

LEGEND

ICE AND SNOW

- Glacier ice, exposed as of August 31, 1976
- Snow, as of August 31, 1976
- Snowline, generalized as of September 26, 1970
- Past positions of glacier terminus (dated):
 - Active ice face
 - Stagnant ice face

EARTH

- Bare rock, talus, or soil
- Moraine, on or off ice and snow
- Stream gravel

DRAINAGE

- Perennial stream, lake
- Perennial stream under snow
- Marsh

VEGETATION

- Forest (mostly cone-bearing trees)
- Brush (deciduous shrubs)
- Meadow/tundra

ACCESS

- Medium-duty road
- Light-duty road
- Trail

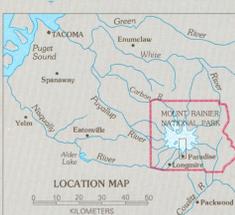
SURVEY POINTS

- Horizontal control station
- Vertical control station (benchmark)
- Auxiliary point
- Spot elevation (no mark on surface)

REFERENCE LINE INTERSECTIONS

- 1-minute latitude, longitude
- 1000-meter Universal Transverse Mercator grid, zone 10

*In 1951 and 1956, stagnant ice existed downstream from the active ice face.



NOTES ON NISQUALLY GLACIER

Nisqually Glacier, a typical small, steep valley glacier cascading down the southern flank of Mt. Rainier, has a long history of scientific observation, one unique in the Western Hemisphere. Its first European visitor was A.V. Kautz in 1857, and it was described in a scientific paper by S.F. Emmons in 1871. The first ice flow measurements were made by J.N. LeConte in 1905. Since 1918 the terminus position has been measured annually, and since 1931 surveys of three transverse elevation profiles have been made every year, largely by Arthur Johnson. A program of mapping the glacier at 5-year intervals also was begun in 1931. This 1976 map continues that cycle and commemorates this long history of glaciological studies by showing past terminus positions and other items of interest.

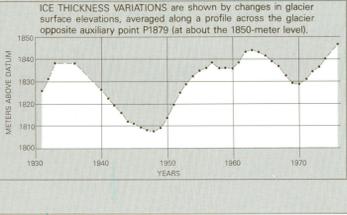
The glacier responds dramatically to climatic variations. It is nourished by snowfalls which are among the heaviest in the world; snow depths of over 12 meters were measured in 1972. The year 1976 was characterized by a cool, wet summer following a winter with slightly above-average snowfall. The snow-covered area shown on this map is larger than normal for late August, and is typical of early July conditions in most years. For comparison the snowline in late summer of 1970, a below-normal year, also is shown. In 1976, relatively little glacier ice was exposed; in normal years ice is exposed up to about the 2100- to 2600-meter level.

Although the glacier is a thin one, generally less than 100 meters, the ice flows fairly rapidly, reaching a maximum in May or June of about 0.2-0.3 meters a day opposite Glacier Vista, over a meter a day at the base of the icefall, and even more in the steepest part of the icefall at the 3,500-meter level. The flow slows to its minimum of about half that rate in November or December.

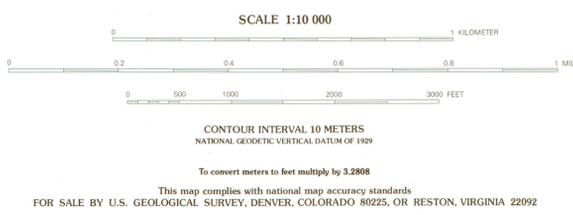
The maximum length of Nisqually Glacier since the last ice age (which peaked some 20,000 years ago) occurred about 1840. Except for a minor advance from about 1903 to 1906, the glacier retreated continuously until the early 1960's, when the terminus started to advance again.

This advance had been anticipated. Surveys made in 1946 showed upper levels of the glacier beginning to thicken. This action continued, and in 1949 thickening was apparent at the middle profile (see figure below). In 1955 lower levels began to thicken, and by 1961-62 the terminus was moving across bare ground, continuing its progress until 1968. It then receded slightly until 1974. In 1976 a second wave of thickening reached the terminus, and it was advancing again.

The 1946 thickening (a surprise, as virtually all of the world's mountain glaciers were then in retreat) might have been the first indication of the major global change to a slightly cooler and more moist climate evident in the 1940's. In response to this change Nisqually Glacier became nearly 50% thicker and flowed 20 times faster than before, thus showing it to be a very sensitive recorder of climatic changes.



Mapped, edited, and published by the Geological Survey in cooperation with the National Park Service
Control by USGS and NOS/NOAA
Topography by photogrammetric methods from aerial photographs taken August 31, 1976
Glacier features and vegetation classified by USGS Project Office, Glaciology
Warning: Glacier crevasses not shown
Projection and 10,000-foot grid ticks: Washington coordinate system, south zone (Lambert conformal conic)
1000-meter Universal Transverse Mercator grid ticks, zone 10, shown in blue. 1927 North American datum
For previous mappings, see map sheets Nisqually Glacier 1921, 1936, 1941, and 1946 published 1960, Nisqually Glacier 1951, 1956, and 1961 published 1963, Nisqually Glacier 1966 published 1968, and Nisqually Glacier 1971 published 1973



Interor-Geological Survey, Reston, Virginia-1976
1 plan sheet

UTM GRID AND 1976 MAGNETIC NORTH DECLINATION AT CENTER OF MAP

NISQUALLY GLACIER
WASHINGTON
1976