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LIQUEFACTION SUSCEPTIBILITY OF THE GREATER TACOMA URBAN AREA, PIERCE AND KING COUNTIES, WASHINGTON

by

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2003

This research was supported by the U.S. Geological Survey (USGS) under award number 99HQGR0073. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government. Additional support was provided by the Washington Department of Natural Resources.

EXAMPLES OF HISTORIC LIQUEFACTION EFFECTS

The strong ground shaking that occurs during an earthquake can cause loose, sandy soil layers to become more compacted as the sand grains rearrange themselves. This is similar to the effect of shaking a sugar container to make more space at the top. Liquefaction occurs if the spaces between the sand grains are water saturated at the time of the earthquake. As the sand layer compacts during the earthquake, the ground water is expelled under pressure and will often vent to the surface.

The following two photographs document liquefaction effects in a residential neighborhood in Puyallup (site 9) that were caused by the 1949 Olympia earthquake. In the upper photograph, the street is flooded with standing water over two feet deep. This is the ground water expelled from the underlying loose soil as as result of liquefaction; there were no reported breakages in the water lines servicing the area. The lower photograph shows that expelled ground water can carry significant amounts of liquefied sand to the ground surface, depositing it in cone-shaped piles called sand blows.

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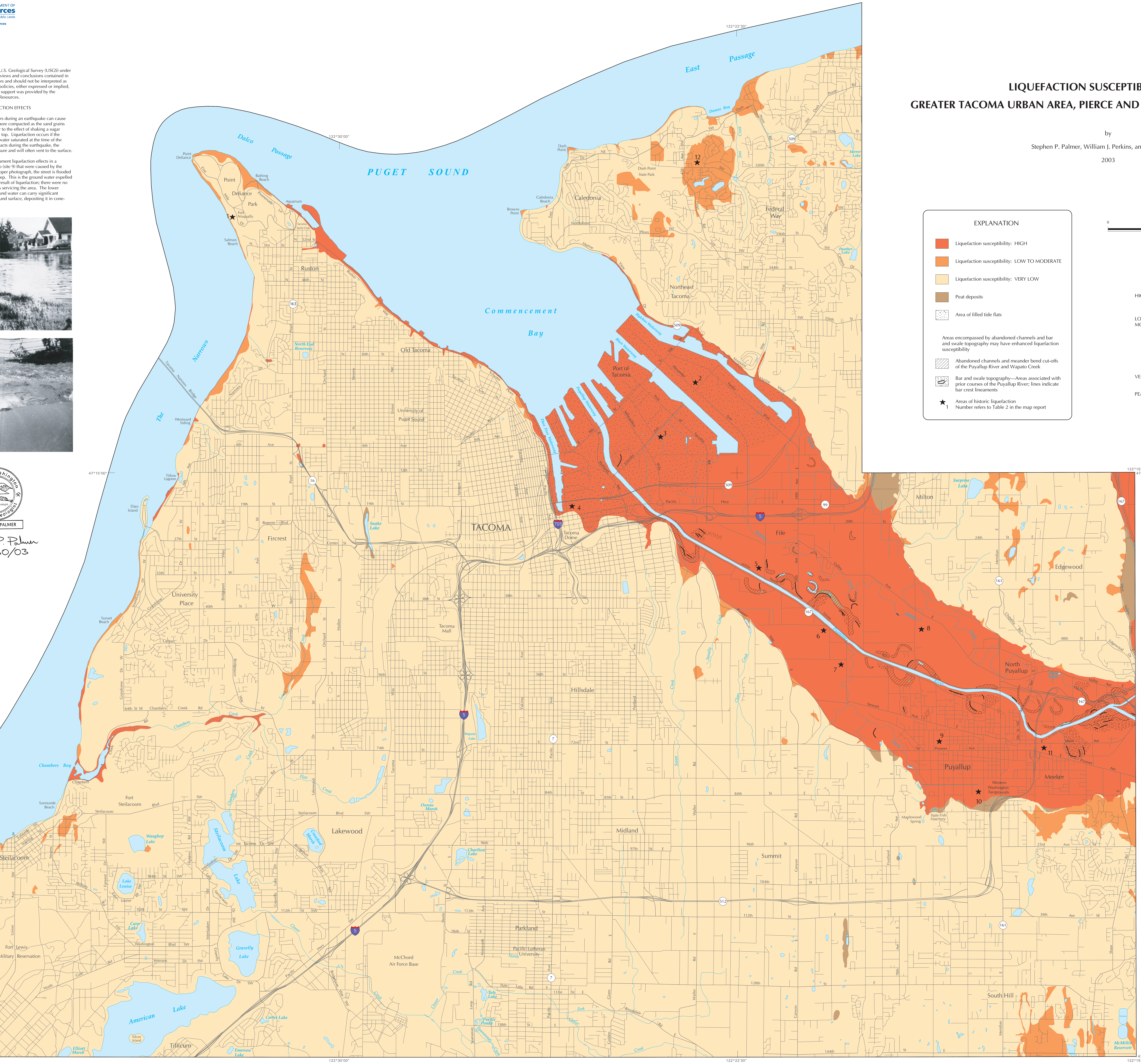

EXPLANATION

- Liquefaction susceptibility: HIGH
- Liquefaction susceptibility: LOW TO MODERATE
- Liquefaction susceptibility: VERY LOW
- Peat deposits
- Area of filled tide flats

Areas encompassed by abandoned channels and bar and swale topography may have enhanced liquefaction susceptibility

- Abandoned channels and meander bend cut-offs of the Puyallup River and Wapato Creek
- Bar and swale topography—Areas associated with prior courses of the Puyallup River; lines indicate bar crest lineaments
- ★ 1 Areas of historic liquefaction Number refers to Table 2 in the map report

SCALE = 1:30,000

0 0.75 1.5 2.25 3
miles

0 0.75 1.5 2.25 3
kilometers

HIGH	Areas underlain by artificial fill and recent (Holocene) deposits of the Puyallup River and major streams (such as Chambers Creek).
LOW TO MODERATE	Areas underlain by recent (Holocene) beach and landslide deposits and sandy outwash, glacial lake, and ice contact deposits from the recession of the latest (late Pleistocene) continental glaciation (Vashon Stade) of the Fraser Glaciation. The liquefaction susceptibility of these sandy glacial deposits is greatest where they are disturbed by grading and in areas with a shallow ground-water table.
VERY LOW	Areas underlain by all other Pleistocene glacial and nonglacial deposits.
PEAT DEPOSITS	Areas underlain by recent (Holocene) peat deposits, mainly in the Puyallup Valley. Peat is not susceptible to liquefaction but may undergo permanent displacement or loss of strength as a result of earthquake shaking. Also, sand beds within the peat deposits may be liquefiable.

WHAT IS LIQUEFACTION?

LIQUEFACTION is a phenomenon in which strong earthquake shaking causes a soil to rapidly lose its strength and behave like quicksand. Liquefaction typically occurs in artificial fills and areas of loose sandy soils that are saturated with water, such a low-lying coastal areas, lake shores, and river valleys. When soil strength is lost during liquefaction, the consequences can be catastrophic. Movement of liquefied soils can rupture pipelines, move bridge abutments and road and railway alignments, and pull apart the foundations and walls of buildings.

Ground movement resulting from liquefaction caused massive damage to highways and railways throughout southern Alaska during the 1964 Good Friday earthquake. Liquefaction was a contributing factor to the severe building damage that occurred in the Marina District of San Francisco during the 1989 Loma Prieta earthquake. Control of the ensuing fires in the Marina District was severely hampered because water lines in the area were broken by liquefaction-induced ground movement. Damage cause by liquefaction to the port area of Kobe, Japan, during the 1995 earthquake resulted in billions of dollars in reconstruction costs and lost business.

WHAT IS A LIQUEFACTION SUSCEPTIBILITY MAP?

A LIQUEFACTION SUSCEPTIBILITY MAP provides an estimate of the likelihood that the soil will liquefy as a result of earthquake shaking. This type of map depicts the relative hazard in terms of high, moderate, or low liquefaction susceptibility. The hazard zones shown on this map were determined using geologic mapping and quantitative analysis of data from more than 500 geotechnical borings drilled in the study area.

HOW CAN THIS MAP BE USED?

LIQUEFACTION HAZARD MAPS such as this can be used for many different purposes by a variety of users. For example:

Emergency managers can determine which critical facilities and lifelines are located in hazardous areas.

Building officials and engineers can select areas where detailed geotechnical studies should be performed before new construction or retrofitting older structures.

Facilities managers can assess the vulnerability of corporate and public facilities, including schools, and recommend actions required to minimize earthquake damage and loss.

Insurance providers can determine relative seismic risk to aid in the calculation of insurance ratings and premiums.

Land use planners can recommend appropriate zoning and land use in high hazard areas to promote long-term mitigation of earthquake losses by reducing vulnerability.

Private property owners can guide their decisions on retrofitting, purchasing, and upgrading their properties.

This map is meant only as a general guide to delineate areas prone to liquefaction. It is not a substitute for site-specific investigation to assess the potential for liquefaction for any development project. Because the data used in the liquefaction susceptibility assessment have been subdivided on the basis of regional geologic mapping, this map cannot be used to determine the presence or absence of liquefiable soils beneath any specific locality. This determination requires a site-specific geotechnical investigation performed by a qualified practitioner. For additional information, refer to the enclosed map report.

Map location consists of all of the Tacoma South and Puyallup and parts of the Gig Harbor, Tacoma North, Poverty Bay, and Steilacoom 7.5-minute USGS topographic quadrangles.

Lambert conformal conic projection
1927 North American Datum
Transportation sources:
King County Information and Telecommunication Division
Pierce County Geographic Information Services Division
Other base map information:
Washington Department of Natural Resources
Geographic Information System database 2001
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