Surficial Geologic Map of the Lewiston Orchards South Quadrangle and Part of the Asotin Quadrangle, Nez Perce County, Idaho

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2003

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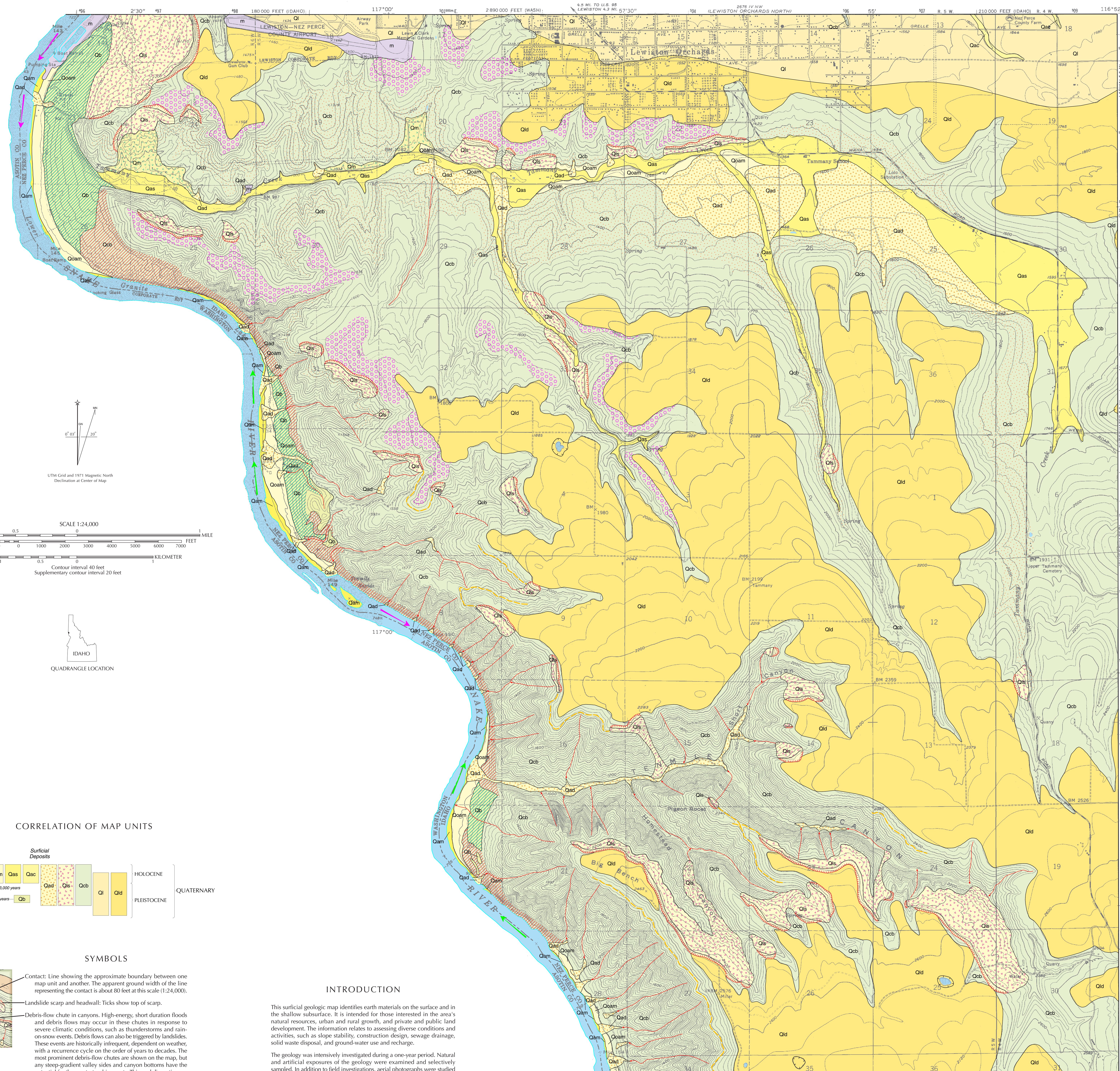
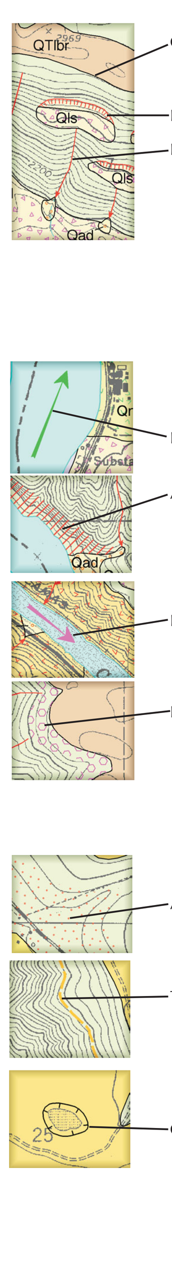


SYMBOLS



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).

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 steep-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 Bonneville Flood.

Area of Bonneville Flood-scoured basalt.

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 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.

Area of Tertiary sedimentary interbed. Adapted from Hooper and others (1985) or identified through interpretations of aerial photographs. Shown because of important causal relationship with landslides, and because of possible resource for sand.

Trace of Tertiary sedimentary interbed identified through interpretations of aerial photographs. Shown because of important causal relationship with landslides, and because of possible resource for sand. Because landslides are numerous, other locations of interbeds probably exist, but cannot be shown without specific evidence.

Closed topographic depression located in gently dipping surface of basalt. Possibly formed by periglacial processes that modified an original basalt flow-top configuration.

INTRODUCTION

This surficial geologic map 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 southern part of Lewiston and a portion of the Snake River canyon are the prominent features on the map. They are located near the boundary between the Columbia Plateau and the Northern Rocky Mountains. The physiography is dominated by the Lewiston basin, a crustal depression between the Northern Rocky Mountains, the Blue Mountains, and the Palouse portion of the Columbia Plateau. Miocene basalt flows of the Columbia River Basalt Group are folded and faulted into the Lewiston basin. Sediments of the Latah Formation are interbedded with basalt flows in the basin, reflecting the effect of tectonic deformation on the drainage system, including placement of the present course of the Snake River which meets the Clearwater River in northwest Lewiston. The cooler and dryer climate of the Pleistocene brought on the cyclical deposition of wind-blown silt which forms a thin loess cap on the basalt surface that dips gently northward. In the late Pleistocene the Snake River was inundated by both Bonneville and Lake Missoula Floods. Giant gravel bars deposited by the Bonneville Flood are prominent features along the Snake River. Several times Lake Missoula Floods reversed the flow of the Snake River depositing silt, sand, and ice-rafted cobbles and boulders in the valley up to an elevation of 1,200 feet.

DESCRIPTION OF MAP UNITS

m **Made ground (Holocene)**—Large-scale artificial fills composed of excavated, transported, and emplaced construction materials of highly varying composition, but typically derived from local sources. Includes the Corps of Engineers levee system and large fills at the Lewiston regional airport. Many smaller areas of made ground in the urban areas are too small to map at this scale.

Qam **Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Snake 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 granitic, metamorphic, and island-arc volcanic rocks derived from Hells Canyon, and a large component of Columbia River Basalt. In the adjoining Clarkston quadrangle, water- and test-well logs near the confluence with the Clearwater River indicate gravel thicknesses of 40-60 feet over a presumed river-cut surface on basalt. Mainstream alluvium is called riverwash-aquents 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 silty sand overlying river channel gravel. These alluvial deposits form one or more levels of old point bars and flood plains 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 25 to 36 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 upstream dams. The sand overlying channel gravel is several feet thick. Soils developed in older mainstream alluvium include the Chard, Lapwai, and Bridgewater series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qas **Alluvium of side streams (Holocene)**—Channel and flood-plain deposits in Tammany Creek valley. Comprised of thin beds of silt and sand that are probably reworked loess and Lake Missoula Floods backwater sediments. Thickness 10-40 feet. Soils developed in side-stream alluvium include the Chard, Lapwai, and Bridgewater series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qac **Alluvium and colluvium (Holocene)**—Stream, slope-wash, and gravity deposits. Predominantly beds of silt, clay, and sand 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 basalt. Soils developed in these deposits include the Broadax and Slickpoo series (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 Floods 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).

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, sedimentary interbeds 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. Location of landslide deposits in canyons is controlled by the presence of sedimentary interbeds and the hydrogeologic regime. The largest landslides occur where canyon-cutting has exposed the landslide-prone sediments to steep topography. Slope failures have occurred where the fine-grained sedimentary interbeds 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. Landslide activity in the Clearwater and Snake River valleys may have been induced by the catastrophic rising and lowering of river water during the Bonneville and Lake Missoula Floods. 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. Basalt outcrops are predominant in steep Snake River canyon walls especially upstream of giant gravel bars (*Qb*) where the valley was scoured and steepened by the Bonneville Flood. More gently sloping areas are mantled with thin loess (typically 1-5 feet thick), especially near boundaries with loess (*Ql* and *Qld*). 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 (*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 Alpowa, Bryden, Crowers, Endicott, Gwin, Jacket, Kettenback, Lickskillet, Limekiln, Linville, and Slickpoo series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Ql **Loess (Holocene and Pleistocene)**—Calcareous wind-blown silt. Exposures show one to several layers of loess that represent periods of rapid deposition of air-borne dust. Thickest layers may have formed immediately after Lake Missoula Floods backwater events in the Snake River valley. Buried soils mark the tops of loess depositional units. Forms cap on youngest Lake Missoula Floods deposits and blankets the relatively flat dip-slope surface of basalt. Partly correlates with the Palouse Formation, but lacks the distinctive Palouse Hills of the eastern Columbia Plateau, and unlike the Palouse Formation, is predominantly composed of a single late Pleistocene deposit. Thickness 5-20 feet based on well logs, field observations, and map relationships. In some areas apparent thickness based on topography may be misleading, and relief is due to erosion of underlying basalt surface before loess deposition. Thickness may be greater than 20 feet on some north-facing slopes where it is thickened by primary wind drift and where vegetation prevents subsequent erosion. Loess is thinnest on steep, south-facing slopes where sheet wash erosion is common. Thin loess with Holocene soil development caps Lake Missoula Floods backwater sediments, and probably represents rapid deposition following the Lake Missoula Floods at the end of the Pleistocene. Loess less than 5 feet is not included in this unit, but thin loess is a common soil parent material throughout the map area (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999). As slopes steepen loess thins and grades into areas of basalt colluvium (*Qcb*). Loess thins toward the south and grades into thin loess on duripan (*Qld*). Soils developed in loess include the Broadax, Hatwai, and Oliphant series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qld **Loess on duripan formed in gently sloping basalt surface (Holocene and Pleistocene)**—Calcareous wind-blown silt that forms a thin blanket on the gentle dip-slope surfaces of basalt. Relatively soft silt buries a duripan (indurated lime- and silica-cemented angular basalt clasts), but the lime and silica cement diminishes as elevations and precipitation increase south and east toward the plateau escarpment. Relatively unweathered basalt is within a few feet below this contact. Loess is typically 1-6 feet thick, but is thicker on east- and north-facing sides of drainages where it is thickened by primary wind-drift deposition and where vegetation limits subsequent erosion. Soils developed in this unit include the Broadax, Bryden, Calouse, Endicott, Hatwai, Jacket, Oliphant, and Redmore series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qm / Qm **Lake Missoula Floods backwater deposits (Pleistocene)—**Rhythmites deposited when backwaters from Lake Missoula Floods inundated the Snake River valley. Similar depositional environment, sedimentology, and age as Lake Missoula Floods rhythmites of eastern Washington (Smith, 1993; Waitt, 1980, 1985). In eastern Washington, Mount St. Helens tephra forms a 13,000-year time line in Missoula Floods rhythmites. Primarily alternating thin beds of gray sand and pale brown silt. Cross-bedded, dark-gray, basalt-rich granule gravel and coarse sand may be present at the base. Includes cut and fill structures and sandy clastic dikes. The clastic dikes are common features in the deposits and may follow coarser, sand and gravel facies. Typically capped by 1-3 feet of loess and commonly reworked into sandy, silty colluvium. Found locally up to 1,200 feet in elevation, the approximate maximum flood level. Mapped as a diagonal line pattern where rhythmite deposits mantle Bonneville Flood point bars such as Tammany Bar (see *Qb* below). In a measured section near Tammany Creek, well-exposed rhythmites were sampled for paleomagnetic secular-variation analysis. We measured paleomagnetic directions of samples from the Tammany site and compared the directions and secular variation curves with the Touchet beds exposed in the Burlingame Canyon site near Walla Walla (Kietzman, 1985). The comparison suggests the Tammany section correlates with rhythmites 11-19 of the thirty-two rhythmites at Burlingame Canyon. Lake Missoula Floods temporarily reversed the course of the Snake River (see *Flow direction* in Symbols). The Chard series is the most common soil developed in Lake Missoula Flood deposits (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qb **Bonneville Flood gravel (Pleistocene)**—Gravel and sandy gravel of giant point bars that form large, elongate slopes on the inside of bends in the Snake River valley. Upstream ends of the bars grade into areas of flood-scoured basalt (see symbol). Includes the giant point bar informally named Tammany Bar that truncates the mouth of Tammany Creek valley (O'Connor, 1993, Figure 48). The gravel pit in the north end of Tammany Bar exposes details of the growth of the giant point bar as it was formed. According to Jim O'Connor (written communication, 2001), Bonneville Flood gravels overlie sand deposits that he interprets as pre-Bonneville Snake River alluvium. Organic material from the sandy alluvium has a radiocarbon age of 27,860 ± 345 years before present (University of Arizona radiocarbon-date AA4774). The giant point-bar deposits are poorly sorted and bedding consists of large cross-beds and crude layers of alternating bouldery gravel and sand. The cross-beds dip in the flow direction of the Snake River. In the upper part of the section, a greater concentration of boulders demonstrates the winnowing effect of decelerating flood waters, a characteristic common to Bonneville Flood bars (O'Connor, 1993). The sand and fine gravel clasts are predominantly very angular basalt fragments probably derived from the Snake River canyon just upstream. Non-basalt pebbles and cobbles are generally well rounded. Coarse gravel clast lithologies reflect a Hells Canyon source with at least half basalt and the remainder mostly granitoids and greenschist facies volcaniclastics (Hooper and others, 1985). Tammany Bar is capped with 2-20 feet of Lake Missoula Floods rhythmites.

The Bonneville Flood originated at Red Rock Pass where approximately 14,500 years ago Lake Bonneville spilled over the divide between the Great Basin and the Snake River drainage. O'Connor (1993) describes the hydrology, hydraulics, and geomorphology of the flood, providing a more complete picture of the history and character of the flood and the many landforms and deposits resulting from the flood. Of importance in the Lewiston area is the typical stepwise nature of the flood's profile at its maximum discharge. The catastrophic stream flows were too great to be accommodated within the many narrow canyons of the Snake River, and a constriction just downstream from Lewiston probably caused hydraulic ponding within the Lewiston-Clarkston valley. O'Connor (1993) estimates a maximum water-surface altitude of approximately 1,040 feet based on upper limits of flood-scoured basalt at the south end of Tammany Bar.

REFERENCES

Hooper, P.R., G.D. Webster, and V.E. Camp, 1985, Geologic map of the Clarkston 15-minute quadrangle, Washington and Idaho: Washington Division of Geology and Earth Resources, Geologic Map GM-31, 11 p., 1 pl., scale 1:48,000.

Kietzman, D. R., 1985, Paleomagnetic survey of the Touchet Beds in Burlingame Canyon of southeast Washington: Eastern Washington University M.S. thesis, 149 p.

O'Conner, J.E., 1993, Hydrology, hydraulics, and geomorphology of the Bonneville flood: Geological Society of America Special Paper 274, 83p.

Smith, G.A., 1993, Missoula flood dynamics and magnitudes inferred from sedimentology of slackwater deposits on the Columbia Plateau, Washington: Geological Society of America Bulletin. v. 105, p. 77-100.

U.S. Department of Agriculture, Natural Resources Conservation Service, 1999, Soil survey geographic (SSURGO) database for Lewis and Nez Perce counties: USDA-NRCS Soil Survey Division, National SSURGO Database Data Access, ID611, http://www.ftw.nrcs.usda.gov/ssur_data.html.

Waitt, R.B., Jr., 1980, About 40 last-glacial Lake Missoula jökulhaups through southern Washington: Journal of Geology, v. 88, p. 653-679.

Waitt, R.B., Jr., 1985, Case for periodic, colossal jökulhaups from Pleistocene glacial lake Missoula: Geological Society of America Bulletin, v. 95, p. 1271-1286.

Base map from USGS digital raster graphic 1984 (Asotin), 1972 (Lewiston Orchards South).

Topography by photogrammetric methods from aerial photographs taken 1970 (Asotin) and 1955 (Lewiston Orchards South). Field checked 1971 (Asotin) and 1958 (Lewiston Orchards South). Lewiston Orchards South photorevised 1972.

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.

Field work conducted 2001.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program.

Reviewed by Terry Howard.

Digital cartography by B. Benjamin E. Studer and Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Map version 7-9-2004.

Published and sold by the Idaho Geological Survey
University of Idaho, Moscow, Idaho 83844-3014