Surficial Geologic Map of the Kamiah Quadrangle, Idaho and Lewis Counties, Idaho

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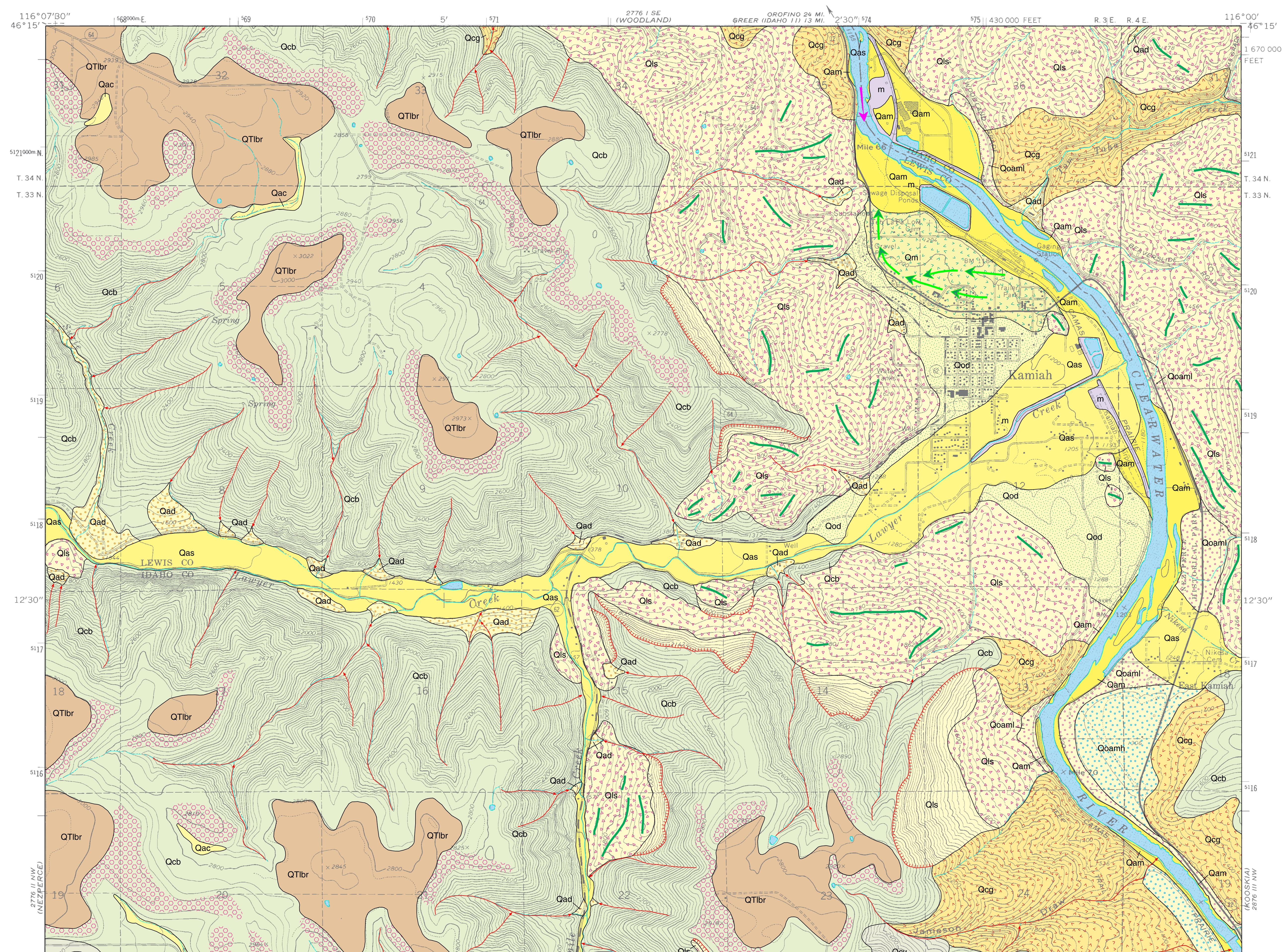


Base map scanned from USGS film-positive base, 1967.

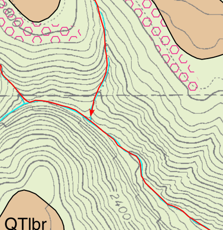
Topography by photogrammetric methods from aerial photographs taken 1966. Field checked 1967.

1927 North American Datum.

Projection and 10,000-foot grid ticks based on Idaho coordinate system, west zone.

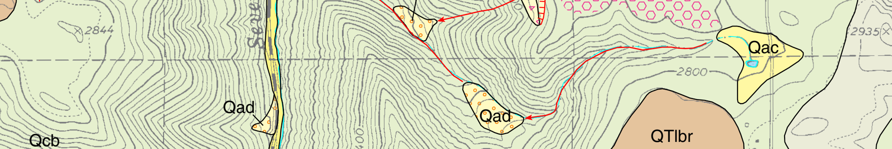
1000-meter Universal Transverse Mercator grid ticks, zone 11.

National geodetic vertical datum of 1929.

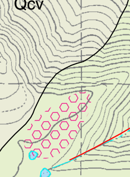


UTM Grid and 1967 Magnetic North Declination at Center of Map

SCALE 1:24,000



Contour interval 40 feet
Supplementary contour interval 20 feet



QUADRANGLE LOCATION

Field work conducted 2002.

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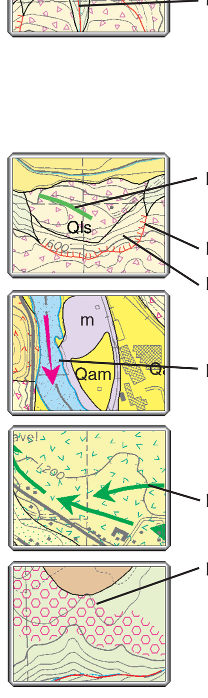
Digital cartography by Loudon R. Stanford and B. Benjamin E. Studer at the Idaho Geological Survey's Digital Mapping Lab.

Map version 6-26-2003.

SYMBOLS



Contact: Line showing the approximate boundary between one map unit and another. The apparent ground width of the line representing the contact is about 80 feet at this scale (1:24,000).

Debris-flow chute in canyons: Thin and discontinuous alluvial-fan and debris-flow deposits (*Qad*) may be present, but are not mappable at this scale. 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 steep-gradient valley sides and canyon bottoms have the potential for these catastrophic events.

Landslide block: Green line traces crest of block. Primarily large, nearly intact blocks that have been rotated and moved downslope from a steep, headwall-exposed section of basalt.

Landslide scarp: Ticks show top of scarp.

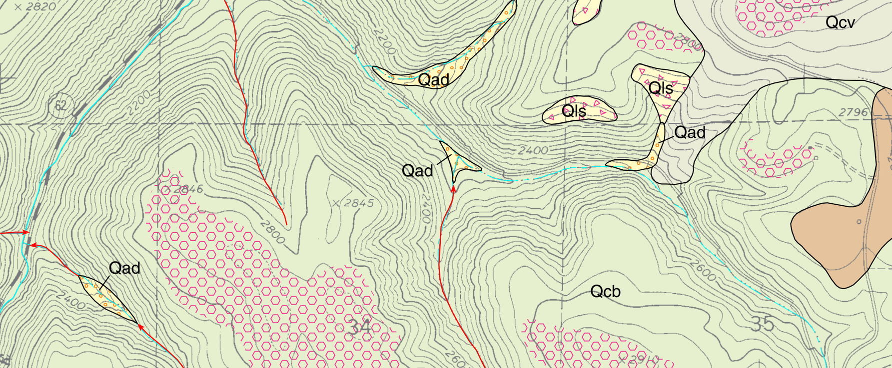
Landslide headwall.

Flow direction of Missoula Floods backwater inundation.

Former river channel cut across Lake Missoula Floods backwater deposits.

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 thicken 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.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

INTRODUCTION

The surficial geologic map of the Kamiah 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 collected. 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.

Kamiah is located in the canyon of the Clearwater River at the mouth of Lawyer Creek. The Clearwater River and Lawyer Creek have cut deep canyons into the Camas Prairie, a portion of the Columbia River Plateau which is composed of Miocene basalt flows of the Columbia River Basalt Group. The canyons expose pre-Miocene granitic and metamorphic rocks that compose the underlying basement rocks and the nearby Northern Rocky Mountains. During the Miocene, lava flows of the Columbia River Basalt Group filled ancestral stream valleys eroded into the basement rocks. The basalt flows created volcanic embayments that now form the eastern edge of the Columbia River Plateau where the relatively flat region meets the mountains. South of Lawyer Creek, the basalt flows surrounded and partly buried buttes composed of the Kamiah volcanic rocks. 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. Large areas of landslide deposits dominate the geology around Kamiah, and are the principal explanation for the unusual width of the Clearwater canyon. During the late Pleistocene multiple Lake Missoula Floods inundated the Clearwater River valley and Kamiah was approximately the upstream limit of the backwater, and the location of a delta built into the backwater by the Clearwater River and Lawyer Creek. Pleistocene loess mantles the weathered and slightly eroded plateau.

SURFICIAL DEPOSITS

m — **Made ground (Holocene)**—Artificial fills composed of excavated, transported, and emplaced 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 gravels 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 in the Kooskia-area soil survey (Webb and others, 1971), and includes the Bridgewater and Joseph soil series in Lewis County (Hahn, 2001) and the Nicodemus soil in the Idaho County (western part) soil survey (Barker, 1982).

Older alluvium of mainstreams (Holocene and Pleistocene)—Primarily stratified sand and gravel of one or more levels of old point bars and terrace remnants (*Qoaml* and *Qoamh*) that are older than alluvium of the present day Clearwater River. Surface heights range from 10 to 100 feet above present mean water level. Interfingers with colluvium and debris-flow deposits at toe of canyon slope. At the confluence of the Clearwater River and Lawyer Creek the unit includes a delta facies (*Qod*).

Qoaml — **Lower-position mainstream facies (Holocene)**—Surface heights are 10-40 feet above present river level. Weakly developed soil lacking a B horizon (Nicodemus series of Webb and others, 1971) suggests a Holocene age.

Qoamh — **Higher-position mainstream facies (Pleistocene)**—Surface heights are 40-100 feet above present river level. Thin loess mantle and moderately developed soil with a Bt horizon (Jacket variant soil of Barker, 1982, and Jacknife loamy variant of Webb and others, 1971) suggest a Pleistocene age. Unit merges with alluvial-fan and delta facies at the confluence with Lawyer Creek.

Qod — **Higher-position delta facies (Pleistocene)**—Formed at the confluence with Lawyer Creek. Unit is sandy in contrast to the gravelly mainstream facies (*Qoamh*) upstream of the confluence. Partly buries landslide debris, but remnant blocks of landslides locally protrude above the alluvial deposits. The unit occurs just upstream of Lake Missoula Floods rhythmites, and ranges in elevation from 1220 to 1280 feet, which is close to and slightly above the highest observed elevation of Lake Missoula Floods ice-rafted gravel in the Clearwater River valley downstream. The sandy grain size strongly contrasts with the coarse-gravel deposits of Lawyer Creek and the Clearwater River, reflecting deposition in lower-energy water, such as Lake Missoula Floods backwater. A Pleistocene age is further suggested by a thin loess surface and a Bt horizon in the soil (Jacket variant of Barker, 1982, and Uhlig series of Hahn, 2001). The Uhlig soil mapped in Kamiah (Hahn, 2001), is similar to the Newlig soil of the Clearwater-area soil survey which "formed in Missoula Flood deposits" (Glenn Hoffman, written comm., 2001, and USDA-NRCS Soil Survey Division, Official Soil Series Descriptions,

Qas — **Alluvium of side streams (Holocene)**—Channel and flood-plain deposits of Lawyer Creek 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. Includes intercalated colluvium and debris flow deposits from steep side slopes. Soils developed in side-stream alluvium include Bridgewater, Itzee, Lapwai, Nicodemus, Nicodemus variant cobbly loam, Nicodemus variant loam, and Tombeall series (Barker, 1982; Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999; Webb and others, 1971).

Qac — **Alluvium and colluvium (Holocene)**—Stream, slope-wash, and gravity deposits. Predominantly beds of silt, clay, sand, and gravel derived from erosion of adjacent units. Stream deposits typically are thin and interfinger with laterally thickening deposits of slope wash and colluvium derived from local loess deposits and weathered volcanic rocks. Soils developed in these deposits include the Jacknife, Kooskia, Latahco, Lovell, Potlatch, and Wilkins series (Barker, 1982; Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999; Webb and others, 1971).

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 and Mazama ash. 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).

Qls — **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 (see *Landslide block* under Symbols), sedimentary interbeds, and pre-Miocene rocks that have been rotated and moved downslope. 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 without pattern, adjacent to and below the landslide scarp) from which material broke away (see Symbols). The headwall area may include talus formed after landslide movement. Location of landslide deposits 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 to steep topography. Slope failures have occurred where the fine-grained sedimentary interbeds and weathered clay-rich basement rocks are saturated by ground water moving toward the valleys. 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. Grades into more gently sloped upland areas mantled with thin loess and clayey residuum (typically 1-5 feet thick), especially near contacts with loess and basalt residuum (*QTlbr*) and colluvium from Kamiah volcanic rocks (*Qcv*). 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) including periglacial stone stripes. Colluvium is thicker on north- and east-facing slopes, and is associated with landslides (*Qls*) 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 relicts 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 interfingers 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 Bluesprin, Ferdinand, Flybow, Gwin, Hooverton, Jacket, Kettenback, Klicker, Klickson, Meland, Melhorn, Riggins, and Suloaf series (Barker, 1982; Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999; Webb and others, 1971).

Qcv — **Colluvium from Kamiah volcanic rocks (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. Derived from felsic volcanic rocks that include rhyolite, vitrophyre, ash-flow tuff, and welded tuff (Kauffman, 2003). Emplaced by gravity movements on slopes of buttes. Includes rock outcrops where colluvium is thinner and more erosion-resistant layers of volcanic rocks form laterally traceable ledges. Grades into more gently sloped areas that are mantled with thin loess and clayey residuum (typically 1-6 feet thick), especially near contacts with loess and basalt residuum (*QTlbr*). Distribution and thickness of colluvium is dependent on slope aspect, upper and lower slope position, and lithology of rocks from which colluvium is derived. Commonly exhibits patterned-ground features (see Symbols). Soils developed in these colluvial deposits include the Ferdinand, Flybow, Riggins, Meland series (Barker, 1982).

Qcg — **Colluvium from granitic 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 canyons where there are outcrops of granite and gneiss. Includes local debris-flow deposits and isolated outcrops. May include areas of thin loess, and colluvium and debris-flow deposits from upslope basalt sections. Grades laterally, as slope gradients decrease, into areas where thin loess mantles 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 interfinger with alluvium in valley bottoms. Soils developed in granitic colluvium include the Dragnot, Johnson, and Yakus series (Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999; Webb and others, 1971).

Qm — **Lake Missoula Floods backwater deposits (Pleistocene)**—Rhythmites deposited when Lake Missoula Floods backwaters inundated the Clearwater River valley. Primarily alternating thin beds of gray sand and pale brown silt. Similar depositional environment, sedimentology, and age as Lake Missoula Floods rhythmites of eastern Washington (Smith, 1993; Waitt, 1980, 1985). Lake Missoula Floods temporarily reversed the course of the Clearwater River within the area of backwater inundation (see *Flow direction* in symbols). At times of maximum flood, rhythmites were deposited in west Kamiah at an elevation close to 1,200 feet. As the rhythmites were being deposited, the Clearwater River and Lawyer Creek formed a delta in the flood backwater (see *Qod* above). Soils developed in Lake Missoula Flood backwater deposits include the Uhlig series (Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

QTlbr — **Loess and basalt residuum (Quaternary and Tertiary)**—Thin Quaternary loess mantling Tertiary residuum on remnant surfaces of the basalt plateau. Loess 1-10 feet in thickness mantles basalt which ranges from angular to spheroidally weathered. Residuum includes clay-rich weathered felsic rocks near the contact with colluvium from Kamiah volcanic rocks (*Qcv*). Loess is thinnest on steep, south-facing slopes where sheet wash erosion is common. In areas where angular basalt is found, the basalt is commonly broken clasts of weathered rock. Most weathered spheroids have indurated cores of basalt which grade outward into yellowish and reddish color. Fresh basalt is often near or at the present surface. Where loess is thin, spheroidally weathered basalt boulders are seen in man made piles and lag boulders of weathered spheroids are encountered in plowed fields. Includes gravelly basalt colluvium on local steeper slopes where stream incision has occurred, and local deposits of thin alluvium to small in area to show at this scale. Soils in the unit include the Chicane, Fenn , Mohler, Nez Perce, and Ulhorn series (Barker, 1985; Hahn, 2001; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

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