NATURAL RESOURCES

WASHINGTON GEOLOGY

VOL. 22, NO. 4
DEC. 1994

INSIDE THIS ISSUE

- Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941, p. 3
- Guide to geologic, mineral, fossil, and mining history displays in Washington, p. 11
- INDEX TO WASHINGTON GEOLOGY, 1993–1994, p. 20

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Jennifer M. Belcher - Commissioner of Public Lands
Kaleen Cottingham - Supervisor

WASHINGTON GEOLOGY

Vol. 22, No. 4
December 1994

Washington Geology (ISSN 1058-2134) is published four times each year by the Washington State Department of Natural Resources, Division of Geology and Earth Resources. This publication is free upon request. The Division also publishes bulletins, information circulars, reports of investigations, geologic maps, and open-file reports. A list of these publications will be sent upon request.

DIVISION OF GEOLOGY AND EARTH RESOURCES

Raymond Lasmanis, *State Geologist*
J. Eric Schuster, *Assistant State Geologist*
William S. Lingley, Jr., *Assistant State Geologist*

Geologists (Olympia)
Joe D. Dragovich
Wendy J. Gerstel
Robert L. (Josh) Logan
David K. Norman
Stephen P. Palmer
Patrick T. Pringle
Katherine M. Reed
Henry W. (Hank) Schasse
Timothy J. Walsh
Weldon W. Rau *(volunteer)*

Geologists (Spokane)
Robert E. Derkey
Charles W. (Chuck) Gulick

Geologists (Regions)
Garth Anderson *(Northwest)*
Rex J. Hapala *(Southwest)*
Lorraine Powell *(Southeast)*
Stephanie Zurenko *(Central)*

Senior Librarian
Connie J. Manson

Librarian I
Rebecca Christie

Editor
Katherine M. Reed

Computer Information Consultant
Carl F. T. Harris

Cartographers
Nancy A. Eberle
Keith G. Ikerd

Production Editor/ Designer
Jaretta M. (Jari) Roloff

Data Communications Technician
J. Renee Christensen

Administrative Assistant
Janis G. Allen

Regulatory Programs Assistant
Mary Ann Shawver

Clerical Staff
Katherine E. (Karin) Lang
Steve Luceno

MAIN OFFICE
Department of Natural Resources
Division of Geology
and Earth Resources
PO Box 47007
Olympia, WA 98504-7007

Phone: (206) 902-1450
Fax: (206) 902-1785
Internet:
cjmanson@u.washington.edu
rcgg490@wadnr.gov

(See map on inside back cover for office location.)

FIELD OFFICE
Department of Natural Resources
Division of Geology
and Earth Resources
904 W. Riverside, Room 209
Spokane, WA 99201-1011

Phone: (509) 456-3255
Fax: (509) 456-6115

Publications available from the Olympia address only.

Printed on recycled paper.
Printed in the U.S.A.

Cover Photo: WPA Slide Control Project No. 831 was conducted under the direction of the Seattle Engineering Department from 1935–1941. Regulations of the WPA required that all work done with federal assistance be accomplished with unskilled, manual labor using hand tools. Work items under the project included test borings and design and construction of drainage trenches and tunnels. Shown here is trench construction in the Perkins Lane area, looking northward up Perkins Lane alignment from the intersection of Perkins Lane and West Ruffner and West McLaren Streets. Perkins Lane 3400 block. (Used with permission of the Special Collections Division of the University of Washington Libraries, UWNeg#15386.)

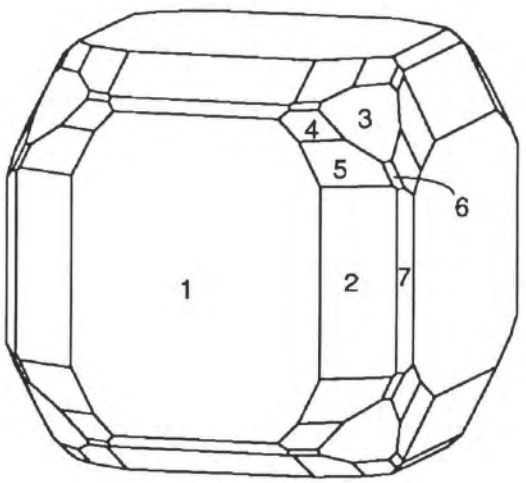
A Tribute to Field Collectors

Raymond Lasmanis
Washington State Department of Natural Resources
Division of Geology and Earth Resources
PO Box 47007, Olympia, WA 98504-7007

Erosion and weathering aided by frost action, melting snows, torrential rains, and landslides reduce mountains to beach sand. Rock crushers rumble in quarries to produce raw materials for our roads and buildings. Crystals, the flowers of the mineral kingdom, once created, suffer the same fate as the granite hill or limestone ledge.

Thousands attend annual mineral and gem shows here in the Northwest and across the nation and are exposed to the beauty and geometric variety of crystals. Collectors also contribute to the science of mineralogy. Advances in crystal chemistry and morphology continue to be made, based on material collected in the field. Many discoveries have direct practical applications to today's societal needs. Whether amateur or professional, dedicated field collectors continue to make significant contributions.

If it were not for these collectors working in mine sites or in remote locations, we would not have the opportunity to be awed by the beauty of minerals. Further, we would miss chances to improve our understanding of our planet and science would suffer.



Drawing of a pyrite crystal from the Spruce Claim, King County, Washington.

Crystal forms present:

Face no.	Miller Indices	Form type
1	100	cube
2	210	pyritohedron
3	111	octahedron
4	211	trapezohedron
5	421	diploid
6	221	trisoctahedron
7	110	dodecahedron

(By permission of R. Peter Richards, Morphogenesis, Inc., 154 Morgan St., Oberlin, OH 44074.)

Draining Seattle— WPA Landslide Stabilization Projects, 1935–1941

Stephen Evans, R.P.G., Consulting Geologist
1061 N.E. 102nd St.
Seattle, WA 98125-7519

There's not much to look at. Just water splashing gently from the end of a galvanized pipe located above three generations of seawall south of Discovery Park. Behind the rocks and concrete slabs of succeeding bulkheads, the wooden piles and heavy timbers of the original seawall protrude from the sand, eaten by decades of worms and surf. Above the seawall, where a tunnel portal once was, the hillside shows evidence of an access ramp bulldozed into the slope. Farther south along the beach, on the alignment of West Bertona, a concrete pipe spouts another stream of water (Figs. 1 and 2). (See also Fig. 13.)

Glamorous Washington Depression-era projects like the Grand Coulee Dam got all the press. But many, much less conspicuous projects carried out under the U.S. Work Projects Administration (WPA) also significantly affected the northwest region and Seattle.

The Need for Landslide Control

Many long-term Seattle residents are aware that parts of the city are going downhill—literally. Whenever there is a heavy winter storm, landslide problems make the headlines. A road closed here, a house destroyed there (Fig. 3). Once in a while, a resident or worker is killed. The problem was recognized early in the city's history. "This process [landsliding] has gone on from time to time on what is called the Yesler Hill and along the lake shore of Lake Washington..., and along the shores of the bay from South Seattle northward, from a time to which the memory of man runneth [sic] not back," wrote the first city engineer R. H. Thompson. In an 1897 letter to Seattle's Corporation Council, Thompson outlined the problem as a consequence of the interaction of late-Pleistocene, proglacially deposited layers of Lawton Clay and Esperance Sand with ground water.

Periodically, especially stormy winters result in an epidemic of slope problems. The winter of 1933–1934 was such a season. In December of 1933, 15.33 inches of rain fell, leading to 180 separate slides. More heavy rains fell in January of 1934, with further sliding. Lawsuits totaling over $600,000 were filed against the city, as some upset homeowners blamed road and utility improvement work for their problems. Something had to be done, so in emergency Ordinance No. 64873, the City Council set aside an initial budget of $30,000 for planning and constructing drains in the worst slide areas.

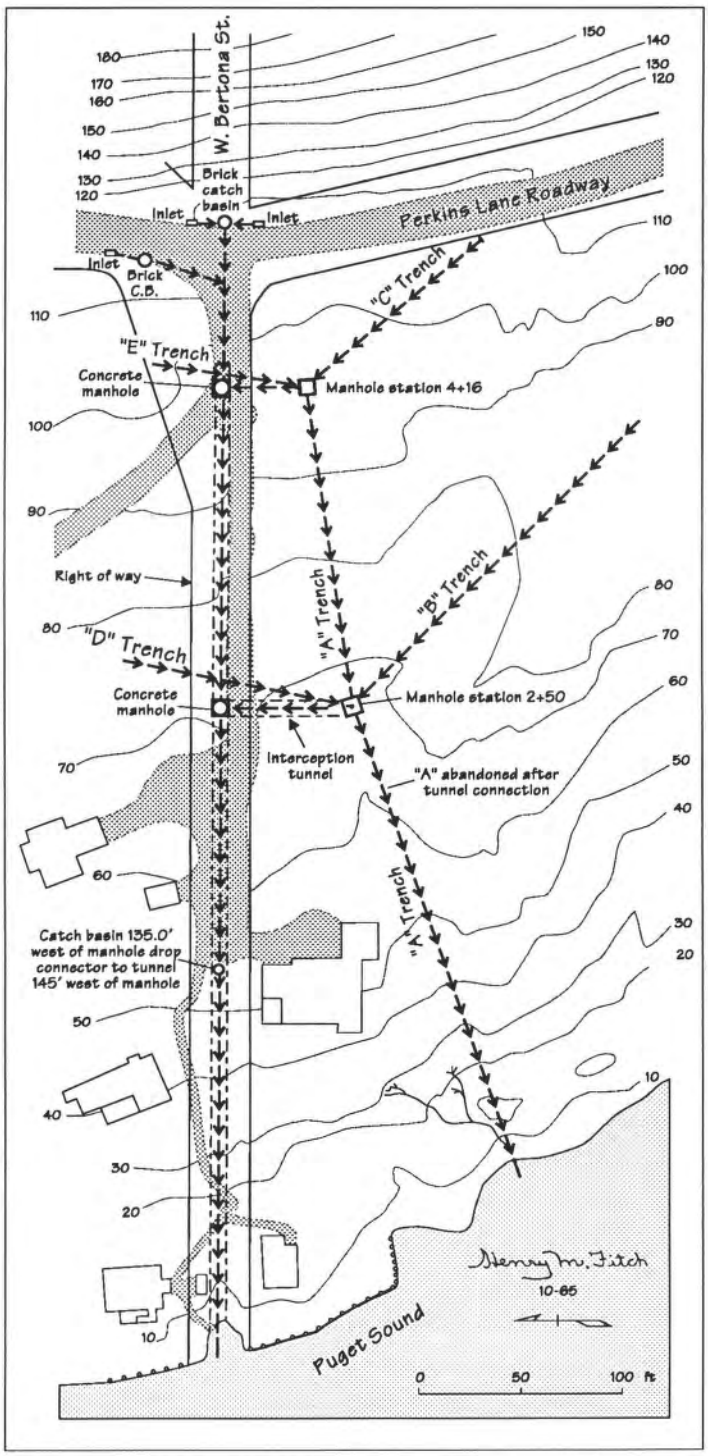


Figure 1. West Bertona Street slide control drainage tunnel south of Discovery Park in the 3200 block of Perkins Lane (site 2, Fig. 2). (Modified from Henry M. Fitch, 1967, figs. D-1 and D-2, p. 47, 48.)

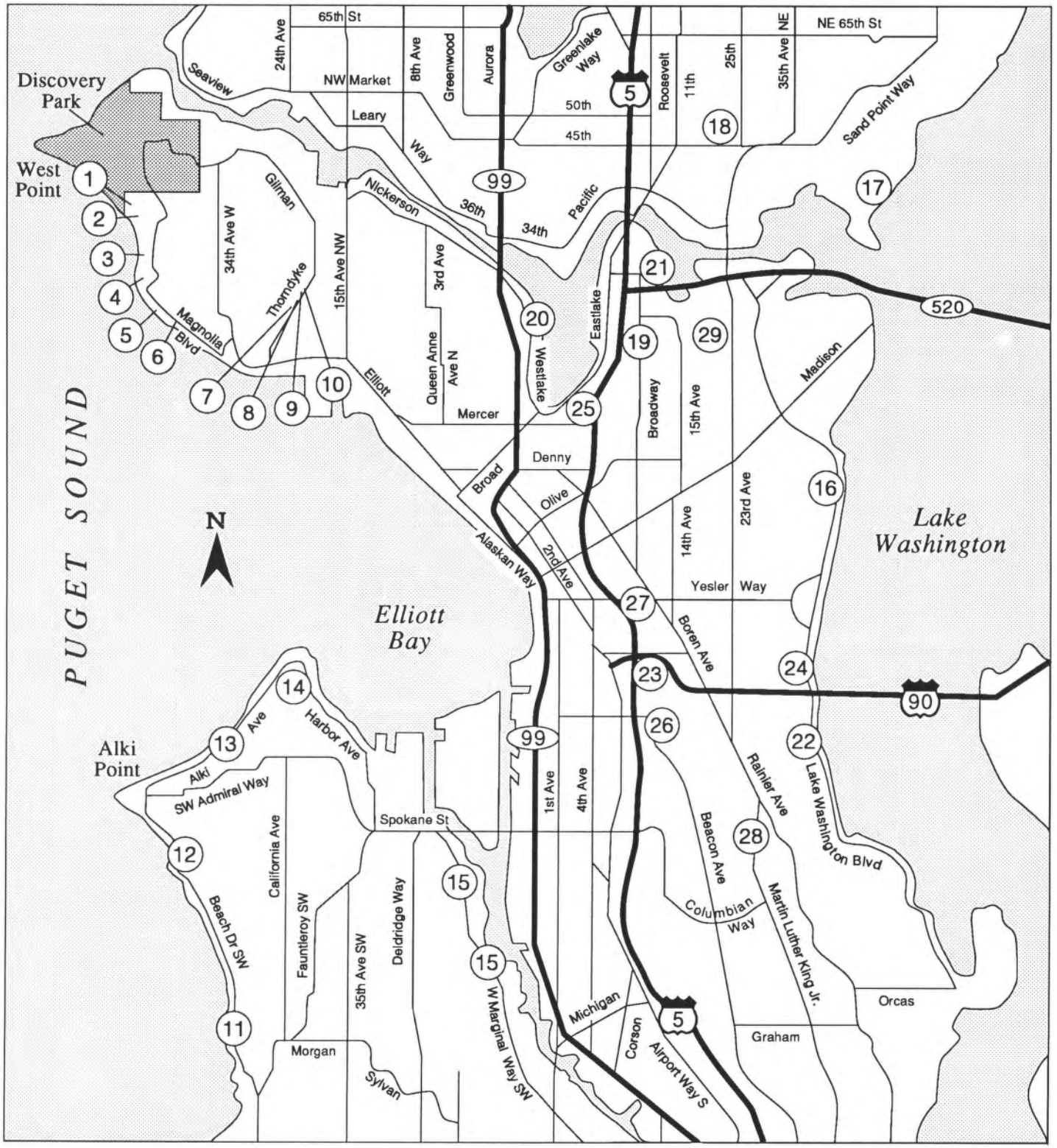


Figure 2. Sketch map of the central Seattle area with key for landslides and work sites, WPA Slide Control Project No. 831:

1. Perkins Lane, 3400 block (W. McLaren St.)
2. Perkins Lane, 3200 block (W. Bertona St.)
3. Perkins Lane, 2600 block (W. Armour St.)
4. Perkins Lane, 2500 block (W. Raye St.)
5. Perkins Lane, 2300 block (W. McGraw St.)
6. Perkins Lane, 1900 block (W. Howe St.)
7. Thorndyke Ave. W and W. McGraw St.
8. Thorndyke Ave. W and W. Wheeler St.
9. Thorndyke Ave. W and W. Smith St.
10. Thorndyke Ave. W and W. Halladay St.
11. Beach Dr. SW, 6000, 6300, and 6500 blocks
12. Chilberg Ave. SW and Aikins Ave. SW
13. Bonair Dr. SW and SW College St.
14. California Way SW and SW Atlantic St.
15. W. Marginal Way SW
16. Madrona Dr. and E. Pine St.
17. 51st Ave. NE (NE 37th St. to 39th St.)
18. Ravenna Ave. NE (NE 45th St. to 50th St.)
19. Broadway Ave. E. and E. Blaine St.
20. Westlake Ave. N. (W. Newton to W. Crockett)
21. Delmar Dr. E. and 11th Ave. N.
22. S. Dose Terrace and 34th Ave. S.
23. 12th Ave S. and S. Norman St.
24. 34th Ave. S. and S. Norman St.
25. Eastlake Ave E. (E. Valley to E. Aloha)
26. Beacon Hill west slope
27. S. Jackson St. to Yesler Way
28. 24th Ave. S. and S. Hinds St.
29. 17th Ave. E. and E. Garfield St.

SLIDE WRECKS 5 HOMES

Figure 3. From the *Seattle Times* of January 22, 1935.

Photo caption reads: One man was injured and five cottages were wrecked when this earth slide occurred at 5:30 o'clock this morning on the west side of Beacon Hill, near Tenth Avenue South and Forest Street. Silvius Underhill suffered a serious head injury. Other residents escaped. This and other slides, caused by rain and melting snow, brought repetitions of last winter's slides.

Excerpt from the article: Other slides interfered with streetcar service and automobile traffic. The Green River at Eagle Gorge went over its banks this morning. At Auburn, 25 miles south of Seattle, it was feared the river would reach flood levels before night. The White River at Buckley dam had raised about 5 feet in the past 24 hours, the State Highway Department reported. The Snohomish River rose 5 feet. Its tributaries, the Snoqualmie and Skykomish neared overflow. Precipitation in Seattle in twenty-four hours ending this morning amounted to 2.11 inches.

BEACON HILL HOMES TOPPLE IN SLIDE

MAN INJURED IN BEACON HILL HOUSE; RIVERS RISE

Streams Throughout State Rapidly Filling to Capacity: Green River Leaves Banks at Eagle Gorge

Slides menaced life and property today as continued warm weather and heavy precipitation prevailed in Western Washington. Passenger trains, some of which had been snowbound, were coming through as tracks were cleared, but they were many hours late. Snoqualmie Pass still was closed.

Figure 4. *(See p. 7.)* Hand-auger exploratory boring being drilled to test the soil for slide prevention on South Dose Terrace slide—34th Avenue South and Lake Washington Boulevard (site 22, Fig. 2). Photo taken March 16, 1935. (Used with permission of the Special Collections Division of the University of Washington Libraries, UWNeg#15388.)

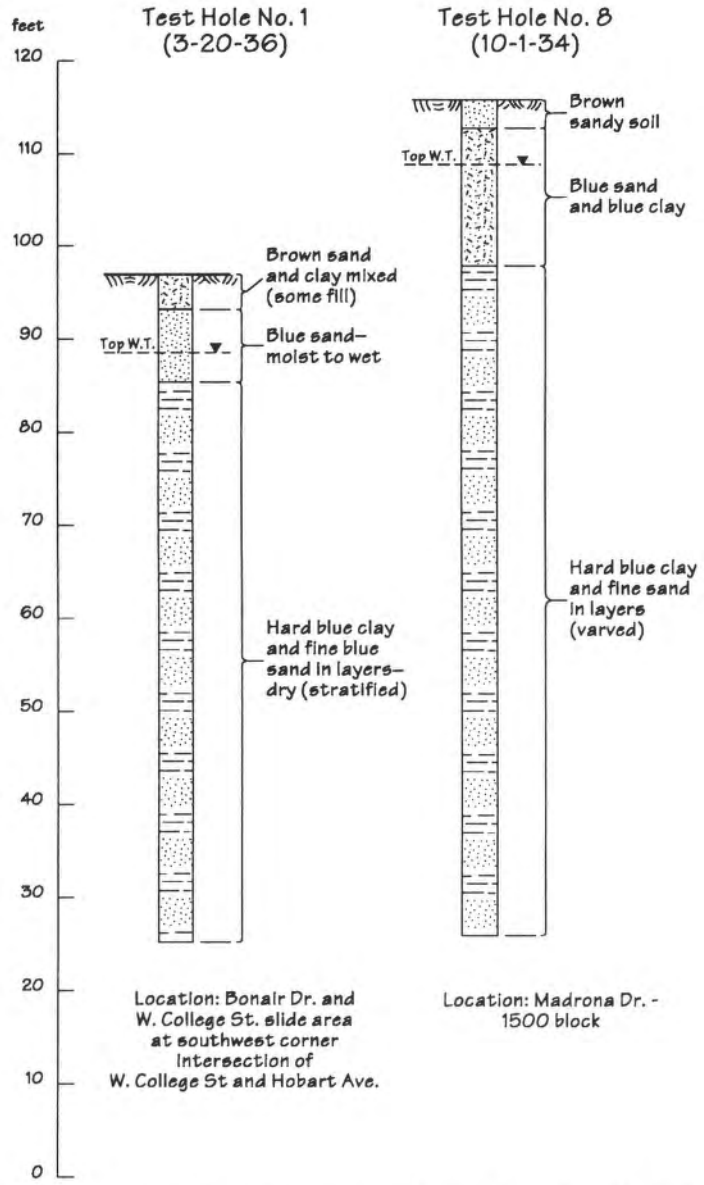


Figure 5. Sample logs of test holes. (Modified from Henry M. Fitch, 1967, p. 124 and 162.)

Figure 6. Closeup of slide control trench drain showing protective lagging and bracing timbers, South Dose Terrace and 34th Avenue South slide (site 22, Fig. 2). Trench width approximately 30 inches. Photo taken March 1935. (Used with permission of the Special Collections Division of the University of Washington Libraries, UWNeg#15389.)

In 1934, the nation was in the depths of the depression. The city had 15,000 unemployed registered with the city's engineering department for work on city projects. With the help of federal and state relief programs, workers replaced water mains throughout the city, built seawalls, and constructed sewer trunk lines to Laurelhurst, Seward Park, Ballard, and other neighborhoods. From the outset of the slide control project, city officials anticipated conducting the construction work as a WPA project. The initial budget was in part used to prepare an application for federal grants to help defray the costs of constructing the slide control drains.

On July 13, 1934, the project kicked off with a meeting in the office of the Seattle Engineering Department. The meeting included city engineer Piper, the sanitary engineer Chase, court engineer McMorris, and city official Forsyth. Their purpose was to develop guidelines for prioritizing, planning, and conducting drainage projects. They based their discussions in part on the results of an on-going survey of 91 slide areas, conducted as a component of WPA Sanitary Survey Project No. 5638, a general survey of King County sanitary facilities under the supervision of Chase.

The WPA Foots the Bill

The studies they initiated led to a petition to the WPA, submitted on July 22, 1935, for funds for a general slide project. The plan asked for $590,000 in federal and city funds to put 721 men to work on 33 slide areas (Fig. 2). Only 29 sites were actually completed. The grant became WPA Slide Control Project No. 831, conducted under the direction of the Seattle Engineering Department. Work items under the project included test borings and design and construction of drainage trenches and tunnels.

The slide drain project was a major undertaking, especially since the regulations of the WPA required that all work done with federal assistance be accomplished with unskilled, manual labor using hand tools. From the first, one of the greatest concerns of the planners was worker safety. The report of the 1934 meeting predicted "... most of the labor furnished will be inexperienced and ill-equipped both physically and in the matter of clothing such as rubber boots, slickers, etc., to work in the conditions required." A March 18, 1935, memorandum to the Seattle City Council describing project plans speaks of "men [working] who are inexperienced, underfed and unwilling, in trenches 15 to 25 feet in depth where the saturated ground is moving and under unfavorable weather conditions." Worse, regulations mandated that just as crew personnel became familiar with their duties, they had to be replaced by new, inexperienced workers because the original men had ex-

Figure 7. A slide drain trench snakes across the hillslope of the Broadway Avenue East and East Blaine Street slide (site 19, Fig. 2). (Used with permission of the Special Collections Division of the University of Washington Libraries, UWNeg#15387.)

pended their hour quotas. To maintain safety and project quality the city hired engineers to closely supervise all work.

Where possible, drilling test borings preceded the design work for the drains. However, in many areas the borings were done in conjunction with the drain construction, and the results were used to develop plans in the field. The test borings were drilled with hand-auger equipment (Fig. 4). Eventually, some 416 test borings were drilled and logged (Fig. 5).

Perkins Lane— A Typical Example

Perkins Lane, midslope on Magnolia Bluff south of Discovery Park, was the site of one of the largest drainage efforts, encompassing six separate projects (sites 1–6, Fig. 2). The area has some of the finest views in Seattle but, with the houses built on loose, soft, wet slide debris accumulated on a sloping shelf of hard, slick Lawton Clay, it is also one of the most unstable. In drain design and construction techniques, the work in the neighborhood was typical of all the projects.

Work commenced in the locale in June of 1936 as some 150 workers equipped with shovels began digging a series of drainage trenches fanning out from the intersection of Perkins Lane, West Ruffner Street, and West McLaren. Drain placement was established on the basis of information derived from 86 test borings.

Imagine yourself working on this site. It may be June, but it's raining and you have no slicker. For a while, the depth of the trench gives you some protection. But it's only 30 inches wide (Fig. 6), like a grave, and eventually the walls tower up to 25 feet above your head. As you dig, water begins dripping, seeping, sometimes even running from between the timbers, down on your head, into the bottom of the trench. It softens the clay you stand on, making it sticky and slick at the same time. And soaking your boots, if you have them.

The trench sides as they snake across the slope (Fig. 7) are shored with timbers. The shoring is braced, so the trench is safe enough, though all those cross braces restrict your movements. And if the whole mass of the loose soil material you're digging through decides to move, the bracing won't help.

The work is easy while you're in slide material. But at the end you're trying to hack 2 feet into hard clay below the slide zone.

Backfilling starts. You lay fired clay or concrete pipe along the bottom of the trench, joints open to allow water in. Next you dump 5 feet of gravel into the trench to cover the pipe. From there to the highest level of water seepage, you carefully

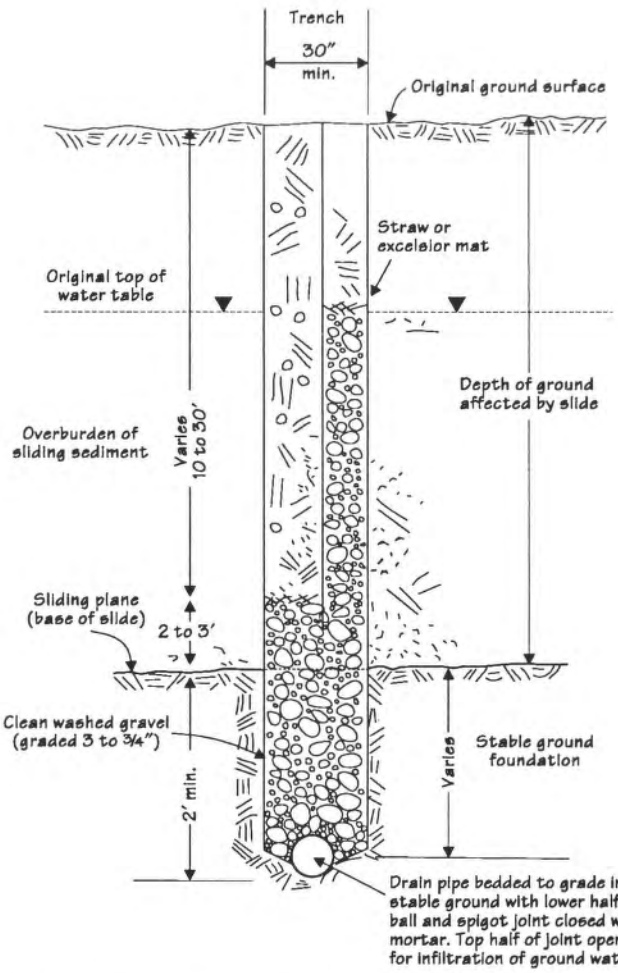


Figure 8. Schematic diagram of a typical trench drain. (Modified from Henry M. Fitch, 1967, fig. 1, p. 5.)

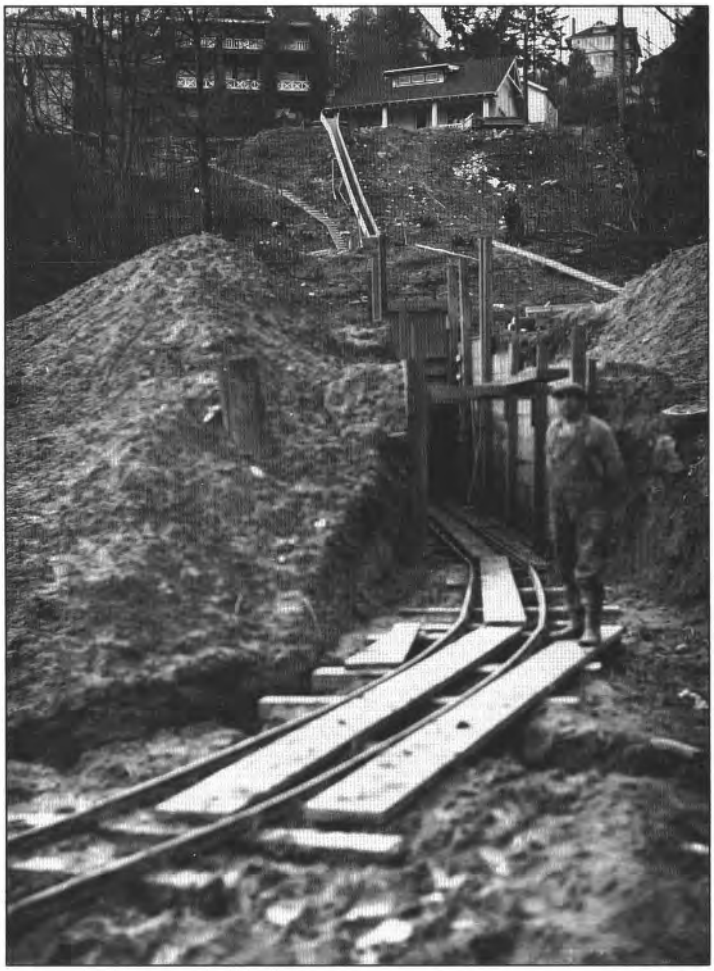


Figure 9. Slide control drain tunnel portal, Madrona Drive and East Pine Street slide (site 16, Fig. 2). (Courtesy of the City of Seattle Engineering Department.)

place a 1-foot-wide gravel strip on the uphill side of the trench, filling the remainder of the trench width with compacted dirt (Fig. 8).

Trenching in the manner described above was the primary drainage measure undertaken during the landslide stabilization project. By February of 1937, the trenching around Perkins, McLaren, and Ruffner was complete and encompassed four trenches totaling nearly 925 linear feet (Cover photo). Close by to the south, around West Bertona Street, five more drains, some 1,650 feet, were built. One drain goes all the way down to the ocean shore. More drains were constructed in the project areas further south. In all, some 20,000 feet of drainage trenches were fabricated throughout Seattle by the time WPA Slide Control Project 831 was terminated.

However, some areas couldn't be drained by this method because heavy ground water flows and (or) the depth of unstable slide material made it unsafe to trench into the hard substrate below the slide zones. Digging into the substrate was necessary to fully intercept the ground water flows contributing to the instability of the soil. In other areas, it was difficult to dispose of the water collected in the trench drains. The topography did not lend itself to daylighting the drain pipes, or the discharge area was unstable. The solution for disposal of collected ground water and to drain untrenched areas was to dig tunnels. Eventually, four tunnels were dug below Perkins Lane alone. Other tunnels were excavated in the Bonair Drive SW/SW College Street, Madrona Drive/East Pine Street, Ravenna Avenue NE, and Delmar Drive East/11th Avenue North slide areas.

Tunneling usually began in the loose debris near the toe of the slide area (Fig. 9). The first part was the hardest work, as the soft soil constantly threatened to cave in at the tunnel face. Heavy timber beams supported the roof and wall plank shoring, protecting workers from most danger. Working room was limited as the tunnels were 4 feet wide by 6 feet high (Fig. 10).

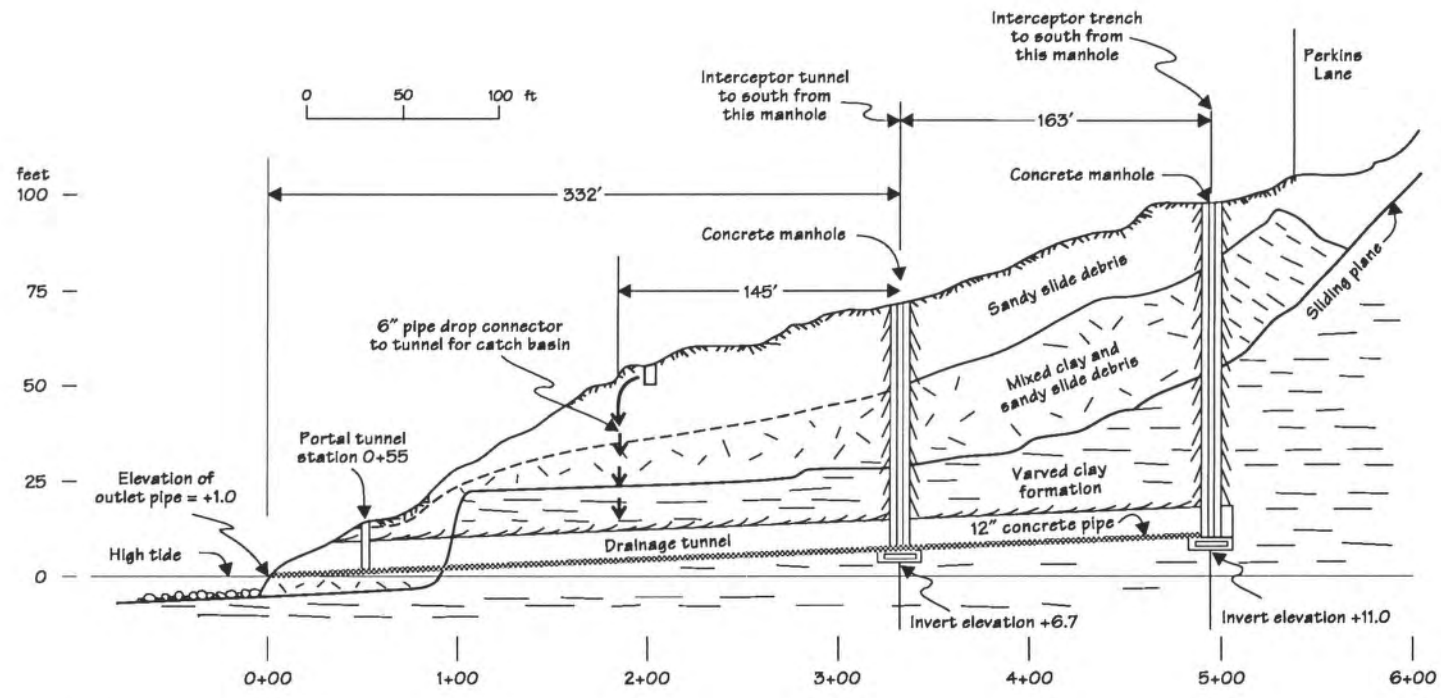


Figure 10. Soil and construction profile of a section of the West Bertona Street slide control drainage tunnel, Perkins Lane 3200 block slide area. See Figure 1 for plan view. Elevation is in reference to Seattle Engineering datum. (Modified from Henry M. Fitch, 1967, fig. D-3, p. 48.)

Farther into the hillside, hard clay was encountered. The tunnels were designed to be placed in the substrate below the slide zones whenever possible—for safety reasons and stability.

The northernmost tunnel in the Perkins Lane project area was planned to end below the Perkins Lane/West Ruffner/West McLaren intersection, where all the trench drains converged. This tunnel was designed to conduct the ground water collected in the trenches to a safe discharge and to provide additional drainage. The tunnel was begun in the hillside immediately above the seawall, and the first 60 feet were in slide material. By the time the terminus was reached after months of careful digging, the tunnel extended almost 700 feet into the hillside and was more than 100 feet below the surface. During tunneling, workers hand-drilled five air shafts down from the surface to the tunnel. Wood stave or steel pipes inserted in the boreholes kept the holes open and allowed air to flow to the tunnelers.

A manhole shaft was excavated to connect the drains to the tunnel. Starting from the surface, a 6-foot-square shaft was sunk, centered on the final ventilation boring (Figs. 11 and 12). The shaft was framed with 6-inch-square timbers. To sink the shaft, workers used hydraulic jacks and hammers to drive heavy planks 6 feet into the ground, then dug out the soil within the confines of the planks. The excavated soil was simply dumped down the vertical air hole, whose casing was destroyed as the shaft was sunk. The soil was removed through the tunnel and dumped over the seawall. As the digging reached the penetration limit of the planks, the next lower set of framing timbers was placed and the process repeated until the tunnel was reached.

To finish, masons built a 46-inch-diameter brick manhole casing inside the square shaft and filled the space between the timbers and brick casing with gravel. The drains were connected to a drop pipe within the manhole casing, which in turn was connected to a wood stave, clay, or concrete drain pipe laid in a trench in the bottom of the tunnel. Finally, the workers backfilled the tunnel with sand and gravel, removing the timbers as they retreated. Ironically, after all the effort of constructing the tunnel in Perkins Lane was expended, the drainage trench flows were redirected into the Seattle sewer system in the 1940s.

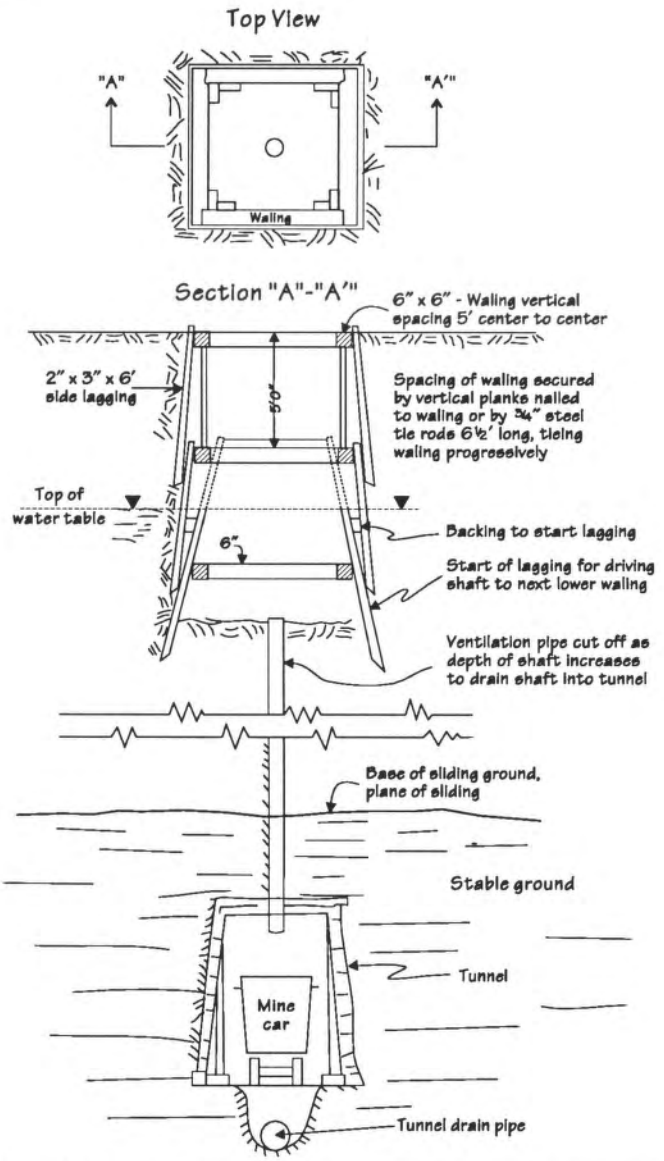


Figure 11. Schematic illustration of manhole drop shaft and slide drain tunnel, showing timber framing of shaft. (See Figs. 9 and 12 for photos.) (Modified from Henry M. Fitch, 1967, fig. II, p. 7.)

The Project Ends

The onset of World War II brought a halt to construction, as labor was redirected to wartime jobs. By the time WPA Slide Control Project 831 was closed down, the total project expenditure for labor, equipment, and materials amounted to

Figure 12. Manhole shaft being excavated, showing waling and access, Madrona Drive and East Pine Street slide (site 16, Fig. 2). (Courtesy of the City of Seattle Department of Engineering.)

roughly $1,000,000, and at least exploratory borings had been completed on 29 of the original 33 proposed project areas. In 1967, Henry M. Fitch of the Seattle Engineering Department, who had supervised much of the work, compiled a summary report on the project for the Department.

Periodically, the Seattle engineers check the drains to see if they continue to function. According to Herb Allwine (personal commun., 1994) of the Seattle Engineering Department, those that have been checked within the last few years appear to be working as intended.

Today, only traces of the WPA effort can be seen, even by those who look for it. There are some old iron grates and manhole covers marked 'drain' on Perkins Lane. And the pipes above the seawall, which even after last summer's months of dry weather still emitted ground water, even though the trench drains are no longer connected to them.

When next you walk the beach south of Discovery Park, should you notice a shallow stream of water flowing across the beach, look to the seawall. Chances are you'll see the water flowing from the old concrete or galvanized steel drain pipes (Fig. 13). Think of the men who built them. And the system still works!

References

Fitch, H. M., 1967, WPA slide control drainage projects (1935–1941): Seattle Engineering Department unpublished report, 3 v.

Seattle Engineering Department, 1967, W.P.A. slide survey 1934–1938, sanitary survey, W.P.A. project no. 5638: Seattle Engineering Department unpublished report, 1 v.

Tubbs, D. W., 1975, Causes, mechanisms and prediction of landsliding in Seattle: University of Washington Doctor of Philosophy thesis, 88 p.

Phelps, M. L., 1978, Public works in Seattle—A narrative history; The Engineering Department 1875–1975: Seattle Engineering Department, 304 p. ■

Figure 13. Drain pipe protruding through the seawall at the West Bertona Street tunnel portal. (See also Figs. 1 and 10.) Photo taken September 1994 by S. Evans.

Natural Resources and Your Christmas Tree

This holiday season, the last thing on our minds is the natural resources that bring pleasure to the season. The lights, decorations, greeting cards, and wrapping paper add to the excitement of the holidays, but the Christmas tree is the most memorable. Have you ever thought about the raw materials that bring this image together? The majority of these raw materials were furnished by the mining and petroleum industries.

Although many of us drive to the forest to cut a Christmas tree, most of them are grown on tree farms. Like all crops, they are grown with fertilizers. About half of the world's production of sulfur and over 90 percent of the phosphates and potash go into fertilizers, of which the sapling trees receive a share. Surface and ground water resources are also needed.

Strands of tiny lights add to the list of minerals that bring holiday cheer. The wires are made of copper; the insulation and wall plugs are formed by the combination of petrochemicals with pumice, limestone, marble, vermiculite, silica, feldspar, or trona. The glass bulbs contain feldspar, silica, clay, nepheline syenite, and trona; filaments in the bulbs are made of thin conductive strips of tungsten metal, which comes from the minerals scheelite and wolframite.

The glittering tree ornaments are made from a variety of materials. Plastic ornaments contain petrochemicals; ceramic and glass ornaments are made of ingredients similar to light bulbs and also contain borates and metals such as iron, copper, and lead. The star at the top of the tree could be made from aluminum, silver, or copper. The ornament hangers and tree stands also are typically a metal alloy containing iron or aluminum. Colorful paints and glazes used to decorate the ornaments are based on petrochemicals, mica, or clay and are pigmented with ingredients such as lithium from spodumene, titanium from rutile, manganese from pyrolusite, and rare-earth elements from uncommon minerals. The papers and woods that the paints are applied to commonly contain clay as an additive or filler.

Well over 20 different raw materials are used to create a decorated Christmas tree. And what about the resources that go into the gifts, or the electricity to light the tree? Wow!

by Doug Jones and Virginia T. McLemore
reprinted from Lite Geology, Winter 1992,
New Mexico Bureau of Mines and Mineral Resources

Guide to Geologic, Mineral, Fossil, and Mining History Displays in Washington

David A. Knoblach
Marenakos Rock Center
30250 SE High Point Way
Issaquah, WA 98027

National parks, monuments, and recreation areas, state parks, and a variety of museums, universities, and sites have mineral specimens and interpretive displays that focus on Washington's geologic and mining histories (Fig. 1). Although exhibits are typically small, many museums have excellent collections of petrified wood, geodes, Ellensburg Blue agates, fossils, Mount St. Helens ash, locally recovered meteorites, various minerals and rocks, and stone archaeological artifacts from Washington and elsewhere. Some national parks and monuments feature ranger-guided walks and talks that describe geology. Some museums also have undisplayed mineral, fossil, and archaeological specimens that provide valuable information for education and research.

Many of Washington's geologic displays are featured in this directory, but it is not an exhaustive list. Selected outdoor points of interest also have been included. Museums not listed here may contain at least some information about local geology, mines, and archaeology in their archives.

These museums are compendiums of acquired and donated items that typically focus on local history. Shoestring budgets are common for these institutions. Many of the listed museums are small, volunteer-supported organizations with dedicated staff whose expertise may not include geology. Some displays may have mislabeled or unlabeled specimens. Nonetheless, these exhibits can be educational. New or traveling exhibits also periodically replace displays at some locations.

Listed admission fees are for adults only; admission for seniors, students, children, and groups may vary. Normal visiting hours may be brief at some museums, but many allow off-season and after-hours access by prior arrangement. Please telephone before visiting on holidays or with large groups. Beginning January 15, 1995, a new area code (360) will apply to the telephone numbers in western Washington marked by an asterisk (for example: 206*).

The information given here was current at time of publication, but is subject to change. Entries are given in alphabetical

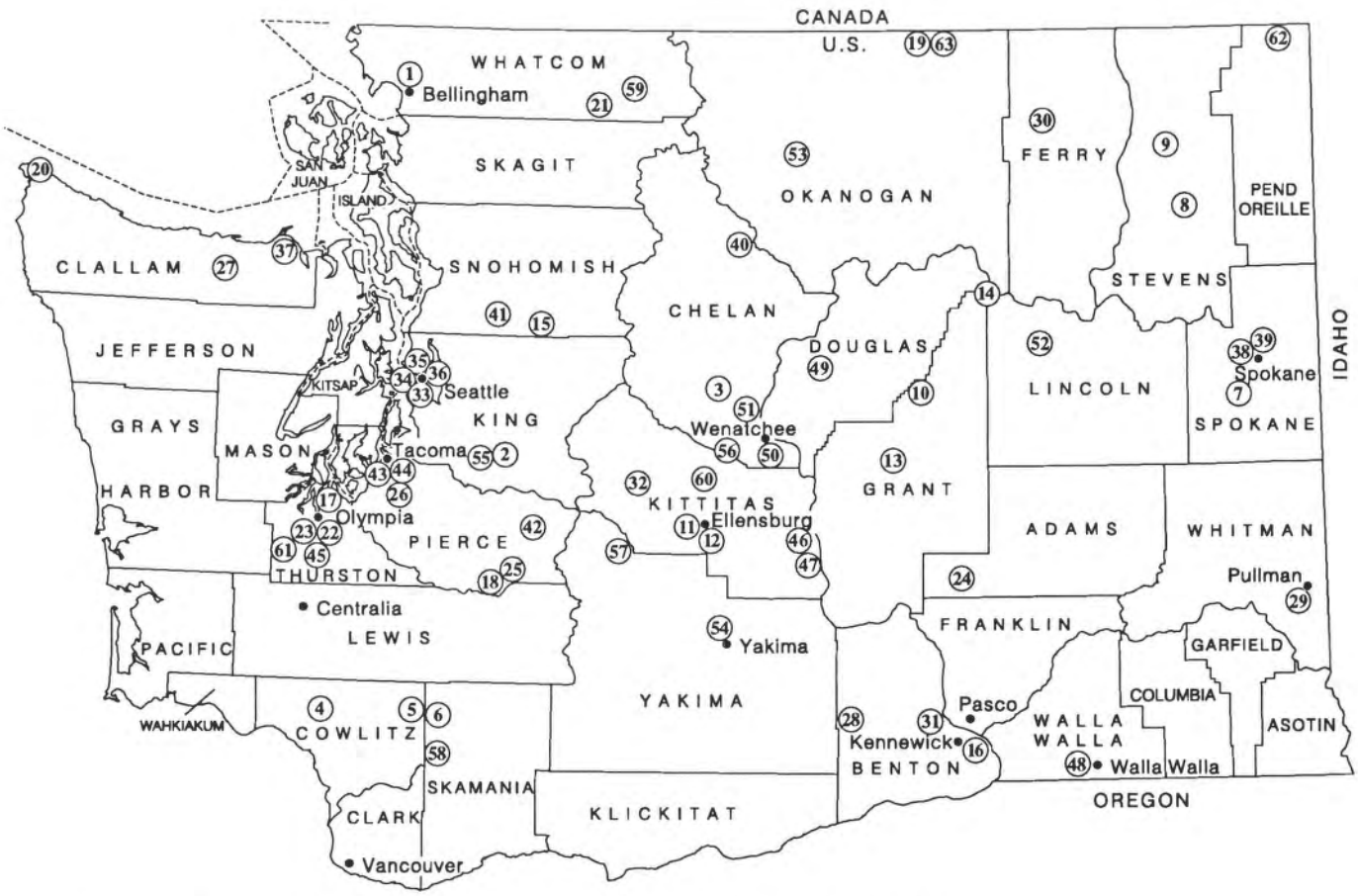


Figure 1. Sketch map showing display locations. Numbers on map match circled numbers in listings.

order by name of the town or nearby locality; circled numbers are locations keyed to Figure 1.

DISPLAYS

Bellingham (Whatcom Co.): ① *Western Washington University Geology Department*, Environmental Studies Bldg., (206*) 650-3581. Open Mon-Fri, 7:00 am-9:30 pm; Sat, 7:30 am-6:00 pm; Sun, 7:30 am-11:30 pm. Free admission. Large, well-organized display covering three floors (basement-2nd floor). Displays include the geology of the Western Washington University campus, Skagit County, and the North Cascades, minerals of Washington, varieties of sedimentary, igneous, and metamorphic rocks, gold mining and various ore minerals, fluorescent minerals, amber, rhodonite, quartz varieties, gypsum, garnets, carbonates, asbestos varieties, tektites and meteorites, local coal mining and fossil fuels, fossils from Washington (including a Pleistocene mammoth tusk, bone, and tooth and leaves from the Eocene Chuckanut Formation), Eocene fossil fish and insects from the Green River Formation (Wyoming), Miocene shark teeth (Florida), thin-sectioned crystals viewed under polarizing light, various seismometers, and tools of geology.

Black Diamond (King Co.): ② *Black Diamond Historical Museum*, 32627 Railroad, (206*) 886-2142. Open Thur, 9:00 am-4:00 pm; Sat/Sun, noon-3:00 pm. Donation suggested. Basic mining equipment, displays, and coal samples from the local coal mining industry; model of coal town and mine with railroad.

Cashmere (Chelan Co.): ③ *Chelan County Historical Society Museum* (Figs. 2 and 3), 600 Cottage Ave., (509) 782-3230. Open Mon-Sat, 10:00 am-4:30 pm; Sun, 1:00-4:30 pm; Apr-Oct. $3.00 suggested donation. Large exhibit displaying roughly 2,000 Native American stone tools, many collected from Columbia Plateau cave dwellings, and a petroglyph. Six cases of minerals, including petrified wood, geodes, ores, and carbonates. Outdoor exhibits include the original 1879 Blewett mines assay office, which assayed $39 million of gold at $7.31/oz, complemented by basic mining equipment.

Castle Rock area (Cowlitz Co.): ④ *Mount St. Helens Visitor Center*, Mount St. Helens National Volcanic Monument, exit 49 off Interstate 5, 5 miles east of Castle Rock on State Route 504, (206*) 274-2100. Open daily, 9:00 am-6:00 pm, Apr-Sept; daily, 9:00 am-5:00 pm, Oct-Mar. Free admission. Museum dedicated to the events immediately before, during, and after the 1980 eruption of Mount St. Helens; films, video, and slide programs. Center provides a general introduction to the national volcanic monument. Large interpretive display based on (1) plate tectonics, "ring of fire", and Cascade Range; (2) historical perspective of Mount St. Helens, including mining activity; (3) day-by-day chronology around the 1980 eruption with a walk through an idealized stratigraphic exhibit of the volcano; and (4) volcano monitoring and ecological management programs following the eruption. Some ranger talks include geology.

Castle Rock area (Cowlitz Co.): ⑤ *Coldwater Ridge Visitor Center*, Mount St. Helens National Volcanic Monument, approximately 43 miles east of Castle Rock on State Route 504, (206*) 274-2131. Open daily, 9:00 am-6:00 pm, May-Sept; daily, 9:00 am-5:00 pm, Oct-Apr. Free admission. Center focuses on the biologic destruction by and recovery after the 1980 eruption, but includes geology. Description and slide show of the volcanic eruption, destruction of Spirit Lake, and volcanic debris from eruption, including hummocks and mudflows. Interactive interpretive exhibit that simulates future biologic and geologic changes. Short, interpretive trail through a recovering area. Three daily interpretive ranger walks and talks on biology and geology (summer).

Castle Rock area (Cowlitz/Skamania Co.): ⑥ *Johnston Center Observatory*, Mount St. Helens National Volcanic Monument (under construction), located east of Castle Rock at the new eastern terminus of the State Route 504 addition. Tentative opening in late 1996 or early 1997. Museum will focus on the geologic aspects of the volcano.

Cheney (Spokane Co.): ⑦ *Eastern Washington University*, Hall of Sciences (1st floor), (509) 359-2286. Open Mon-Fri, 8:00 am-5:00 pm, during school year. Free admission. Several cases of displays that include petrified wood, ammonites and other fossils, metamorphic rocks, and minerals.

Chewelah (Stevens Co.): ⑧ *Chewelah Historical Museum*, N. 501 3rd St. E., (509) 935-8991. Open daily, 1:00-4:00 pm, May 1-Labor Day. Donation suggested. Two large rooms containing displays about the historic Northwest Magnesite Company, including photos, idealized model of the bedrock stratigraphy from the mine drilling program, model tramway, mining equipment, and some rock and mineral samples.

Colville (Stevens Co.): ⑨ *Keller Heritage Center* (Fig. 4), Stevens County Historical Society, 700 N. Wynne, (509) 684-5968. Open daily, 1:00-4:00 pm, May 1-30; open Mon-Sat, 10:00 am-4:00 pm, and Sun, 1:00-4:00 pm, June-Sept. $1.00 suggested donation. Three cases containing local rock and ore minerals, Mount St. Helens ash collected from 25 locations, small interpretive display on the geological and biological changes in Washington by geologic time period, and basic historical mining equipment and photos of local mining activities .

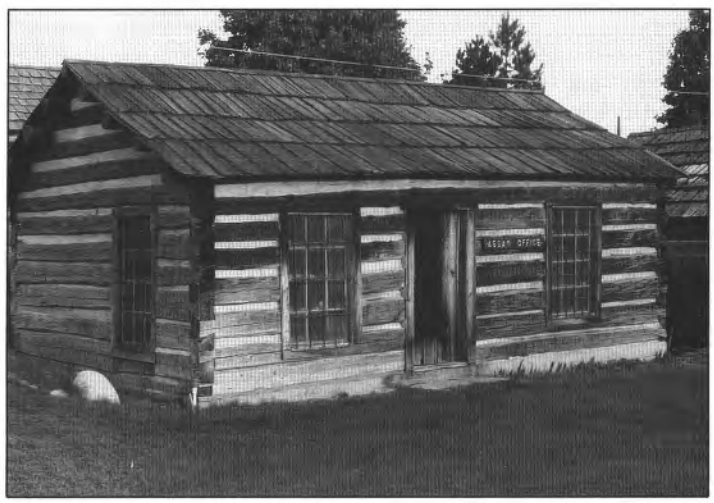


Figure 2. The original Blewett mines assay office (1879) relocated from the Blewett Pass area (Chelan Co.) and preserved with several other buildings at the Chelan County Historical Society Museum in Cashmere. The exhibits here feature basic assaying and mining equipment and a large archeological display of Native American stone tools.

Coulee City area (Grant Co.): ⑩ *Dry Falls Interpretive Center*, located on State Route 17, 2 miles south of the junction with U.S. Route 2, (509) 632-5214. Open daily, 10:00 am-6:00 pm, May-Sept. Free admission. Museum overlooks the Dry Falls and the Grand Coulee formed by the Pleistocene Bretz floods from glacial Lake Missoula and focuses on the geologic history of the Columbia Plateau. Rock samples, Pleistocene mammoth tooth, and interpretive film. Interpretive board featuring the Blue Lake rhino, a mold formed from a rhino-like mammal entombed by a Miocene lava flow near Blue Lake just south of the center.

Ellensburg (Kittitas Co.): ⑪ *Kittitas County Museum*, 114 E. 3rd, (509) 925-3778. Open Tues-Sat, 10:00 am-3:00 pm. Donation suggested. Large exhibit of local petrified wood, geodes, and a large specimen of Ellensburg Blue agate.

Ellensburg (Kittitas Co.): ⑫ *Central Washington University Geology Department*, Lind Science Hall, (509) 963-2701. Open daily, 8:00 am-5:00 pm, during school year. Free admission. Many displays featuring rocks and minerals, fossil fish, turtles, and leaves, Pleistocene mammoth tooth and tusk, interpretive boards, and maps.

Ephrata (Grant Co.): ⑬ *Grant County Pioneer Village and Historical Museum*, 742 Basin St. N., (509) 754-3334. Open Mon-Sat, 10:00 am-5:00 pm, and Sun 1:00-4:00 pm, 1st weekend in May-Sept. 30. Adult: $2.00. Large collection, chiefly petrified wood, in a small, one-room building. Display describes the area's geologic history and includes a Pleistocene mammoth bone.

Grand Coulee area (Grant/Okanogan Co.): ⑭ *Grand Coulee Dam Visitor Center*, (509) 633-9265. Open daily, 8:30 am-8:30 pm, Memorial Day-Labor Day; otherwise open daily, 9:00 am-5:00 pm. Free admission. Stop 4b located inside the Grand Coulee Dam on the tour features the Agate/Artifact Room, which contains polished geodes, thunder eggs, agates, and jaspers. Stop 2a on the dam tour has a small interpretive display about the geologic history of the Columbia Plateau and a few rock samples.

Index (Snohomish Co.): ⑮ *Pickett Historical Museum*, Ave. "A" & 5th St., (206*) 793-1534 or (206*) 793-1844. Open Sun, noon-3:00 pm, Memorial Day-Labor Day. Adult: $1.00. Small interpretive display and photos of the historic local dimension stone (granodiorite) and gold mining industries. Nearby park displays a 10-foot-diameter circular grit saw used in the old stone quarry.

Kennewick (Benton Co.): ⑯ *East Benton County Historical Museum*, 205 Keewaydin Dr., (509) 582-7704. Open Tues-Sat, noon-4:00 pm. Donation suggested. The museum entry floor and boardroom floor are surfaced with tiles containing a large number of polished slabs of petrified wood, jaspers, and geodes. Two cases of stone tools and points.

Lacey (Thurston Co.): ⑰ *Waynick Museum*, Saint Martin's College and Abbey, basement of Lynch Center, (206*) 491-4700. Open Tues, 12:30-4:30 pm, during school year. Free admission. Large exhibit includes fluorescent rocks, concretions, geodes, ore minerals, carbonates, Mount St. Helens ash, and a mineral display demonstrating the Mohs hardness scale, as well as Eocene fossil fish from the Green River Formation (Wyoming), invertebrate fossils, petrified wood, nuts, and seeds, and a dinosaur tooth.

Longmire (Pierce Co.): ⑱ *Longmire Museum*, Mount Rainier National Park, (206*) 569-2211. Open daily, 9:00 am-6:00 pm (summer); Mon-Fri, 9:00 am-4:30 pm, and Sat/Sun, 9:00 am-5:00 pm (winter). Admission free with $5.00 park entrance fee. Displays on glaciers, volcanic rocks, and idealized stratigraphic cross section of Mount Rainier, rock samples from the Cascade Range, and rounded and angular rocks shaped by glaciation and frost/freeze action.

Molson (Okanogan Co.): ⑲ *Molson School Museum*, approximately 15 miles east of Oroville on Oroville–Toroda Creek Rd., and 5 miles north on Molson Rd. (watch for signs), (509) 485-3292. Open daily, 10:00 am-5:00 pm, Memorial Day weekend-Labor Day. Donation suggested. Small mining exhibit featuring the Poland-China gold mine with some tools, rock samples, and a small mineral display.

Neah Bay (Clallam Co.): ⑳ *Makah Cultural and Research Center* (The Makah Museum), State Route 112 (Bay View Ave.), (206*) 645-2711. Open daily, 10:00 am-5:00 pm, June 1-Sept. 16; Wed-Sun, 10:00 am-5:00 pm, Sept. 17-May 31. Adult: $4.00. Although chiefly an archeological center, 18 showcases display Native American artifacts taken from Ozette, a 300- to 500-year-old Makah village that was buried by a mudslide. Stone and bone technology cases. Replica longhouse, dioramas, and various canoes.

Newhalem (Whatcom Co.): ㉑ *North Cascades National Park Visitor Center*, 502 Newhalem St., (206*) 386-4495. Open daily, 8:30 am-6:30 pm, mid-Apr to mid-Nov; Sat/Sun, 9:00 am-4:30 pm, mid-Nov to mid-Apr. Free admission. Topographic relief map of the North Cascades with geologic interpretive display. Weekly geologic talk by park ranger.

Figure 3. Washington's state gem, petrified wood, displayed at the Chelan County Historical Society Museum in Cashmere. Petrified wood is featured in several local museums, the largest displays are in Ellensburg, Ephrata, Pullman, and Vantage.

Olympia (Thurston Co.): ㉒ *Washington Division of Geology and Earth Resources*, Natural Resources Bldg., Room 148, 1111 Washington St. SE, (206*) 902-1450. Open Mon-Fri, 8:30 am-4:30 pm. Free admission. Display of various Washington rocks, minerals, and fossils. Seismometer (in the rotunda) and comprehensive library of Washington geologic literature.

Olympia (Thurston Co.): ㉓ *General Administration Building*, Columbia & 11th St., (206*) 753-5439. Open Mon-Fri, 7:00 am-6:00 pm, year-round. Free admission. Lobby has two large cases containing polished and carved opals (including a few black opals), geodes, various minerals, and fossils.

Othello (Adams Co.): ㉔ *Othello Community Museum*, 3rd & Larch St., (509) 488-2920 or (509) 488-2268. Open Sat, 1:00-5:00 pm, June 1-Oct 31. Donation suggested. Pictures of local columnar basalt mesas and interpretive displays about the Pleistocene Bretz floods, Mount St. Helens eruption (with samples from local ash falls); two Pleistocene mastodon tusks from Alaska, newspaper clippings about local archaeology with a display case of stone tools, two pieces of petrified wood, and a sample of coal.

Paradise (Pierce Co.): ㉕ H*enry M. Jackson Memorial Visitor Center*, Mount Rainier National Park, (206*) 569-2211. Open daily, 9:00 am-7:00 pm, June-Aug; daily, 9:30 am-6:00 pm, May and Sept only; Sat/Sun and holidays only, 10:00 am-5:00 pm (Columbus Day–1st weekend in May). May be closed depending on snow conditions. Admission free with $5.00 park entrance fee. Formation and volcanic hazards of Mount Rainier, including displays on earthquakes, erosion, volcanic mountain building, glaciers, and glacial effects on rock; seismometer and samples of volcanic and glacially scoured rock; display documenting the gradual disintegration of the Paradise Glacier and time-lapse film on the movement of a glacier on Mount Rainier; film describing mountain building and glacial erosion. Daily geology walk led by park rangers (July 1–Labor Day).

Parkland (Pierce Co.): ㉖ *Pacific Lutheran University*, Rieke Science Center (1st floor), Earth Science Department wing, (206*) 535-7568. Open weekdays, 8:00 am-5:00 pm, during school year. Free admission. Small display of fossils, minerals, and ore samples; interpretive posters prepared by students; shoreline invertebrate diorama; maps; and satellite images.

Port Angeles area (Clallam Co.): ㉗ *Hurricane Ridge Visitor Center*, Olympic National Park, 17 miles south of Port Angeles on Hurricane Ridge Road, (206*) 452-0330. Open daily, 9:30 am-5:30 pm, July 1–Labor Day; daily variable hours (generally 9:30 am-5:30 pm) after Labor Day until June 30. Exhibit may not be continuously staffed *and* may be closed depending on snow conditions. Admission free with $5.00 park entrance fee. Displays about local geologic history and topography of the Olympic Mountains with rock samples including pillow basalt, schist, and gabbro. Weekly ranger-led talks during the summer that include local geology and glaciation.

Prosser (Benton Co.): ㉘ *Benton County Historical Museum*, located in Prosser City Park and 7th St., (509) 786-3842. Open Tues-Sat, 10:00 am-4:00 pm; Sun, 1:00-5:00 pm; Mon, 1:00-5:00 pm, on holidays only. Adult: $1.00. Mount St. Helens eruption, with ash from various localities, small display of calcite and quartz varieties, geode, pyrites, garnet, and galena, as well as some vein quartz from the Hanson gold mine in Oroville, California.

Pullman (Whitman Co.): ㉙ *Jacklin Collection*, Washington State University, K. B. Webster Physical Sciences Bldg. (1st floor, foyer area), (509) 335-3009. Open Mon-Fri, 8:00 am-5:00 pm, during school year. Free admission. Large collection of petrified wood with some other fossils (900 square feet of displays). Interpretive board about fossils and evolution. Ore mineral and rock display in lobby.

Republic (Ferry Co.): ㉚ *Stonerose Interpretive Center*, 15 N. Kean St., (509) 775-2295. Open Tues-Sat, 10:00 am-5:00 pm, May-Oct; plus Sun, 10:00 am-4:00 pm, mid-June to mid-Sept. Adult: $1.00. Small museum featuring local Eocene fossil insects and plants. Interpretive brochures. Public fossil hunting with permit from the center; a daily maximum of three fossils may be kept by visitors. Tools for extracting fossils rent for $2.50 per set.

Richland (Benton Co.): ㉛ *Hanford Science Center*, 825 Jadwin Ave., (509) 376-3026 or (509) 376-6374. Open Mon-Fri, 8:00 am-5:00 pm, Sat, 9:00 am-5:00 pm. Free admission. Newly remodeled museum with operating seismometer, Geiger counter demonstrating the radiation blockage properties of various materials, and computer-operated video explaining the drilling and hazardous waste program.

Roslyn (Kittitas Co.): ㉜ *Roslyn Historical Museum Society*, 203 Pennsylvania Ave. (509) 649-2776. Open daily, 10:30 am-4:30 pm, mid-Apr to Oct 31. $1.00 suggested donation. Collection of various local coal mining memorabilia, photos, coal samples, and equipment.

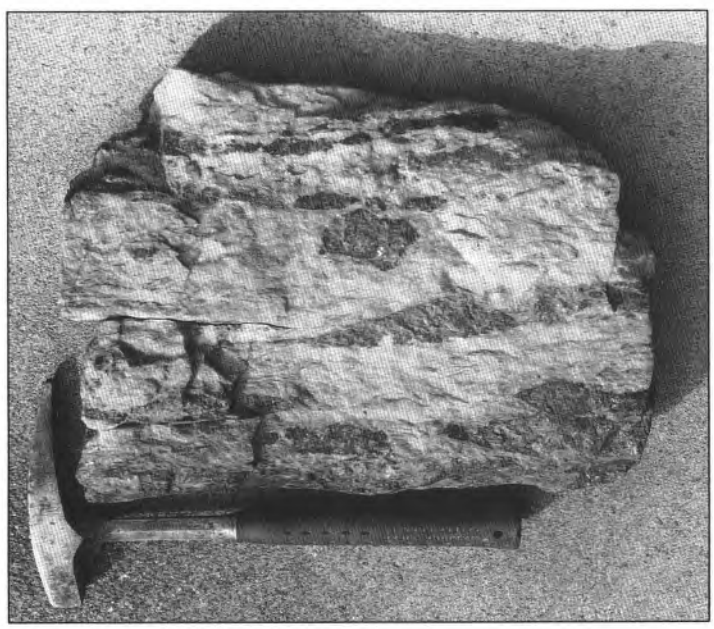


Figure 4. Sphalerite-bearing ore from northern Stevens Co. donated by Northwest Alloys, Inc., of Addy and displayed at the Keller Heritage Center, Stevens County Historical Society of Colville. There are several excellent rock and mineral collections in Washington.

Seattle (King Co.): ㉝ *Klondike Gold Rush Museum National Historic Park*, 117 S. Main St., (206) 553-7220. Open daily 9:00 am-5:00 pm. Free admission. Museum focuses on the 1897-1898 Klondike Gold Rush and Seattle's involvement as a staging area. Interpretive displays and films about mining history, with some basic mining equipment and demonstrations of gold panning. Interpretive talks by park rangers.

Seattle (King Co.): ㉞ *Pacific Science Center*, 200 2nd Ave. N. (in Seattle Center), (206*) 443-2879. Open Mon-Wed, Fri, 10:00 am-5:00 pm; Thur, 10:00 am-9:00 pm; Sat/Sun, 10:00 am-6:00 pm. Adults: $6.00. Occasional limited exhibits. Currently features eight large dinosaur replicas from Steven Spielberg's movie, Jurassic Park; includes bone casts, some dinosaur fossils, 40 dinosaur eggs, and insect-bearing amber. Reservations recommended. Exhibit ends January 22, 1995.

Seattle (King Co.): ㉟ *Thomas Burke Memorial Washington State Museum*, University of Washington, NE 45th St. & 17th Ave. NE, (206) 543-5590. Open daily, 10:00 am-5:00 pm. Adult: $3.00. Large display of minerals and fossils, including agates, petrified wood, quartz varieties, fluorescent minerals, carbonates, marine invertebrate fossils, skeletons of a Pleistocene crocodile, *Allosaurus*, ground sloth, sabertooth tiger, and early horse. Paleontological preparation display. Very large collection of undisplayed fossils and minerals.

Seattle (King Co.): ㊱ *University of Washington Geology Department*, Johnson Hall (Floor G), (206) 543-1190. Open daily, 8:00 am-5:00 pm, during school year. Free admission. Seismometer, maps, and interpretive displays on Mount Rainier glaciers, Wrangellia, Canyonlands National Park (Utah), and other subjects. *The Quaternary Research Center* (Room 19, (206) 543-1166, open Mon-Fri, 8:00 am-noon and 1:00-4:30 pm) has a large specialized geologic library.

Sequim (Clallam Co.): ㊲ *Museum and Arts Center*, 175 W. Cedar Street, (206*) 683-8110. Open daily, 9:00 am-4:00 pm. Donation suggested. Features remains from the Pleistocene Manis mastodon, including tusk, leg bone, and teeth. Interpretive video.

Spokane (Spokane Co.): ㊳ *Cheney-Cowles Museum*, W. 2316 1st. Ave., (509) 456-3931. Open Tues & Thur-Sat, 10:00 am-5:00 pm; Wed, 10:00 am-9:00 pm; Sun, 1:00-5:00 pm. Adult: $3.00. Display of 20 hand samples of ore, containing lead, silver, copper, and zinc, from the Coeur d'Alene (Idaho), Republic and Metaline (Washington), and Silverton (British Columbia) mining districts, with some basic mining equipment and historical mining photos.

Spokane (Spokane Co.): ㊴ *Whitworth College Geology Department*, Eric Johnson Science Center, 1st floor hallway and rooms 121 and 124, (509) 466-3265. Open Mon-Fri, 8:00 am-12:00 pm and 1:00 pm-5:00 pm, during school year. Free admission. Contact Science Center secretary to schedule admission to rooms. Large mineral collection featuring chemical mineral families, mineral and rock properties, metallic ores, invertebrate fossils, and petrified wood. Many well-organized and labeled samples also available in drawers and cabinets.

Stehekin (Chelan Co.): ㊵ *Golden West Visitor Center*, Lake Chelan Recreation Area, (206*) 856-5703 (ext. 14); satellite telephone subject to delays between speech and reception. Open daily; 12:30-2:00 pm, Mar 15-May 14; 7:30 am-4:00 pm, May 15-Sept 14; 10:30 am-2:00 pm, Sept 15-Oct. 16. Free admission. Small display about plate tectonics with some rock types. Slide show includes historic notes on local gold and copper mining.

Sultan (Snohomish Co.): ㊶ *Sky-Valley Museum*, 4th St. & U.S. Route 2 (above Post Office), (206*) 793-0650. Open 10:00 am-2:00 pm, 1st and 3rd Tues of the month. Donation suggested. One case of rocks and minerals with an additional shelf of geodes and petrified wood that children can handle.

Sunrise (Pierce Co.): ㊷ *Sunrise Visitor Center*, Mount Rainier National Park, located at the western terminus of Sunrise Road off State Route 410, (206*) 663-2454. Open Sun-Fri, 9:00 am-6:00 pm, and Sat, 9:00 am-7:00 pm, July 1 to mid-Sept. Admission free with $5.00 park entrance fee. Small display of rocks, glacial flour, and idealized geologic cross section of Mount Rainier. Daily ranger-led geologic talk and weekly walk to examine glacial geology (summer only).

Tacoma (Pierce Co.): ㊸ *University of Puget Sound Geology Department*, Thompson Hall (1st floor), (206) 756-3121. Open daily, 8:00 am-5:00 pm, during school year. Free admission. Display of various rocks, minerals, and geologic maps. Tri-directional seismometer displayed with interpretive notes.

Tacoma (Pierce Co.): ㊹ *Washington State Historical Society Museum*, 315 N. Stadium Way, (206) 593-2830. Open Tues-Sat, 10:00 am-5:00 pm. Adult: $2.50. Small display of basic mining equipment. Projected to open in July 1996, the new museum next to Union Station depot will feature a recreation of a coal mine based on the Roslyn area and a large display about the geologic history, topography, climate, and biological zones of Washington.

Tenino (Thurston Co.): ㊺ *South Thurston County Historical Society (Tenino Depot Museum)*, located across railroad tracks at Park & Ritter Sts., with entry at Howard & Park Sts., (206*) 264-4321, (206*) 264-4637 or (206*) 264-4620. Open Thur-Sun, noon-4:00 pm, mid-Apr to mid-Oct. Donation suggested. Display about the local historic dimension stone industry (Tenino sandstone), including basic quarrying equipment, historical photos, and a few examples of other Washington dimension stones. Small display of minerals.

Vantage (Kittitas Co.): ㊻ *Ginkgo Petrified Forest Museum*, Ginkgo Petrified Forest State Park, 0.5 miles north of Interstate 90 and 0.5 miles east on Ginkgo Ave., (509) 856-2700. Open weekends, mid-June to mid-Sept; call for hours. Free admission. Museum focuses on the geologic history of the Columbia Plateau. Many samples of petrified wood with some examples of Ellensburg Blue agates, Washington minerals, fossils, Mount St. Helens ash, and Native American petroglyphs. Slide show. Approximately 2.5 miles north of the Interstate 90 exit, an interpretive trail (free, open dawn to dusk daily) leads through Ginkgo Petrified Forest.

Vantage area (Grant Co.): ㊼ *Wanapum Heritage Center*, Wanapum Dam, approximately 5 miles south of Vantage on State Route 243 on the east side of the river, (509) 754-3541 (ext. 2571 or 2501). Open Mon-Fri, 8:30 am-4:30 pm; weekends, 9:00 am-5:00 pm. Free admission. Displays about the formation of the Columbia Plateau with some examples of petrified wood, basalt, stone archaeological artifacts, and exhibit on historic placer and lode gold mining.

Walla Walla (Walla Walla Co.): ㊽ *Whitman College Geology Department*, Hall of Science Bldg., 1st floor, (509) 527-5225. Open daily, 8:00 am-5:00 pm, during school session. Free admission. Large display containing large pieces of native copper, Eocene fossil fish from the Green River Formation (Wyoming), fossil leaves, nuts, and wood from the Clarno Formation (Eocene, Oregon), many other vertebrate and invertebrate fossils (including a 4-foot-diameter nautiloid and an echinoderm with spines); display about preservation of fossils; collection of zeolites, silicates, and other minerals, crystal models, and geologic maps.

Waterville (Douglas Co.): ㊾ *Douglas County Historical Museum* (Fig. 5), 124 Central Ave., (509) 745-8435 or (509) 745-8635. Open Tues-Sun, 11:00 am-5:00 pm, Memorial Day to 2nd week of Oct. Donation suggested. Large rock and mineral collection that includes petrified wood, fluorescent minerals, ores, and meteorites. Interpretive display on the 11,250 year-old Clovis Cache archeological site in East Wenatchee.

Wenatchee (Chelan Co.): ㊿ *North Central Washington Museum*, 127 S. Mission St., (509) 664-5989. Open Mon-Fri, 10:00 am-4:00 pm; Sat-Sun, 1:00-4:00 pm. $2.00 suggested donation. Closed weekends in January and selected holidays. Large collection of mostly marine invertebrate fossils displayed by geologic period and with interpretive tape. Fossils include some small dinosaur bone fragments. Large interpretive display on the archaeological dig at the Clovis Cache site in East Wenatchee (see Waterville), with replicas of stone spearpoints, displays of Rock Island petroglyphs, and a few Native American stone tools.

Wenatchee area (Chelan Co.): ㊿① *Rocky Reach Dam Visitor Center*, located on U.S. Route Alternate 97, about 7 miles north of Wenatchee, (509) 663-7522. Open daily, 8:00 am-5:00 pm, Feb. 16 to day before Memorial Day; daily, 8:00 am-8:00 pm, Memorial Day to Labor Day; daily, 8:00 am-5:00 pm, day after Labor Day to Jan. 1. Free admission. Displays on the geologic history of the Columbia Plateau, with rocks, petrified wood, and fossils, as well as stone tools and petroglyphs.

Wilbur (Lincoln Co.): ㊿② *Big Bend Historical Society*, Cole St. and Raymond St., (509) 647-5772 or (509) 647-5734. Open 1:00-5:00 pm, 3rd weekend of May; Sat, 2:00-4:00 pm, June 1 to Aug. 30. Donation suggested. Small room containing display of petrified wood, Republic-area fossils, local minerals, Mount St. Helens ash, geodes, meteorite fragment, and arrowheads.

Winthrop (Okanogan Co.): ㊿③ *Shafer Museum*, Corral St. & Castle Ave., (509) 996-2712. Open daily, 10:00 am-5:00 pm, Memorial Day weekend to Labor Day weekend; open weekends only, 10:00 am-5:00 pm, May. Donation suggested. Exhibits include mining equipment, arrastra (see Liberty in the list of outdoor sites), and assay office from the historic Slate Creek gold mining district, as well as some rocks.

Yakima (Yakima Co.): ㊿④ *Yakima Valley Museum*, 2105 Tieton Drive, (509) 248-0747. Open Mon-Fri, 10:00 am-5:00 pm, Sat/Sun, noon-5:00 pm. Adult: $2.50. Large mineral display featuring numerous examples of Ellensburg Blue and other blue agates, geodes, quartz varieties, and other minerals. Also included are petrified wood, invertebrate and vertebrate fossils, including a Pleistocene mammoth bone and tooth and mastodon tooth and tusk section, ammonites, Green River Formation fish (Eocene, Wyoming), and a dinosaur (*Apatosaurus*) femur.

Selected Outdoor Sites

Black Diamond area (King Co.): ㊺ *Flaming Geyser State Park*, location from Auburn, take the Auburn–Black Diamond Rd. and turn right on SE Green Valley Rd., 11 miles, (206) 931-3930. Open daily, 8:00 am-6:00 pm. Free admission. Site of a coal test hole drilled in 1911; gas from this hole subsequently became ignited. Only very minor amounts of gas now seep from the drill site; a (temporary) flame several inches high can be lit with a match. Gas bubbles from an undisturbed gas seep (Bubbling Geyser) can be observed at a site along a nearby stream and accessed by a trail.

Blewett site (Chelan Co.): ㊺⑥ *Blewett arrastra*, located on U.S. Route 97, about 11 miles south of the junction (near Cashmere) with U.S. Route 2. The exhibit is unattended and open continuously, but may be snow-covered in winter. Free admission. Well-worn base of an arrastra, a primitive tool used to process ore from the historic Blewett mines. (See also Liberty.) Located on west side of road between the base of stairway (near guardrail) and creek. Interpretive board located near parking area on east side of road. Watch for traffic when crossing highway.

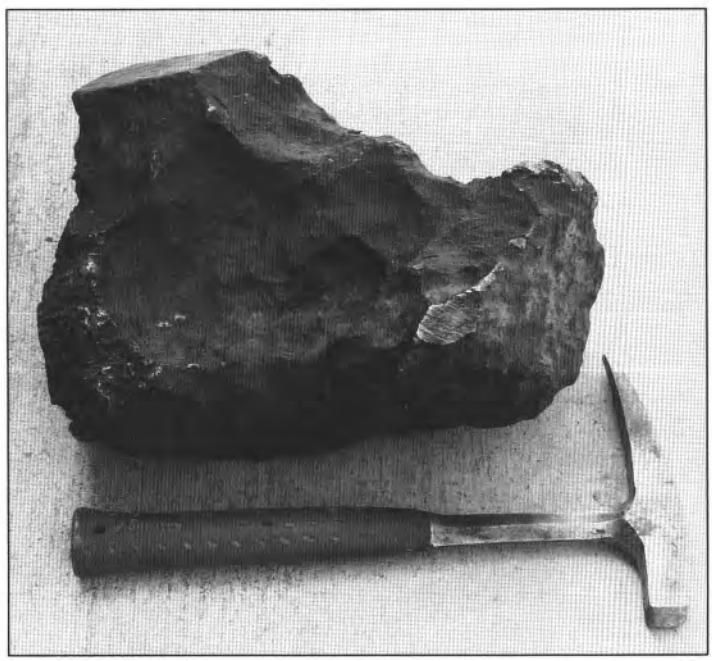


Figure 5. The Waterville meteorite, an 82-pound (original weight) iron-nickel meteorite found in 1917 near Waterville. The meteorite now weighs 73.25 pounds after subsequent sampling (note flat areas on upper left and front right sides). This was the first known meteorite recovery in Washington and is displayed with two other sizable meteorites at the Douglas County Historical Museum in Waterville.

Bumping Lake area (Yakima Co.): ⑤⑦ *Boulder Cave National Recreation Trail*, Wenatchee National Forest, located on State Route 410, 21.3 miles west of the junction with U.S. Route 12 (near Naches); cross the Naches River bridge (to the south) and follow Forest Road 1704 west 1.25 miles, (509) 653-2205. Unattended and open daily 8:00 am-6:00 pm, Apr. 2 to Oct. 31. Free admission. Cave closed for bat hibernation at other times. This wide, 400-foot-long cavern was formed by Devil Creek, which first eroded a steep-sided canyon through a lava flow and then meandered and undercut a sedimentary unit, causing the collapse of part of the flow. Interpretive boards. This is the largest cave of its type in North America. Hike to cave 0.75 mile up gentle hill (200-foot elevation gain) from parking area. Bring a lantern and jacket. Devil Creek runs through cave causing wet conditions in spring.

Cougar area (Skamania Co.): ⑤⑧ *Apes Headquarters (Ape Cave)*, Mount St. Helens National Volcanic Monument, located off State Route 503 east of Cougar, continue east on Forest Road 90, turn north on Forest Road 83, and then west on Forest Road 8303, (206*) 750-3900. Headquarters open Memorial Day to Labor Day, 10:00 am-5:30 pm. (Ape Cave is open year-round, but the forest roads are closed during winter). Admission free. Optional lantern rental $3.00 (summer). Named by a Boy Scout group (The Apes) that explored the cave, it is the longest lava tube in both North and South America (about 12,800 feet long). Interpretive board, daily (summer) ranger-led cave hikes Mon-Fri, 12:00, 1:30, 2:30; and Sat/Sun. 11:30, 12:30, 1:30, 2:30, 3:30, 4:30. Access stairways provided near each end of the cave. Bring raincoat for wet conditions in cave (from surface snowmelt or rainfall) and a warm jacket.

Diablo Lake (Whatcom Co.): ⑤⑨ *Diablo Lake Overlook*, North Cascades National Park, located on State Route 20, about 12 miles east of Newhalem, (206*) 386-4495. Exhibit is unattended and open continuously except when road is closed in winter. Free admission. Recently updated display shows eight major rock types found in the North Cascades and interpretation of plate tectonics. Occasional park-ranger talks about local glaciation (summer).

Liberty (Kittitas Co.): ⑥⓪ *Liberty arrastra* (no telephone). Located about 1.7 miles east of U.S. Route 97 on north side of Liberty Road. Exhibit is unattended and open continuously, but is covered by snow in winter. Free admission. Covered working replica of a historic arrastra used for processing ore in the Liberty–Blewett mining areas, and interpretive board. (See also Blewett site.)

Littlerock area (Thurston Co.): ⑥① *Mima Mounds Natural Area Preserve*. From Littlerock, go west on 128th Ave. and at the "T" road intersection, go right on Waddell Creek Road about 1 mile to entrance on left, (206*) 753-3410. Open daily dawn to dusk. Free admission. The preservation area is unattended and may be closed at various times for renovation work. Small, covered interpretive display and trails through this unusual topography. No dogs allowed on preserve.

Metaline area (Pend Oreille Co.): ⑥② *Gardner Cave*, Crawford State Park, 11 miles north of Metaline, on Boundary Road off State Route 31, (509) 446-4065 or (509) 456-4169. Open only for guided tours by park rangers, Thur-Mon, 10:00, 12:00, 2:00, 4:00, May to mid-Sept. Free admission. Please call to verify hours. Upper part of cave is lighted and has walkways and stairways. Lower cavern open by permission only. Washington's largest limestone cave (more than 2,000 feet long), featuring rimstone pools, stalactites, stalagmites, various flow structures, and a large column. Bring a warm jacket.

Molson (Okanogan Co.): ⑥③ *Old Molson Museum*, approximately 0.5 miles south of Molson School Museum on Molson Junction Road (see Molson on display list), (509) 485-3292. Exhibit is unattended and open continuously, but may be snowed in during winter. Donation suggested. Various historic buildings including 1896 Poland-China & Molson gold mine assay office, some mining equipment, and a small display of Washington minerals.

Editor's note: The author would like to know of other geological displays or outdoor features like those listed and that are open to the public. Additions may be published in future issues of *Washington Geology*. The author has applied for copyright of this material. ■

Thurston County Ground Water Report Released

The long-awaited study, **Hydrology and quality of ground water in northern Thurston County, Washington,** by N. P. Dion, G. L. Turney, and M. A. Jones, has just been issued as U.S. Geological Survey Water Resources Investigations Report 92-4109.

Copies are available from the USGS Water Resources Office, 1201 Pacific Ave., Suite 600, Tacoma, WA 98402, (206) 593-6510, and from Thurston County Public Health & Social Services, 2000 Lakeridge Dr. SW, Olympia, WA 98502, (206) 786-5581.

STAFF NOTES

Steve Luceno is our new Clerk Typist 2, replacing **Penny Dow**, who has gone to the Department of Social and Health Services. Steve is a 17-year Olympia resident and has held various temporary clerical positions with the State for the past 7 years. His previous position was Clerk Typist 2 with the Department of Labor and Industries.

Jan Allen has been promoted within the Department of Natural Resources from Administrative Assistant 1 at the SEPA Center to Administrative Assistant 2 for the Division of Geology and Earth Resources. She has a B.A. in education from the Evergreen State College and a teaching certificate through the University of Puget Sound. Jan has been with DNR for 10 years, working her way up from a position as Word Processing Operator 1 with the Olympic Region in Forks. On the way, she spent 7 months with the Engineering Division before going to the Lands and Minerals Division for 7 years, the last four of which have been in the SEPA Center. The SEPA Center was started in Lands and Minerals and only moved to the Policy, Analysis, and Research office in May of this year as part of the departmental reorganization. Jan is originally from Bakersfield, California, and has been in Washington since 1977.

Selected Additions to the Library of the Division of Geology and Earth Resources

August, 1994, through October 1994

THESES

Amadi, Eric Ejike, 1992, The 1990 Nooksack Forks, Washington, earthquake sequence—Sequence geometry and temporal characteristics: Boise State University Master of Science thesis, 103 p.

Cooper, Craig Emerson, 1994, Downstream fining in a mountain stream channel affected by debris flow: Western Washington University Master of Science thesis, 50 p.

Rasmussen, Michael Grant, 1993, The geology and origin of the Overlook gold deposit, Ferry County, Washington: University of Washington Doctor of Philosophy thesis, 154 p., 1 pl.

Swanson, Dan, 1993, Variations in the grain size distribution and the chemical composition of the Mount Rainier C-ash unit: University of Puget Sound Senior thesis, 1 v.

Williams, Barbara Cooke, 1992, Comparison of multivariate statistics and the geochemical code WATEQ4F for water quality interpretation in acidic tailings: University of Idaho Doctor of Philosophy thesis, 164 p.

U.S. GEOLOGICAL SURVEY REPORTS

Crosson, R. S.; Creager, K. C., 1992, Earthquake hazard research in the Pacific Northwest and Alaska—Final technical report, 1991: U.S. Geological Survey contract report, 1 v.

Fuhrer, G. J.; Fluter, S. L.; McKenzie, S. W.; Rinella, J. F.; Crawford, J. K.; Cain, D. J.; Hornberger, M. I.; Bridges, J. L.; Skach, K. A., 1994, Surface-water-quality assessment of the Yakima River basin in Washington—Major- and minor-element data for sediment, water, and aquatic biota, 1987–91: U.S. Geological Survey Open-File Report 94-308, 223 p.

Hickman, Stephen; Sibson, Richard; Bruhn, Ronald, editors; Jacobson, Muriel, compiler, 1994, Proceedings of workshop LXIII—The mechanical involvement of fluids in faulting: U.S. Geological Survey Open-File Report 94-228, 615 p.

Includes:

Moore, J. C.; Cochrane, G. R.; Moore, G. F., Reversed-polarity seismic reflections along faults of the Oregon accretionary prism—Indicators of fluid migration and accumulation, p. 92-106.

Howell, D. G.; and others, editors, 1993, The future of energy gases: U.S. Geological Survey Professional Paper 1570, 890 p.

Includes:

Lorenson, T. D.; Kvenvolden, K. A., A comparison of hydrocarbon gases from natural sources in the northwestern United States, p. 453-470.

Hubbard, L. L., 1994, Floods of November 1990 in western Washington: U.S. Geological Survey Open-File Report 93-631, 10 p., 1 pl.

Ingebritsen, S. E.; Mariner, R. H.; Sherrod, D. R., 1994, Hydrothermal systems of the Cascade Range, north-central Oregon: U.S. Geological Survey Professional Paper 1044-L, 86 p., 2 pl.

Kresch, D. L., 1994, Variability of streamflow and precipitation in Washington: U.S. Geological Survey Water Resources Investigations Report 93-4132, 32 p.

Krimmel, R. M., 1993, Mass balance, meteorological, and runoff measurements at South Cascade Glacier, Washington, 1992 balance year: U.S. Geological Survey Open-File Report 93-640, 38 p.

McGee, K. A.; Casadevall, T. J., 1994, A compilation of sulfur dioxide and carbon dioxide emission-rate data from Mount St. Helens during 1980–88: U.S. Geological Survey Open-File Report 94-212, 23 p.

McLaughlin, R. J.; Sliter, W. V.; Frederiksen, N.; and others, 1994, Plate motions recorded in tectonostratigraphic terranes of the Franciscan complex and evolution of the Mendocino triple junction, northwestern California: U.S. Geological Survey Bulletin 1997, 60 p.

Sullivan, M. E., 1994, South Cascade Glacier, Washington—Hydrologic and meteorological data, 1957–67: U.S. Geological Survey Open-File Report 94-77, 105 p., 1 disk.

Switzer, J. C.; Porcella, R. L., compilers, 1994, Catalogue of U.S. Geological Survey strong-motion records, 1991: U.S. Geological Survey Circular 1101, 12 p.

Tomlinson, S. A., 1994, Instrumentation, methods, and preliminary evaluation of evapotranspiration for a grassland in the Arid Lands Ecology Reserve, Benton County, Washington, May–October 1990: U.S. Geological Survey Water-Resources Investigations Report 93-4081, 32 p.

Wagner, R. J.; Lane, R. C., 1994, Selected ground-water information for the Columbia Plateau regional aquifer system, Washington and Oregon, 1982–85—Volume III, Ground-water quality data: U.S. Geological Survey Open-File Report 93-359, 226 p.

Wells, R. E.; Cascadia Working Group, 1993, Cascadia—Regional lithospheric studies of the Pacific Northwest: U.S. Geological Survey Open-File Report 93-706, 38 p.

Whiteman, K. J.; Vaccaro, J. J.; Gonthier, J. B.; Bauer, H. H., 1994, The hydrogeologic framework and geochemistry of the Columbia Plateau aquifer system, Washington, Oregon, and Idaho: U.S. Geological Survey Professional Paper 1413-B, 73 p.

OTHER REPORTS ON WASHINGTON GEOLOGY

Barnes, L. G., 1993, Early Cenozoic fossil Cetacea from the Olympic Peninsula, Washington: Natural History Museum of Los Angeles County [under contract to] the National Geographic Society, 17 p.

Danner, W. R., 1994, The pseudocoprolites of Salmon Creek, Washington: University of British Columbia Department of Geological Sciences Report 19, 7 p.

Garland, Dave; Erickson, Denis, 1994, Ground water quality survey near Edaleen Dairy, Whatcom County, Washington, January 1990 to April 1993: Washington Department of Ecology Publication 94-37, 1 v.

Hughes, Geoffrey, 1994, Radon in Washington: Washington State Department of Health Environmental Radiation Program Special Report, 101 p.

Includes:

Goetz, V. L., Radon potential of Washington from a geologic viewpoint. p. 87-93.

Jamestown S'Klallam Tribe, 1994, The DQ plan—The Dungeness–Quilcene water resources management plan: Jamestown S'Klallam Tribe [Sequim, Wash.], 1 v.

King County Department of Public Works, Surface Water Management Division, 1993, Green River channel migration study: King County Department of Public Works, 46 p., 5 pl.

King County Parks, Planning, and Resources Department, 1994, King County comprehensive plan—Executive proposed plan, June 1994: King County Parks, Planning and Resources Department, 160 p.

Lander, J. F.; Lockridge, P. A.; Kozuch, M. J., 1993, Tsunamis affecting the west coast of the United States, 1806–1992: U.S. National Geophysical Data Center Key to Geophysical Records Documentation 29, 243 p.

Rashin, Ed; Clishe, Casey; Loch, Andy, 1994, Effectiveness of forest road and timber harvest best management practices with respect to sediment-related water quality impacts: Washington Department of Ecology Publication 94-67; Timber, Fish and Wildlife Program TFW-WQ8-94-001, 1 v.

Schuett-Hames, Dave; Pess, George, 1994, A strategy to implement watershed analysis monitoring—Assessment of parameters and methods, monitoring module outline, recommendations for program development: Timber, Fish and Wildlife Program TFW-AM14-94-001, 57 p.

Swanson, D. A.; Haugerud, R. A., editors, 1994, Geologic field trips in the Pacific Northwest: University of Washington Department of Geological Sciences, 2 v.

Includes:

Brandon, M. T.; Cowan, D. S.; Feehan, J. G., Fault-zone structures and solution-mass-transfer cleavage in Late Cretaceous nappes, San Juan Islands, Washington. v. 2, p. 2L 1-19.

Brownfield, M. E.; Affolter, R. H.; Johnson, S. Y.; Flores, R. M., Tertiary coals of western Washington. v. 1, p. 1E 1-18.

Bucknam, R. C.; Leopold, E. B.; Hemphill-Haley, Eileen; Ekblaw, D. E.; Atwater, B. F.; Benson, B. E.; Phipps, J. B., Holocene tectonics in western Washington. v. 2, p. 2C 1-15.

Easterbrook, D. J., Stratigraphy and chronology of early to late Pleistocene glacial and interglacial sediments in the Puget Lowland, Washington. v. 1, p. 1J 1-38.

Evarts, R. C.; Swanson, D. A., Geologic transect across the Tertiary Cascade Range, southern Washington. v. 2, p. 2H 1-31.

Galster, R. W.; Laprade, W. T.; Beaman, B. R., Engineering geology of Seattle and vicinity. v. 2, p. 2D 1-16.

Hammond, P. E.; Brunstad, K. A.; King, J. F., Mid-Tertiary volcanism east of Mount Rainier—Fifes Peak volcano-caldera and Bumping Lake pluton–Mount Aix caldera. v. 2, p. 2J 1-19.

Haugerud, R. A.; Brown, E. H.; Tabor, R. W.; Kriens, B. J.; McGroder, M. F., Late Cretaceous and early Tertiary orogeny in the North Cascades. v. 2, p. 2E 1-53.

Hopson, C. A.; Mattinson, J. M., Chelan Migmatite Complex, Washington—Field evidence for mafic magmatism, crustal anatexis, mixing and protodiapiric emplacement. v. 2, p. 2K 1-21.

Kuper, H. T.; MacDonald, Anne; Burns, S. F.; Kuper, D. E.; Schuster, R. L.; Logan, R. L.; Pringle, P. T., Character of landslides in western Washington and Oregon. v. 1, p. 1L 1-22.

Lindsey, K. A.; Reidel, S. P.; Fecht, K. R.; Slate, J. L.; Law, A. G.; Tallman, A. M., Geohydrologic setting of the Hanford site, south-central Washington. v. 1, p. 1C 1-16.

Magloughlin, J. F., Migmatite to fault gouge—Fault rocks and the structural and tectonic evolution of the Nason terrane, North Cascade Mountains, Washington. v. 2, p. 2B 1-17.

Nesbitt, E. A.; Campbell, K. A.; Goedert, J. L., Paleogene cold seeps and macroinvertebrate faunas in a forearc sequence of Oregon and Washington. v. 1, p. 1D 1-11.

Paterson, S. R.; Miller, R. B.; Anderson, J. L.; Lund, S. P.; Bendixen, J. E.; Taylor, N. W.; Fink, Tom, Emplacement and evolution of the Mt. Stuart batholith. v. 2, p. 2F 1-47.

Pringle, P. T., editor; Driedger, C. L.; Frank, D. G.; McKenna, Juliet M.; Murphy, M. T.; Scott, K. M.; Sisson, T. W.; Vallance, J. W.; and others, Mount Rainier, a Decade Volcano GSA field trip. v. 2, p. 2G 1-23.

Reidel, S. P.; Tolan, T. L.; Beeson, M. H., Factors that influenced the eruptive and emplacement histories of flood basalt flows—A field guide to selected vents and flows of the Columbia River Basalt Group. v. 1, p. 1B 1-18.

Stein, J. K., Geoarchaeology of sites on San Juan Island, Washington. v. 1, p. 1I 1-22.

Suczek, C. A.; Babcock, R. S.; Engebretson, D. C., Tectonostratigraphy of the Crescent terrane and related rocks, Olympic Peninsula, Washington. v. 1, p. 1H 1-11.

Thackray, G. D.; Pazzaglia, F. J., Quaternary stratigraphy, tectonic geomorphology, and fluvial evolution of the western Olympic Peninsula, Washington. v. 2, p. 2A 1-29.

Waitt, R. B.; O'Connor, J. E.; Benito, Gerardo, Scores of gigantic, successively smaller Lake Missoula floods through channeled scabland and Columbia valley. v. 1, p. 1K 1-88.

Waitt, R. B.; Pierson, T. C., The 1980 (mostly) and earlier explosive eruptions of Mount St. Helens volcano. v. 2, p. 2I 1-37.

U.S. Geodynamics Committee, 1994, Mount Rainier—Active Cascade volcano; Research strategies for mitigating risk from a high, snow-clad volcano in a populous region: National Academy Press, 114 p.

University of Washington Geophysics Program, 1994, Quarterly network report 94-B on seismicity of Washington and western Oregon, April 1 through June 30, 1994: University of Washington Geophysics Program, 29 p.

Washington Department of Health, Division of Radiation Protection, 1994, Closure of the Dawn Mining Company uranium millsite in Ford, Washington—Draft supplemental environmental impact statement: Washington Department of Health, 1 v.

Washington Foundation for the Environment, 1991, The Washington natural heritage education project—Natural resources education; A supplementary curriculum for Washington history classes, activity guide and background information, grades 7-9: Washington Foundation for the Environment, 1 v., 1 videotape.

PAPERS ON WASHINGTON GEOLOGY

Anundsen, Karl; Abella, S. E. B.; Leopold, E. B.; Stuiver, Minze; Turner, Sheila, 1994, Late-glacial and early Holocene sea-level fluctuations in the central Puget Lowland, Washington, inferred from lake sediments: Quaternary Research, v. 42, no. 2, p. 149-161.

Booth, D. B., 1994, Glaciofluvial infilling and scour of the Puget Lowland, Washington, during ice-sheet glaciation: Geology, v. 22, no. 8, p. 695-698.

Chamberlain, V. E.; Lambert, R. St J., 1994, Lead isotopes and the sources of the Columbia River Basalt Group: Journal of Geophysical Research, v. 99, no. B6, p. 11,805-11,817.

Chleborad, A. F., 1994, Modelling and analysis of the 1949 Narrows landslide, Tacoma, Washington: Association of Engineering Geologists Bulletin, v. 31, no. 3, p. 305-327.

Clague, J. J.; Bobrowsky, P. T., 1994, Tsunami deposits beneath tidal marshes on Vancouver Island, British Columbia: Geological Society of America Bulletin, v. 106, no. 10, p. 1293-1303.

Evarts, R. C.; Gray, L. B.; Turrin, B. D.; Smith, J. G.; Tosdal, R. M., 1994, Isotopic and fission-track ages of volcanic and plutonic rocks and hydrothermal alteration in the Spirit Lake quadrangle and adjacent areas, southwestern Washington: Isochron/West, no. 61, p. 25-47.

Hoblitt, R. P.; Harmon, R. S., 1993, Bimodal density distribution of cryptodome dacite from the 1980 eruption of Mount St. Helens, Washington: Bulletin of Volcanology, v. 55, no. 6, p. 421-437.

Lutter, W. J.; Catchings, R. D.; Jarchow, C. M., 1994, An image of the Columbia Plateau from inversion of high-resolution seismic data: Geophysics, v. 59, no. 8, p. 1278-1289.

McCrory, P. A., 1994, Spirit leveling—Measuring the earth's pulse: Quinault Natural Resources, v. 17, no. 2, p. 30-31.

Pierson, T. C.; Janda, R. J., 1994, Volcanic mixed avalanches—A distinct eruption-triggered mass-flow process at snow-clad volcanoes: Geological Society of America Bulletin, v. 106, no. 10, p. 1351-1358.

Shevenell, Lisa; Goff, F. E., 1993, Addition of magmatic volatiles into the hot spring waters of Loowit Canyon, Mount St. Helens, Washington, USA: Bulletin of Volcanology, v. 55, no. 7, p. 489-503.

Smith, G. A., 1991, Facies sequences and geometries in continental volcaniclastic sediments. *In* Fisher, R. V.; Smith, G. A., editors, Sedimentation in volcanic settings: SEPM (Society for Sedimentary Geology) Special Publication 45, p. 109-121.

Sorenson, S. S.; Grossman, J. N., 1993, Accessory minerals and subduction zone metasomatism—A geochemical comparison of two melanges (Washington and California, U.S.A.): Chemical Geology, v. 110, no. 1-3, p. 269-297.

Squires, R. L.; Goedert, J. L., 1994, New species of early Eocene small to minute mollusks from the Crescent Formation, Black Hills, southwestern Washington: The Veliger, v. 37, no. 3, p. 253-266.

Trehu, A. M.; Asudeh, Isa; Brocher, T. M.; Luetgert, J. H.; Mooney, W. D.; Nabelek, J. L.; Nakamura, Y., 1994, Crustal architecture of the Cascadia forearc: Science, v. 266, no. 5183, p. 237-243.

Tschernich, R. W., 1994, Zeolites from the 200/237 quarry, near Wolf Point, Cowlitz County, Washington: Micro Probe, v. 7, no. 10, p. 2-10.

Wuethrich, Bernice, 1994, It's official—Quake danger in Northwest rivals California's: Science, v. 265, no. 5180, p. 1802-1803.

OTHER REPORTS, GENERAL TOPICS

Mutti, Emiliano; and others, 1993, Turbidites sandstones: Istituto di Geologia Universita di Parma, 275 p.

Temanex Consulting, Inc., 1994, Industrial minerals opportunities in pulp and paper in British Columbia to the year 2003: Temanex Consulting, Inc. [North Vancouver, B.C.], 1 v.

U.S. Bureau of Mines, 1992, Minerals yearbook; Volume III, Minerals in the world economy, 1989 international review: U.S. Bureau of Mines, 52 p.

U.S. Bureau of Mines, 1994?, Minerals yearbook; Volume I, Metals and minerals, 1992: U.S. Bureau of Mines, 1495 p.

U.S. Bureau of Mines, 1994, Minerals yearbook; Volume II, Area reports—Domestic, 1992: U.S. Bureau of Mines, 617 p.

Includes:

Minarik, R. J.; Derkey, R. E.; Gulick, C. W., The mineral industry of Washington. p. 575-585. ■

Index to Washington Geology, 1993–1994

AUTHOR INDEX

Bleeck, J. A.; Sherar, R. L.; Gulick, C. W., 1993, The 'geology' of papermaking: v. 21, no. 3, p. 3-8.

Bloomquist, R. G., *see* Schuster, J. E., 1994.

Brunengo, M. J., 1994, Geologic hazards and the Growth Management Act: v. 22, no. 2, p. 4-10.

Brunengo, M. J., *see also*
Dragovich, J. D., 1993.
Gerstel, W. J., 1994.

Derkey, R. E., 1993, Metallic mineral deposits: v. 21, no. 1, p. 4-25.

Derkey, R. E., 1994, Hot springs and ore deposition on the sea floor off the Washington coast: v. 22, no. 1, p. 24-28.

Derkey, R. E., 1994, Metallic mineral deposits: v. 22, no. 1, p. 16-18.

Derkey, R. E.; Gulick, C. W., 1994, Washington's mineral industry—1993: v. 22, no. 1, p. 3-15.

Derkey, R. E.; Gulick, C. W.; Lingley, W. S., Jr., 1993, Washington's mineral industry—1992: v. 21, no. 1, p. 3-4.

Derkey, R. E., *see also*
Dragovich, J. D., 1994.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton Creek–Mineral River [sic] area, Lewis County, Washington; Part 1—Terrain and geologic factors: v. 21, no. 3, p. 9-18.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton River–Mineral Creek area, Lewis County, Washington; Part 2—Soils, harvest age, and conclusions: v. 21, no. 4, p. 18-30.

Dragovich, J. D.; Derkey, R. E., 1994, A Late Triassic island-arc setting for the Holden volcanogenic massive sulfide deposit, North Cascades, Washington: v. 22, no. 1, p. 28-39.

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Evans, Stephen, 1994, Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941: v. 22, no. 4, p. 3-10.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

Gerstel, W. J., *see also*
Dragovich, J. D., 1993.

Gibbons, S. T., 1993, National Natural Landmarks Program in the Pacific Northwest region: v. 21, no. 1, p. 38-40.

Goetz, V. L., 1993, Radon potential of Washington from a geologic viewpoint: v. 21, no. 2, p. 11-14.

Gulick, C. W., 1994, Industrial minerals: v. 22, no. 1, p. 19-22.

Gulick, C. W.; Lingley, W. S., Jr., 1993, Sand and gravel, quarried rock, and industrial minerals: v. 21, no. 1, p. 25-30.

Gulick, C. W., *see also*
Bleeck, J. A., 1993.
Derkey, R. E., 1993, 1994.

Harris, C. F. T., 1993, The changing role of cartography in DGER—Plugging into the Geographic Information System: v. 21, no. 2, p. 15-16.

Hopkins, D. Q., *see* Wehr, W. C., 1994.

Jazdzewski, S. P., *see* Lingley, W. S., Jr., 1994.

Knoblach, D. A., 1993, Washington's stone industry—A history: v. 21, no. 4, p. 3-17.

Knoblach, D. A., 1994, Guide to geologic, mineral, fossil, and mining history displays in Washington: v. 22, no. 4, p. 11-17.

Lasmanis, Raymond, 1993, National Geologic Mapping Act update: v. 21, no. 3, p. 2.

Lasmanis, Raymond, 1993, Revised state surface mining act—1993: v. 21, no. 2, p. 2.

Lasmanis, Raymond, 1993, Tacoma smelter stack demolished: v. 21, no. 1, p. 41-42.

Lasmanis, Raymond, 1993, Victor F. Hollister exploration files: v. 21, no. 4, p. 2.

Lasmanis, Raymond, 1994, Developments in environmental regulation: v. 22, no. 1, p. 2.

Lasmanis, Raymond, 1994, The Division's role in environmental regulation: v. 22, no. 3, p. 2, 48.

Lasmanis, Raymond, 1994, Growth management in Washington State: v. 22, no. 2, p. 3.

Lasmanis, Raymond, 1994, A tribute to field collectors: v. 22, no. 4, p. 2.

Lewis, S. E., 1994, Fossil earwigs (Dermaptera) from the Klondike Mountain Formation (middle Eocene) of Republic, Washington: v. 22, no. 1, p. 39-40.

Lewis, S. E.; Wehr, W. C., 1993, Fossil mayflies from Republic, Washington: v. 21, no. 1, p. 35-37.

Lingley, W. S., Jr.; Jazdzewski, S. P., 1994, Aspects of growth management planning for mineral resource lands: v. 22, no. 2, p. 36-45.

Lingley, W. S., Jr., *see also*
Derkey, R. E., 1993.
Gulick, C. W., 1993.

Manson, C. J., 1994, Contributions of the Division library to growth management planning: v. 22, no. 2, p. 45-46.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

Palmer, S. P., 1994, Revision to the 1994 Uniform Building Code seismic zone map for Washington and Oregon: v. 22, no. 2, p. 35.

Palmer, S. P., *see also* Gerstel, W. J., 1994.

Pelto, M. S., 1993, Current behavior of glaciers in the North Cascades and effect on regional water supplies: v. 21, no. 2, p. 3-10.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

Pringle, P. T., *see also*
Dragovich, J. D., 1994.

Schasse, H. W., 1993, Coal activity in Washington—1992: v. 21, no. 1, p. 31-32.

Schasse, H. W., 1994, Coal activity in Washington—1993: v. 22, no. 1, p. 23.

Schuster, J. E., 1994, Progress on the state geologic map: v. 22, no. 3, p. 39-42.

Schuster, J. E.; Bloomquist, R. G., 1994, Low-temperature geothermal resources of Washington: v. 22, no. 3, p. 43-45.

Sherar, R. L., *see* Bleeck, J. A., 1993.

Thorsen, G. W., 1994, Earthquake preparedness—When you're not at home: v. 22, no. 3, p. 35-38.

Walsh, T. J., 1993, Proposed seismic zone changes in western Washington: v. 21, no. 1, p. 2, 40.

Walsh, T. J., 1993, Strong motion system installed in Natural Resources Building: v. 21, no. 1, p. 32.

Walsh, T. J., 1994, Growth management planning for abandoned coal mines: v. 22, no. 2, p. 33-34.

Walsh, T. J., *see also* Dragovich, J. D., 1994.

Washington Geology, 1993, Addendum to Oil and gas exploration activity in Washington, 1991 and 1992: v. 21, no. 1, p. 33-34.

Wehr, W. C.; Hopkins, D. Q., 1994, The Eocene orchards and gardens of Republic, Washington: v. 22, no. 3, p. 27-34.

Wehr, W. C., *see* Lewis, S. E., 1993.

SUBJECT INDEX

ABANDONED MINES

Walsh, T. J., 1994, Growth management planning for abandoned coal mines: v. 22, no. 2, p. 33-34.

CARTOGRAPHY and GEOGRAPHIC INFORMATION SYSTEMS

Harris, C. F. T., 1993, The changing role of cartography in DGER—Plugging into the Geographic Information System: v. 21, no. 2, p. 15-16.

CASCADE RANGE

Pelto, M. S., 1993, Current behavior of glaciers in the North Cascades and effect on regional water supplies: v. 21, no. 2, p. 3-10.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

CHELAN CO.

Dragovich, J. D.; Derkey, R. E., 1994, A Late Triassic island-arc setting for the Holden volcanogenic massive sulfide deposit, North Cascades, Washington: v. 22, no. 1, p. 28-39.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

COWLITZ CO.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

EARTHQUAKES AND SEISMOLOGY

Palmer, S. P., 1994, Revision to the 1994 Uniform Building Code seismic zone map for Washington and Oregon: v. 22, no. 2, p. 35.

Thorsen, G. W., 1994, Earthquake preparedness—When you're not at home: v. 22, no. 3, p. 35-38.

Walsh, T. J., 1993, Proposed seismic zone changes in western Washington: v. 21, no. 1, p. 2, 40.

Walsh, T. J., 1993, Strong motion system installed in Natural Resources Building: v. 21, no. 1, p. 32.

ENGINEERING GEOLOGY

Evans, Stephen, 1994, Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941: v. 22, no. 4, p. 3-10.

Palmer, S. P., 1994, Revision to the 1994 Uniform Building Code seismic zone map for Washington and Oregon: v. 22, no. 2, p. 35.

ENVIRONMENTAL PROTECTION

Lasmanis, Raymond, 1994, Developments in environmental regulation: v. 22, no. 1, p. 2.

Lasmanis, Raymond, 1994, The Division's role in environmental regulation: v. 22, no. 3, p. 2, 48.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

FERRY CO.

Lewis, S. E., 1994, Fossil earwigs (Dermaptera) from the Klondike Mountain Formation (middle Eocene) of Republic, Washington: v. 22, no. 1, p. 39-40.

Lewis, S. E.; Wehr, W. C., 1993, Fossil mayflies from Republic, Washington: v. 21, no. 1, p. 35-37.

Wehr, W. C.; Hopkins, D. Q., 1994, The Eocene orchards and gardens of Republic, Washington: v. 22, no. 3, p. 27-34.

FOREST SOILS AND SLOPE STABILITY

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton Creek–Mineral River [sic] area, Lewis County, Washington; Part 1—Terrain and geologic factors: v. 21, no. 3, p. 9-18.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton River–Mineral Creek area, Lewis County, Washington; Part 2—Soils, harvest age, and conclusions: v. 21, no. 4, p. 18-30.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

Fossil collecting, *see* **MINERAL AND FOSSIL COLLECTING**

Geographic Information Systems, *see* **CARTOGRAPHY and GEOGRAPHIC INFORMATION SYSTEMS**

GEOLOGIC HAZARDS

Brunengo, M. J., 1994, Geologic hazards and the Growth Management Act: v. 22, no. 2, p. 4-10.

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Lasmanis, Raymond, 1994, Growth management in Washington State: v. 22, no. 2, p. 3.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

GEOLOGIC MAPS AND MAPPING

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

Lasmanis, Raymond, 1993, National Geologic Mapping Act update: v. 21, no. 3, p. 2.

Schuster, J. E., 1994, Progress on the state geologic map: v. 22, no. 3, p. 39-42.

GEOPHYSICS - SEISMIC SURVEYS

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

GEOTHERMAL RESOURCES

Schuster, J. E.; Bloomquist, R. G., 1994, Low-temperature geothermal resources of Washington: v. 22, no. 3, p. 43-45.

GLACIERS

Pelto, M. S., 1993, Current behavior of glaciers in the North Cascades and effect on regional water supplies: v. 21, no. 2, p. 3-10.

GROWTH MANAGEMENT ACT

Brunengo, M. J., 1994, Geologic hazards and the Growth Management Act: v. 22, no. 2, p. 4-10.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

Lasmanis, Raymond, 1994, Growth management in Washington State: v. 22, no. 2, p. 3.

Lingley, W. S., Jr.; Jazdzewski, S. P., 1994, Aspects of growth management planning for mineral resource lands: v. 22, no. 2, p. 36-45.

Manson, C. J., 1994, Contributions of the Division library to growth management planning: v. 22, no. 2, p. 45-46.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

Walsh, T. J., 1994, Growth management planning for abandoned coal mines: v. 22, no. 2, p. 33-34.

HISTORY

Evans, Stephen, 1994, Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941: v. 22, no. 4, p. 3-10.

Knoblach, D. A., 1993, Washington's stone industry—A history: v. 21, no. 4, p. 3-17.

Knoblach, D. A., 1994, Guide to geologic, mineral, fossil, and mining history displays in Washington: v. 22, no. 4, p. 11-17.

HYDROLOGY

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

Pelto, M. S., 1993, Current behavior of glaciers in the North Cascades and effect on regional water supplies: v. 21, no. 2, p. 3-10.

JUAN DE FUCA RIDGE

Derkey, R. E., 1994, Hot springs and ore deposition on the sea floor off the Washington coast: v. 22, no. 1, p. 24-28.

KING CO.

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Evans, Stephen, 1994, Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941: v. 22, no. 4, p. 3-10.

Schasse, H. W., 1994, Coal activity in Washington—1993: v. 22, no. 1, p. 23.

Land use planning, *see* **GROWTH MANAGEMENT**

LANDSLIDES AND SLOPE STABILITY

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton Creek–Mineral River [sic] area, Lewis County, Washington; Part 1—Terrain and geologic factors: v. 21, no. 3, p. 9-18.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton River–Mineral Creek area, Lewis County, Washington; Part 2—Soils, harvest age, and conclusions: v. 21, no. 4, p. 18-30.

Evans, Stephen, 1994, Draining Seattle—WPA Landslide Stabilization Projects, 1935–1941: v. 22, no. 4, p. 3-10.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

LAWS AND LEGISLATION

Lasmanis, Raymond, 1993, National Geologic Mapping Act update: v. 21, no. 3, p. 2.

LEWIS CO.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton Creek–Mineral River [sic] area, Lewis County, Washington; Part 1—Terrain and geologic factors: v. 21, no. 3, p. 9-18.

Dragovich, J. D.; Brunengo, M. J.; Gerstel, W. J., 1993, Landslide inventory and analysis of the Tilton River–Mineral Creek area, Lewis County, Washington; Part 2—Soils, harvest age, and conclusions: v. 21, no. 4, p. 18-30.

Schasse, H. W., 1994, Coal activity in Washington—1993: v. 22, no. 1, p. 23.

LIBRARY SERVICES

Manson, C. J., 1994, Contributions of the Division library to growth management planning: v. 22, no. 2, p. 45-46.

MARINE GEOLOGY

Derkey, R. E., 1994, Hot springs and ore deposition on the sea floor off the Washington coast: v. 22, no. 1, p. 24-28.

MINERAL AND FOSSIL COLLECTING

Knoblach, D. A., 1994, Guide to geologic, mineral, fossil, and mining history displays in Washington: v. 22, no. 4, p. 11-17.

Lasmanis, Raymond, 1994, A tribute to field collectors: v. 22, no. 4, p. 2.

MINERAL INDUSTRY AND RESOURCES

Bleeck, J. A.; Sherar, R. L.; Gulick, C. W., 1993, The 'geology' of papermaking: v. 21, no. 3, p. 3-8.

Derkey, R. E., 1993, Metallic mineral deposits: v. 21, no. 1, p. 4-25.

Derkey, R. E., 1994, Metallic mineral deposits: v. 22, no. 1, p. 16-18.

Derkey, R. E.; Gulick, C. W., 1994, Washington's mineral industry—1993: v. 22, no. 1, p. 3-15.

Derkey, R. E.; Gulick, C. W.; Lingley, W. S., Jr., 1993, Washington's mineral industry—1992: v. 21, no. 1, p. 3-4.

Dragovich, J. D.; Derkey, R. E., 1994, A Late Triassic island-arc setting for the Holden volcanogenic massive sulfide deposit, North Cascades, Washington: v. 22, no. 1, p. 28-39.

Gulick, C. W., 1994, Industrial minerals: v. 22, no. 1, p. 19-22.

Gulick, C. W.; Lingley, W. S., Jr., 1993, Sand and gravel, quarried rock, and industrial minerals: v. 21, no. 1, p. 25-30.

Knoblach, D. A., 1993, Washington's stone industry—A history: v. 21, no. 4, p. 3-17.

Lasmanis, Raymond, 1993, Tacoma smelter stack demolished: v. 21, no. 1, p. 41-42.

Lasmanis, Raymond, 1993, Victor F. Hollister exploration files: v. 21, no. 4, p. 2.

Lasmanis, Raymond, 1994, Developments in environmental regulation: v. 22, no. 1, p. 2.

Lasmanis, Raymond, 1994, The Division's role in environmental regulation: v. 22, no. 3, p. 2, 48.

Lasmanis, Raymond, 1994, Growth management in Washington State: v. 22, no. 2, p. 3.

Lingley, W. S., Jr.; Jazdzewski, S. P., 1994, Aspects of growth management planning for mineral resource lands: v. 22, no. 2, p. 36-45.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

Schasse, H. W., 1993, Coal activity in Washington—1992: v. 21, no. 1, p. 31-32.

Schasse, H. W., 1994, Coal activity in Washington—1993: v. 22, no. 1, p. 23.

Walsh, T. J., 1994, Growth management planning for abandoned coal mines: v. 22, no. 2, p. 33-34.

Washington Geology, 1993, Addendum to Oil and gas exploration activity in Washington, 1991 and 1992: v. 21, no. 1, p. 33-34.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

Lasmanis, Raymond, 1993, Revised state surface mining act—1993: v. 21, no. 2, p. 2.

Lasmanis, Raymond, 1994, Developments in environmental regulation: v. 22, no. 1, p. 2.

MOUNT RAINIER

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

MOUNT SAINT HELENS

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

NATURAL HISTORY

Gibbons, S. T., 1993, National Natural Landmarks Program in the Pacific Northwest region: v. 21, no. 1, p. 38-40.

OKANOGAN CO.

Bleeck, J. A.; Sherar, R. L.; Gulick, C. W., 1993, The 'geology' of papermaking: v. 21, no. 3, p. 3-8.

Norman, D. K., 1993, Tri-State Agreement on Mining: v. 21, no. 3, p. 19-21.

PALEONTOLOGY

Lewis, S. E., 1994, Fossil earwigs (Dermaptera) from the Klondike Mountain Formation (middle Eocene) of Republic, Washington: v. 22, no. 1, p. 39-40.

Lewis, S. E.; Wehr, W. C., 1993, Fossil mayflies from Republic, Washington: v. 21, no. 1, p. 35-37.

Wehr, W. C.; Hopkins, D. Q., 1994, The Eocene orchards and gardens of Republic, Washington: v. 22, no. 3, p. 27-34.

PAPERMAKING

Bleeck, J. A.; Sherar, R. L.; Gulick, C. W., 1993, The 'geology' of papermaking: v. 21, no. 3, p. 3-8.

PIERCE CO.

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33.

RADON

Goetz, V. L., 1993, Radon potential of Washington from a geologic viewpoint: v. 21, no. 2, p. 11-14.

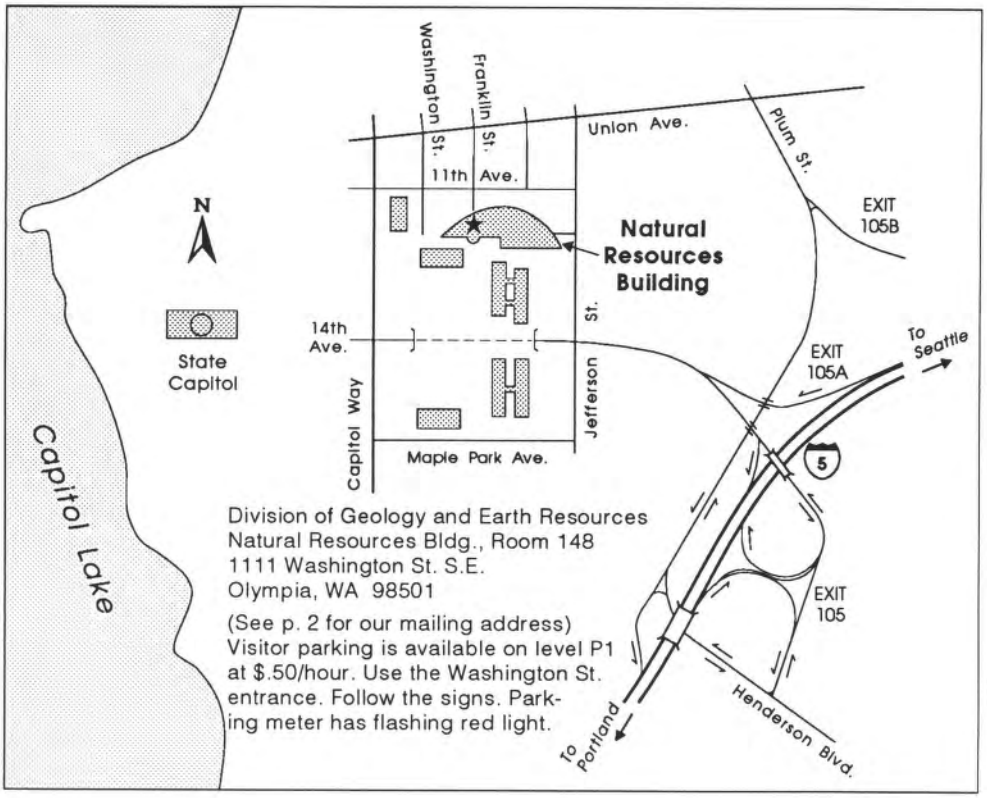
SKAGIT CO.

Gerstel, W. J.; Brunengo, M. J., 1994, Mass wasting on the urban fringe: v. 22, no. 2, p. 11-17.

SMELTERS

Lasmanis, Raymond, 1993, Tacoma smelter stack demolished: v. 21, no. 1, p. 41-42.

HOW TO FIND OUR MAIN OFFICE



SPOKANE CO.

Gerstel, W. J.; Palmer, S. P., 1994, Geologic and geophysical mapping of the Spokane aquifer—Relevance to growth management: v. 22, no. 2, p. 18-24.

THURSTON CO.

Walsh, T. J., 1993, Strong motion system installed in Natural Resources Building: v. 21, no. 1, p. 32.

Schasse, H. W., 1994, Coal activity in Washington—1993: v. 22, no. 1, p. 23.

TSUNAMIS

Thorsen, G. W., 1994, Earthquake preparedness—When you're not at home: v. 22, no. 3, p. 35-38.

VOLCANISM AND VOLCANIC HAZARDS

Dragovich, J. D.; Pringle, P. T.; Walsh, T. J., 1994, Extent and geometry of the mid-Holocene Osceola mudflow in the Puget Lowland—Implications for Holocene sedimentation and paleogeography: v. 22, no. 3, p. 3-26.

Pringle, P. T., 1994, Volcanic hazards in Washington—A growth management perspective: v. 22, no. 2, p. 25-33. ■

UPCOMING MEETINGS

Northwest Geological Society

At the next meeting on January 10, 1995, Kevin Lindsey will speak on Late Neogene backarc basin sedimentation. February and March topics are to be announced.

Meetings are at the University Plaza Hotel, 400 NE 45th St., Seattle. They begin at 5:30 pm; presentations are at 7:30 pm. For information about the society, contact Donn Charnley, 19344 11th Ave NW, Seattle, WA 98177. Professional dues are $20, students $5 annually.

American Institute of Mining and Metallurgical Engineers – Society for Mining, Metallurgy and Exploration

In eastern Washington, AIME-SME members meet jointly on the third Tuesday of the month at the Shilo Inn in Spokane. For more information about meeting times and costs, contact Jack Sakowski, U.S. Bureau of Mines, (509) 352-2700.

Society of Inland Northwest Environmental Scientists

The next meeting of the Society of Inland Northwest Environmental Scientists (SINES) will be on January 26 at 6:30 pm (social hour) or 7:30 pm (meeting) in the Glacier Room at Cavanaugh's Fourth Avenue (110 Fourth Ave.) in Spokane. For more information about this group, call (509) 458-2331 or (509) 838-8120.

ICE AGE FLOODS INSTITUTE

An interagency Ice Age Floods Task Force was formed in 1993. The charge for the task force, which is composed of state, federal, and private entities, is to develop a comprehensive framework for interpreting the Ice Age flood story to the American public. This story affects a four-state area and eight of Washington's National Natural Landmarks.

As an offshoot of the task force, a nonprofit Ice Age Floods Institute was recently formed. The institute is in the process of electing board members and is interested in garnering support from private individuals and local communities. Those interested in becoming a member of the institute should contact:

Ms. Mikki Kisson (Interim chair)
Ice Age Floods Institute
PO Box 1133, Spokane, WA 99210
(509) 659-0663

The task force continues to meet, seeking Congressional recognition and support for this coordinated interpretive effort. It will provide technical expertise to the Ice Age Floods Institute. If you would like additional information about the task force, contact:

Mr. Gerry Tays (Chair)
Coulee Dam National Recreation Area
1008 Crest Dr., Coulee Dam, WA 99116-0037
(509) 633-9441

(from the fall issue of Landmark News, a product of the National Park Service, Seattle office)

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Jennifer M. Belcher - Commissioner of Public Lands
Kaleen Cottingham - Supervisor

Department of Natural Resources
Division of Geology and Earth Resources
PO Box 47007
Olympia, WA 98504-7007

BULK RATE
U.S. POSTAGE PAID
Washington State
Department of Printing

ADDRESS CORRECTION REQUESTED

ADDRESS CORRECTION REQUESTED