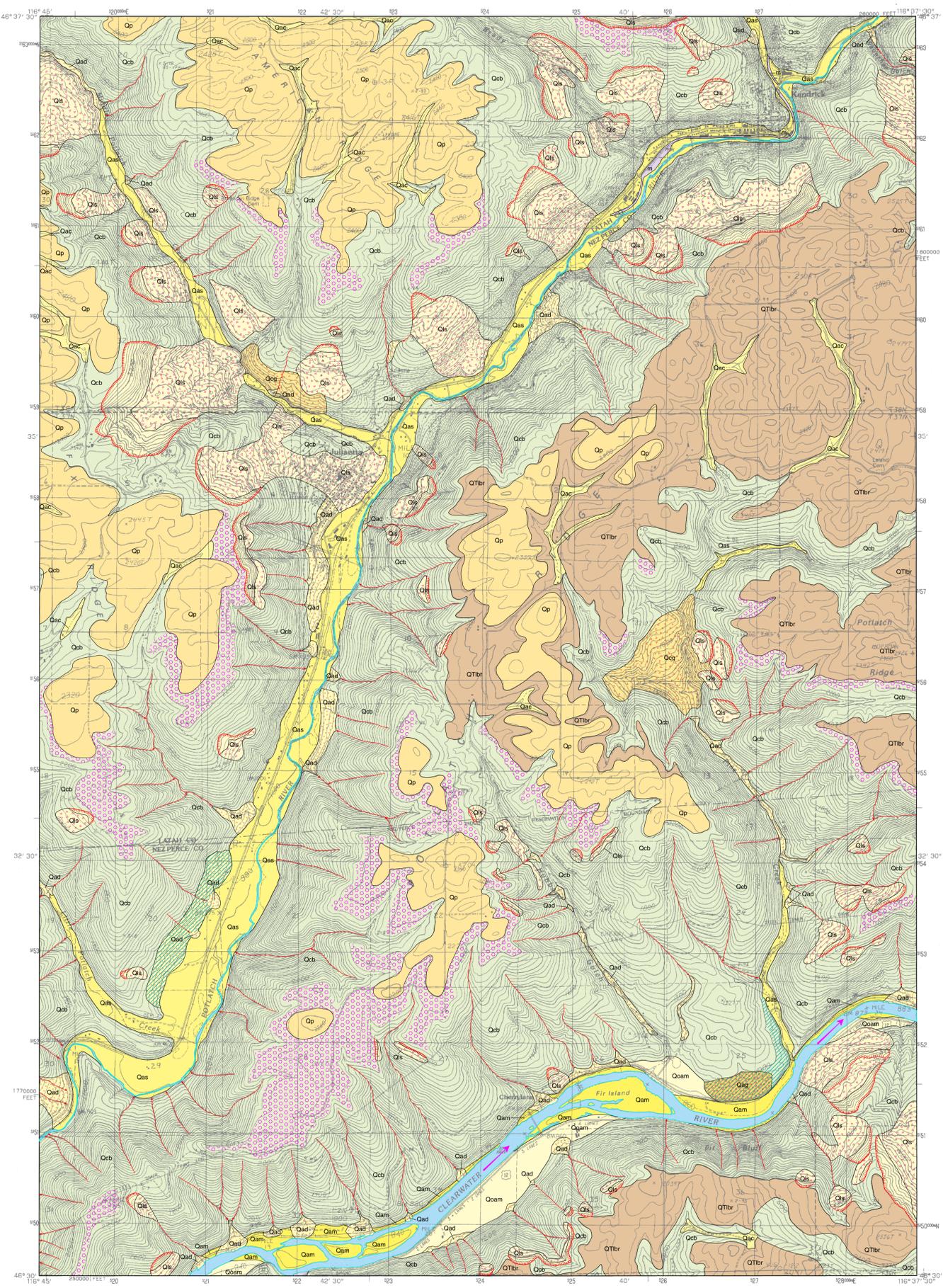
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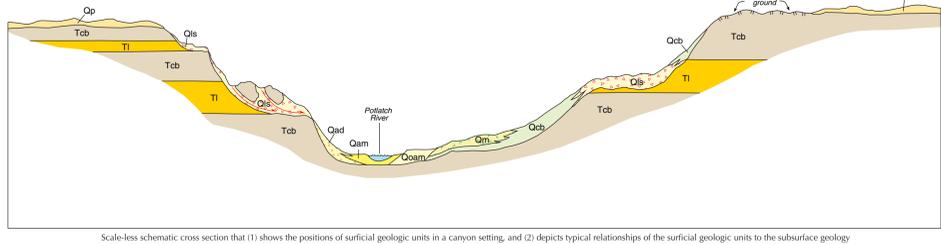
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Disclaimer: This Digital Web Map is an informal report and may be revised and formally published at a later time. Its content and format may not conform to agency standards.



Base map from USGS digital raster graphic, 1990.
Topography by photogrammetric methods from aerial photographs taken 1957. Revised from photographs taken 1987. Field checked 1988. Map edited 1990.
Polyconic projection, 1927 North American Datum.
10,000-foot grid ticks based on Idaho coordinate system, west zone.
1000-meter Universal Transverse Mercator grid ticks, zone 11.
National geodetic vertical datum of 1929.

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Scale-less schematic cross section that (1) shows the positions of surficial geologic units in a canyon setting, and (2) depicts typical relationships of the surficial geologic units to the subsurface geology.