TOWN OF PORTOLA VALLEY

Geologic Safety Committee Meeting
November 13, 2023
10:00 AM

Chet Wrucke, Chair
Nan Shostak, Vice Chair
Patricia McCrory, Secretary
Gary Ernst, Member
Steve Ingebritsen, Member
Bob Wrucke, Member

REGULAR MEETING –
HISTORIC SCHOOLHOUSE - 765 PORTOLA ROAD ~ PORTOLA VALLEY

REMOTE MEETING ADVISORY: On March 1, 2023, all committees in Portola Valley will return to conducting in-person meetings. A Zoom link will be provided for members of the public to participate remotely; however, the Town cannot guarantee there will be no technical issues with the software during the meeting. For best public participation results, attending the meeting in-person is advised.

ASSISTANCE FOR PEOPLE WITH DISABILITIES

In compliance with the Americans with Disabilities Act, if you need special assistance to participate in this meeting, please contact the Town Clerk at (650) 851-1700 or by email at towncenter@portolavalley.net. Notification 48 hours prior to the meeting will enable the Town to make reasonable arrangements to ensure accessibility to this meeting.

VIRTUAL PARTICIPATION VIA ZOOM

To access the meeting by computer:
https://us06web.zoom.us/j/86866361512?pwd=lQ4ESV9vuvg7EBbqGkRQ2tHLDua5Re.1

Webinar ID: ***868 6636 1512***

Passcode: ***791174***

To access the meeting by phone:
1-669-900-6833 or 1-888-788-0099 (toll-free)

*Mute/Unmute – Press *6* **/** *Raise Hand – Press *9*

1. **CALL TO ORDER & WELCOME TO NEW MEMBER, TROY DOUTHIT**

2. **ROLL CALL**

3. **ORAL COMMUNICATIONS FOR ITEMS NOT ON THE AGENDA**
   Speakers' time is limited to three minutes.

4. **APPROVAL OF MINUTES**
   a. Approve meeting minutes from October 9, 2023

5. **OLD BUSINESS**
   a. Review subcommittee report on evacuation for earthquake-triggered wildfire

6. **ADJOURNMENT**
   The next meeting will be held on December 11, 2023 at 10:00 AM

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Land Acknowledgement:

The Town of Portola Valley acknowledges the colonial history of this land we dwell upon—the unceded territory of the Ramaytush (rah-my-toosh) Ohlone, Tamien Nation, and Muwekma (mah-WEK-mah) Ohlone, who endured a human and cultural genocide that included removal from their lands and their sacred relationship to the land. Portola Valley recognizes that we profit from the commodification of land seized from indigenous peoples and now bear the ecological consequences. We seek to understand the impact of these legacies on all beings and to find ways to make repair.

Minutes of
GEOLOGIC SAFETY COMMITTEE MEETING
TOWN OF PORTOLA VALLEY
Monday, October 09, 2023

Meeting location: Town Council Chamber in the Old Schoolhouse. This meeting was streamed via Zoom and recorded.

Committee Members present:

Chester Wrucke [chair]
Nan Shostak [co-chair]
Gary Ernst
Patricia McCrory
Bob Wrucke

Town Council member present:

Mary Hufty

Pending committee member present at the schoolhouse:

Troy Douthit

Committee Member not present:

Steven Ingebritsen

MEETING SUMMARY

Most of the meeting focused on the sub-committee's add-on to the town's evacuation plan, namely how a damaging earthquake might complicate evacuation of the town if accompanied by triggered wildfire. In particular, committee members recommended shortening the draft text while strengthening the executive summary. Revised version to be presented during the November GSC meeting. Committee also reviewed possible historical activity on the Black Mountain and Berrocal fault zones. These are secondary faults within the San Andreas fault system which cross through southern Portola Valley.

Call to order and roll call:

1005. Chairman Chet Wrucke called the meeting to order, noting five committee members were present thus the meeting had a quorum.

Approval of minutes of the previous meeting:

1010. The committee voted to approve the minutes of the previous meeting.

Chet requested comments from the public on topics not on the agenda:

No comments.

Old Business:

A sub-committee, consisting of Nan Shostak, Gary Ernst, Bob Wrucke, had been tasked with drafting an add-on to the updated town evacuation plan being prepared by the Emergency Preparedness Committee. The add-on considers how a damaging earthquake concurrent with wildfire might cut off evacuation routes. Nan outlined the draft plan and requested feedback from the full committee. Consensus that current text needs to be condensed to be more accessible to relevant town staff and committees as well as to town residents in general. A map depicting bridges and fault crossings will be included in the final report as both are considered potential fail points along evacuation routes. An additional concern was raised that intense ground shaking, if surficial deposits are water saturated, could trigger slope failures that block evacuation routes.

New Business:

Nan reviewed historical geologic observations of the Black Mountain and Berrocal fault zones which documented surface disruption following the 1906 San Francisco earthquake. The observations are fragmentary but suggest triggered slip during the 1906 M7.8 event. The committee discussed whether the inferred fault traces should be included on the town geologic map and the process for doing so.

1155. Committee voted to approve a sub-committee, Pat McCrory and Nan Shostak, to inform the Midpeninsula Regional Open Space District about Black Mountain and Berrocal faults as they pertain to plans to open the Woods Estate property (Hawthorns) to the public.

Chet Wrucke requests shorter minutes (!).

Adjournment:

1200. Committee votes to end meeting.

Evacuation of Portola Valley After an Earthquake-Triggered Wildfire v. 2a

1 Summary

It is not a matter of if, but when, the next damaging earthquake will strike Portola Valley. A strong earthquake (magnitude 6 or greater) can create dangerous conditions that could start a fire. Should a large fire develop in Portola Valley after an earthquake, then evacuating all or part of the Town would likely be necessary. Evacuation routes must be passable. Blockages could be catastrophic.

An earthquake-triggered wildfire places special constraints on evacuation. Direct ground displacement and effects of seismic shaking can create obstructions on evacuation routes. Nearly immediate ignition of fires can leave little time to organize an orderly evacuation. Many locations along Portola Valley's major evacuation routes could be severely damaged after a strong earthquake. The knowledge of how and potentially where earthquakes can damage the Town's evacuation routes is essential information for everyone living or working in Portola Valley.

The Town's emergency evacuation routes are highly vulnerable to blockages caused by earthquakes. The Portola Valley Geologic Safety Committee recommends three actions the Town should take now to improve the success of evacuation after an earthquake-triggered wildfire and to mitigate the risk to human life:

- Empower, train and equip the Town's existing volunteer emergency road crew, working in conjunction with the Public Works Department, to inspect, clear and repair roads immediately after a damaging earthquake.
- Designate wildfire safety zones, *i.e.,* large, flat, open areas in the Town where people who cannot evacuate early can shelter from high fire exposure conditions.
- Commission a seismic vulnerability study of the Town's evacuation routes and implement the recommendations of the study.

2 Portola Valley's Faults and Damaging Earthquakes

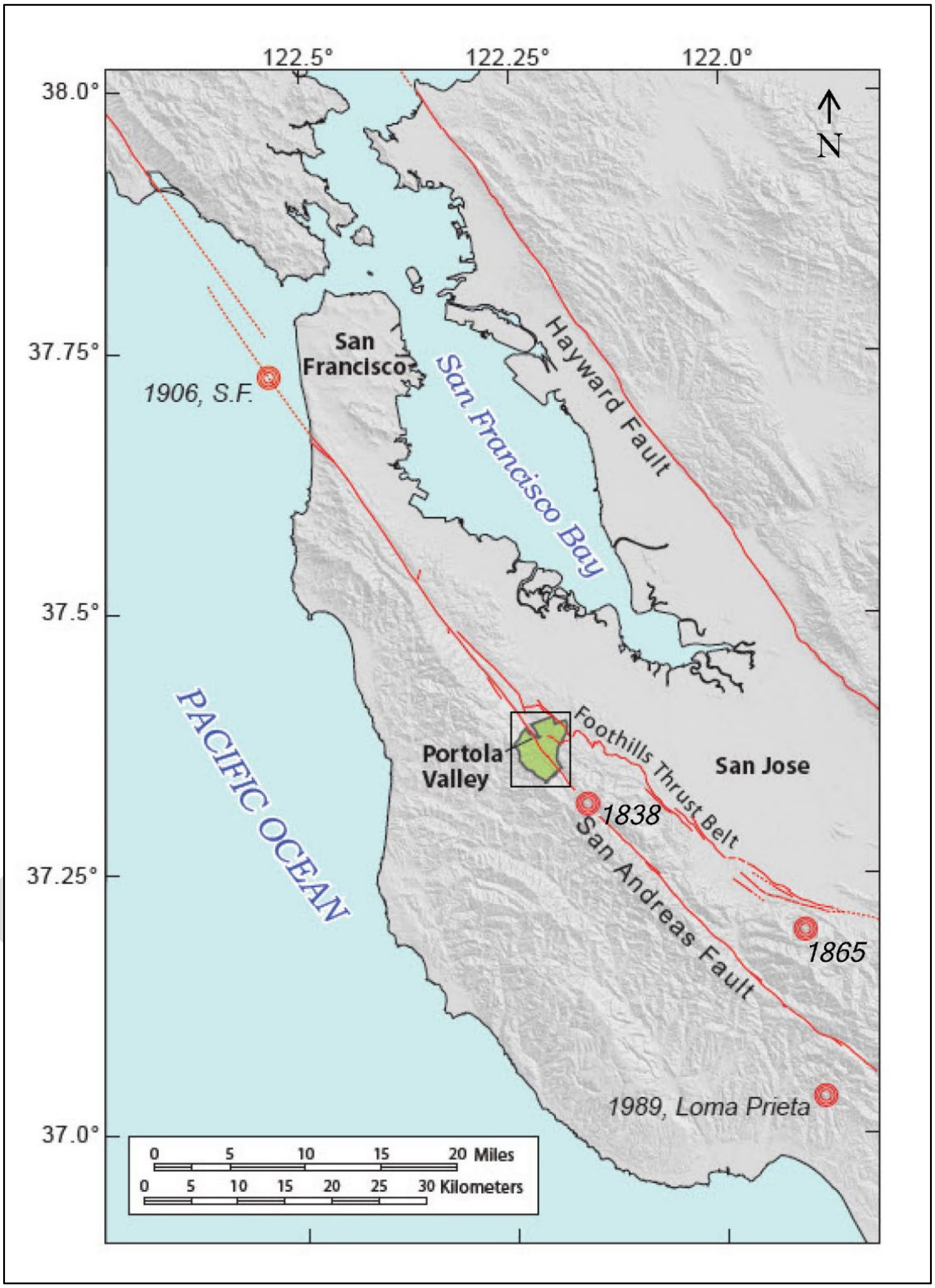

Figure 1. Relief map of the San Francisco Bay Region, showing Portola Valley, the Foothills Thrust Belt, Hayward fault, San Andreas fault, and epicenters of the 1838, 1865, 1906, and 1989 earthquakes. The 1906 and 1989 epicenters are known with good certainty; for the 1838 and 1865 epicenters, best-estimate locations are shown. All epicenters are from the [Historic Earthquakes database of the California Geological Survey](). The box outlined in black is enlarged in Figure 2.

Portola Valley is susceptible to destructive earthquakes because it is bisected by the active San Andreas fault, one of the longest and most dangerous earthquake fault systems in the world. The Town's other important faults are part of a wide, *en echelon* fault zone, the Foothills Thrust Belt, which lies northeast of and roughly parallel to the San Andreas fault (Figure 1). These secondary faults are all capable of movement triggered by an earthquake on the San Andreas fault; moreover, they can independently rupture in damaging earthquakes. Faults known to have been active within the past ~12,000 years are considered the most dangerous, but all faults are weak places in the Earth's crust, and all are susceptible to being triggered by a strong earthquake on another fault.

Earth scientists of the U.S. Geological Survey, the California Geological Survey, and the Town of Portola Valley have mapped most of the known faults in the Town. In addition to the mapped faults, Portola Valley undoubtedly contains other active faults yet to be discovered.

Seismic hazard in Portola Valley arises primarily from ruptures of the San Andreas fault zone and the Foothills Thrust Belt and includes other, less active, faults on the Peninsula. The first, third, and fourth of the Peninsula's four most recent, damaging earthquakes, in 1838, 1906, and 1989, ruptured the San Andreas fault zone. The 1906 and 1989 earthquakes additionally triggered ground displacement in the Foothills Thrust Belt; triggered movement in 1838 also is likely but is not documented. The second event was an independent rupture of the Foothills Thrust Belt in 1865 (Figure 1).

2.1 1838 San Francisco Peninsula earthquake

In June 1838, an earthquake nearly as severe as the 1906 event 68 years later ruptured the San Andreas fault along the San Francisco Peninsula. It was felt in Monterey and caused damage to buildings at the Presidio in San Francisco and at Mission San Jose (in present-day Fremont). Woodside was severely shaken: the tops of redwood trees were snapped off; adobe buildings were badly damaged; and breaks in walls were created that were wide enough for a person to walk through.

The 1838 earthquake is estimated to have had a magnitude of 6.8 – 7.4. Historical records of damage indicate a magnitude of approximately 7.2. Researchers are uncertain about the exact location of the epicenter, but recent work on the 1838 earthquake supports this estimate of magnitude and has placed the likely epicenter on the San Andreas fault somewhere southeast of Page Mill Road. Portola Valley lies between the epicenter and Woodside; therefore, the shaking and damage in Portola Valley were likely to have been at least as severe as in Woodside.

2.2 1865 Southern San Francisco Peninsula

The earthquake of October 8, 1865, had a magnitude estimated at 6.5. Its epicenter was located in the southern Foothills Thrust Belt, in the mountains of the southern San Francisco Peninsula (Figure 1). Buildings along the entire length of the Peninsula were damaged, from Santa Cruz, where brick walls were cracked and chimneys were thrown down, to New Almaden (now southwestern San Jose), where several houses were knocked off their foundations, to San Francisco, where City Hall was destroyed. Numerous other buildings were ruined, and water and gas pipes under the streets were broken. In Half Moon Bay, large rock slides were triggered along the ocean bluffs, and in Redwood City, the front wall of the County courthouse was reported to have been “considerably sprung”.

2.3 1906 San Francisco earthquake

The most recent earthquake causing severe damage in Portola Valley occurred on the San Andreas fault on 18 April 1906 (magnitude 7.8). The epicenter was off the coast of San Francisco (Figure 1), and the surface rupture extended nearly 300 miles from San Francisco to north of Cape Mendocino and, simultaneously, from San Francisco to south of San Juan Bautista. Cities, towns, and villages along the entire length of the rupture experienced severe damage from shaking, and landslides, liquefaction; fires triggered by the shaking were common. Some towns also had damage from direct fault rupture.

In 1906, the rupture transected the valley in the middle of Portola village. The long, strong shaking caused tremendous damage to the young village. Houses were knocked off their foundations, chimneys and water towers were thrown down, and water pipes were bent and/or thrust out of the ground. Structures built across the San Andreas fault were broken into parts separated by several feet. Direct rupture so badly damaged the major roads where crossed by the fault that they were impassable until repaired; damaging ground cracks appeared off the fault in other places. Historical documentation shows that ground displacement in the Foothills Thrust Belt also damaged roads in and near Portola village.

Portola Valley needs to be prepared for a repeat of a 1906-magnitude earthquake.

2.4 1989 Loma Prieta earthquake

The Loma Prieta earthquake of 17 October 1989 was the strongest since 1906 to damage the entire San Francisco Bay Region. It was centered in the San Andreas fault zone south of the San Francisco Peninsula, in the Santa Cruz Mountains northeast of Santa Cruz (Figure 1). This earthquake had a magnitude of 6.8, much weaker than the 1838 and 1906 events. The earthquake did not rupture through Portola Valley, but it triggered ground movement in the Foothills Thrust Belt that locally damaged roads and underground utilities.

In the 1989 earthquake, the Town was largely spared because the epicenter was relatively far away. It did not start a wildfire in Portola Valley. Structures in Portola Valley incurred negligible to moderate damage, and local roads remained usable; the Town lost electric power and much of its landline phone service. Nearby freeway crossings on I-280 were damaged but remained usable. Had the earthquake focus been closer, damage would have been substantial. If the earthquake had occurred near the end of the seasonal rains, earthquake-triggered landslides would have been more likely to obstruct or damage the Town’s roads.

After the 1989 Loma Prieta earthquake, resources were available to respond to each of the many local crises. In a repeat of a 1906-magnitude earthquake (more than 30 times stronger than in 1989), it is unlikely that such resources will be immediately available to Portola Valley.

3 The Importance and Seismic Vulnerability of Portola Valley's Roadways

Figure 2. Evacuation Routes for Portola Valley and Potential Road Obstructions Produced By An Earthquake

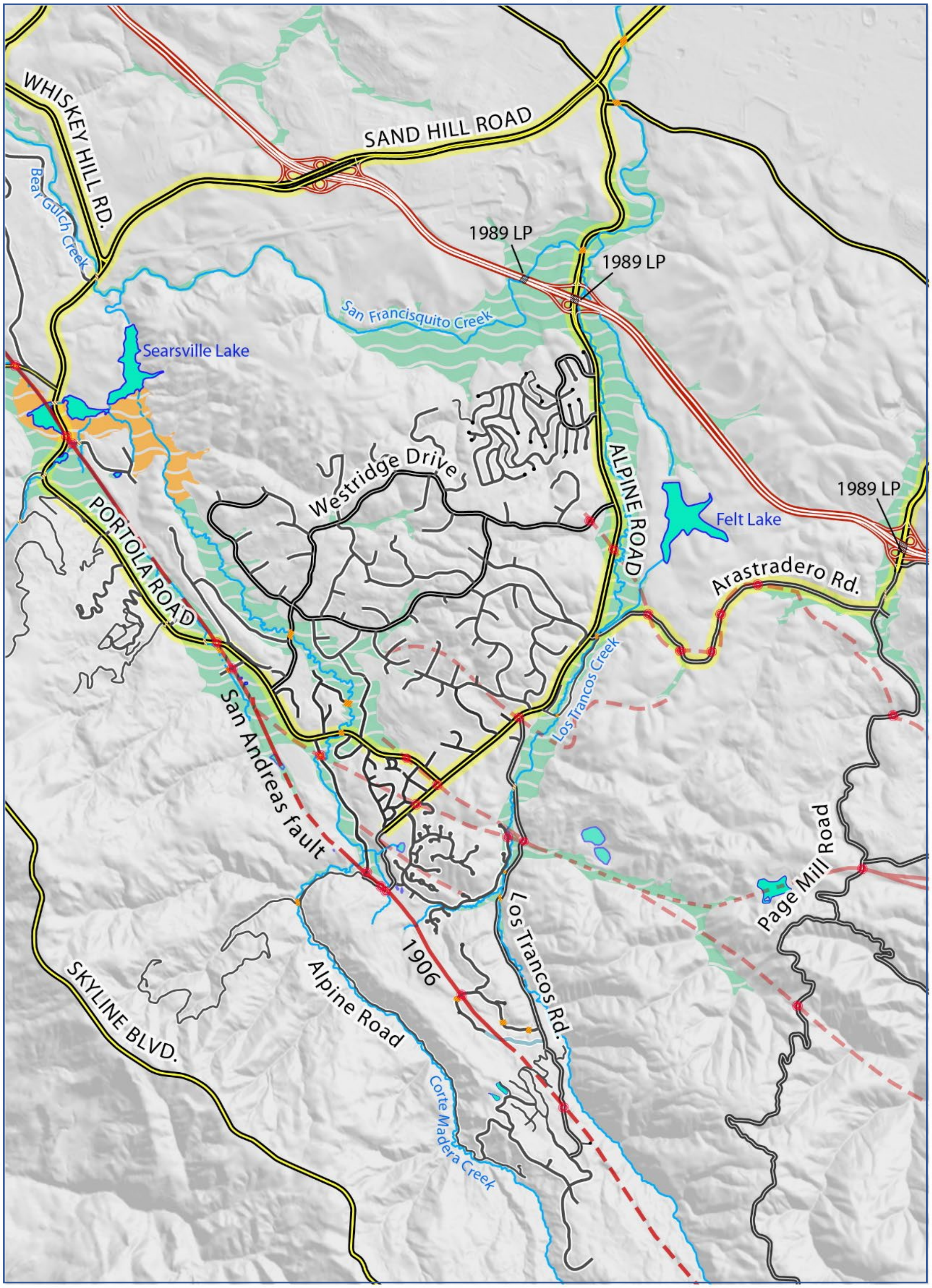

Figure 2 (preceding page). Evacuation routes for Portola Valley and potential road obstructions produced by an earthquake. The major evacuation routes (in yellow): Portola Road/Sand Hill Road, Alpine Road, and Los Trancos Road. Fault crossings on major roads (red circles), bridges (orange and yellow stripes), and large culverts (yellow and brown stripes). Active 1906 trace of the San Andreas fault (bold red line) and other faults (faded red lines). Faults are shown as solid lines where certain, long dashes where uncertain, and short dashes where covered or inferred. Moderate susceptibility to liquefaction (green wavy pattern); high susceptibility to liquefaction (orange wavy pattern). Landslide susceptibility is not shown on Figure 2 as a potential obstruction to the evacuation routes, but mapping by the California Geological Survey and Portola Valley indicates variable susceptibility to land sliding throughout the hillside areas. Sources: Ground Movement Potential Map (Portola Valley, 2017) for The San Andreas fault; USGS Miscellaneous Field Studies Map MF-2332 (Brabb *et al.*, 2000) and *The California Earthquake of April 18, 1906: Report of the State Earthquake Investigation Commission* (Lawson *et al.*, 1908) for faults other than the San Andreas; USGS Open-File Report 2006-1037 for liquefaction susceptibility; Earthquake Zones of Required Investigation (California Geological Survey) and Ground Movement Potential Map (Portola Valley, 2017) for landslide susceptibility; USGS Professional Paper 1552-B (M. Yashinsky, 1998) for freeway bridges damaged in the 1989 Loma Prieta earthquake (diagonal black stripes; marked "1989 LP"); hand-drawn 1906 field map (J.C. Branner; Bancroft Library, UC Berkeley) and hand-written 1906 field notebook (F.W. Turner; Stanford Archives) for evidence of fault activity in 1906.

Portola Valley's roadways are the Town's most important infrastructure resource because virtually all essential activity depends on them. People use the roads for everyday travel, the Woodside Fire Protection District (WFPD) depends on the roads to respond to fires and other emergencies, utility companies need the roads to access their infrastructure (most utility main lines are routed along roads), and after a disaster, outside assistance and supplies will be delivered to Portola Valley using the roads.

Figure 2 shows the Town's major evacuation routes—Alpine Road, Portola Road, and Arastradero Road—and the numerous bridges where these roads cross streams. All of these roads and bridges are vulnerable to direct surface rupture, indirect ground disruption, and shaking from strong earthquakes. Bridges can collapse or separate from their abutments under conditions of strong shaking. Each earthquake-damaged section of road or bridge on an evacuation route will impact the speed and success of evacuation. Damage to secondary streets, not only to the major evacuation routes, can seriously impede evacuation from neighborhoods.

Interstate 280 is also essential for an evacuation of Portola Valley. Shaking during the 1989 Loma Prieta earthquake, although only moderate in Portola Valley, damaged several nearby freeway crossings and bridges. The damaged structures, from north to south on I-280, are: (1) the bridge crossing over San Francisquito Creek, (2) the two Alpine Road undercrossing bridges, (3) the bridge supporting the southbound on-ramp from Page Mill Road, and (4) buckled pavement on the northbound off-ramp to Page Mill Road (Figure 2).

The California Department of Transportation (Caltrans) has determined that the two sets of freeway crossing bridges on I-280 closest to Portola Valley could be seismically damaged—hence unsafe—in a future, strong earthquake. The Caltrans bridge seismic restoration project to strengthen the freeway crossings at Alpine Road and Sand Hill Road began in 2019 and is currently underway.

Portola Valley's evacuation routes also cross numerous culverts of varying diameters and construction, *i.e.*, reinforced concrete or corrugated metal pipe (larger culverts are shown in Figure 2). Like bridges over streams, culverts, which allow streams to flow under roads, are points of potential failure in strong shaking. They are vulnerable to both direct fault rupture and secondary ground failure, particularly liquefaction. Engineering studies have shown that corrugated metal pipe culverts are more vulnerable to ground deformation than are reinforced concrete box culverts.

An evaluation by qualified professionals of the likely seismic performance of the roads, bridges and culverts on Portola Valley's evacuation routes is recommended at the end of this document.

4 How an earthquake can damage the Town's evacuation routes

4.1 Surface faulting and off-fault ground disruption

The amount of damage an earthquake can cause to roads and other infrastructure in Portola Valley will depend chiefly on the magnitude of the earthquake, proximity to the epicenter, whether faults move within the Town, and the time of year (wet or dry season) when the earthquake occurs.

Specific kinds of damage to Portola Valley's evacuation routes are covered in the following sections. The direct earthquake effects include surface faulting, secondary (off-fault) ground deformation, and ground shaking. The main indirect effects are landslides, liquefaction, wildfire, and objects falling across roads. The map in Figure 2 shows known faults where they cross the major evacuation routes and sections of the routes that are susceptible to landslide or liquefaction.

Damage to major roads in and near Portola Valley from the 1906 earthquake is well documented. The 1906 rupture crossed Portola Road and ripped it apart in two places, and it severed Alpine Road south of the intersection with Portola Road. The photograph in Figure 3 (following page), taken shortly after the 1906 earthquake, shows the wide, damaged section of Alpine Road 0.1 mile east-southeast of the intersection with Willowbrook Drive. Today the Town can expect the paved asphalt road at the same location to become severely buckled, broken and impassible during a rupture of the San Andreas fault through Portola Valley.

A rupture on the San Andreas fault can simultaneously offset the two sides of the fault horizontally by many feet and vertically raise or drop the ground by more than a foot. The faults of the Foothills Thrust Belt, conversely, typically produce more vertical than horizontal displacement. Where a slipping fault crosses a road, the displacement can bend, crack, or sever a roadway, bridge and underground utilities. Other significant ground disruptions, such as ground cracks, form within and near a fault zone. They will also damage anything built on them. The San Andreas fault and secondary faults of the Foothills Thrust Belt cross Portola Valley's evacuation routes (Figure 2).

Figure 3. Vertical offset of Alpine Road 5 miles west of Stanford University. Per J. C. Branner. 1906 photograph from *The California Earthquake of April 18, 1906: Report of the State Earthquake Investigation Commission* (Lawson *et al*., 1908).

4.2 Ground shaking

Ground shaking is the most obvious direct effect of an earthquake and is almost always the first effect noticed. Long-duration, strong-acceleration shaking (fast, strong, movement repeated back and forth, up and down) displaces the ground and anything attached to the ground. Strong shaking can severely damage structures not built to modern seismic standards. Roads deformed by strong shaking can be damaged enough to be impassable; bridges and highway overpasses are more vulnerable—they can shake independently of and detach from their abutments. Ground shaking causes indirect earthquake effects such as landslides, liquefaction, wildfire, and falling objects that can also damage or block roads.

4.3 Landslide

Strong seismic ground shaking can trigger landslides. Landslides occur primarily on steep slopes on weak and poorly consolidated soil or rock, geologic conditions common on the steeper hillsides in Portola Valley. Landslides can occur spontaneously, but earthquake-triggered landslides are common. An earthquake that occurs during the rainy season is more likely to trigger landslides than one that happens during the dry season because high water content weakens the soil. A landslide can block a road where a section of it slides downhill or where an earth-slide or rock-slide is deposited onto a road. California Geological Survey mapping shows most hillsides in Portola Valley are susceptible to land sliding. The section of Alpine Road in the vicinity of Coal Mine Ridge, south of Portola Valley Ranch, is especially susceptible to landslides, whether induced by earthquake or saturated soil.

4.4 Liquefaction

Strong ground shaking can also trigger liquefaction of the soil (loss of soil cohesion). Anything built on ground that has liquefied will subside or slump: foundations of buildings will tilt and sink, and roadbeds will buckle. Liquefaction can occur as deep as 30-50 feet below the surface in a seismically strongly shaken, water-saturated, sandy layer in the subsurface. The California Geological Survey's Earthquake Zones of Required Investigation and Portola Valley's map of ground movement potential have identified soil types susceptible to liquefaction under much of both Portola Road and Alpine Road (Figure 2). Not all susceptible soil will liquefy even in a strong earthquake, but liquefaction under either of these two roads will severely compromise the Town's major evacuation routes.

4.5 Wildfire

Wildfire is the most likely earthquake effect that would require Town-wide evacuation.

Large earthquakes commonly create conditions that trigger wildfires. A strong earthquake, which generates very strong shaking for a substantial fraction of a minute or more, initiates a series of events that can result in a widespread fire.

Fire after an earthquake is human-caused. Common sources of ignition are broken gas lines external to buildings, broken connections to electrical or gas appliances, and live power lines that have been snapped off utility poles or buildings.

Fire hazard persists after the first earthquake. A strong main shock normally generates a series of smaller earthquakes (aftershocks), which can begin soon after the first event and gradually die out over a period of months or years.

The Woodside Fire Protection District (WFPD) is the lead agency for wildfire evacuation. WFPD recognizes that a wildfire following an earthquake is substantially more dangerous and challenging than wildfire alone. An earthquake can decrease safety and increase the difficulty of the complex emergency with:

- Damage to roads, bridges, culverts and freeway crossings from ground disruption, landslides, or liquefaction.
- Direct road damage or blockage from fire.
- Multiple road obstructions from downed trees, fallen limbs, toppled utility poles, and downed live power lines.
- More earthquakes (aftershocks) that cause further damage.
- Traffic congestion that gridlocks residents and workers attempting to leave Town on damaged or blocked roadways.

- Road blockages that delay the arrival of aid from neighboring communities and create difficulties in reaching established safety zones within Town.
- Loss of internet and cell phone communication and damage to utility infrastructure (water, sewer, electricity, and gas).

4.6 Objects fallen across roads

Intense shaking during a strong earthquake can cause trees and tree limbs to fall. Falling limbs or trees can injure people, crush cars, damage structures and bring down overhead utility lines. Such fallen trees, branches and power lines will block roads and obstruct evacuation routes.

Utility poles severely shaken by an earthquake can also snap off or topple, blocking roads and dropping life-threatening electrically live wires on the ground. This event is relatively rare, but when one pole snaps or falls, it can cause a chain reaction with other nearby poles. Wires between utility poles typically cross over roads. Utility poles line the major evacuation routes in Portola Valley.to ensure reliability of evacuation routes.

5 Recommendations: Three actions the Town can take now for a successful evacuation after an earthquake-triggered wildfire

Taking these three important steps would significantly help Portola Valley and vicinity achieve a safer evacuation after an earthquake-triggered wildfire and open routes for inbound post-earthquake assistance.

5.1 Maintain a rapid response team to ensure reliability of evacuation routes

Wildfire can develop quickly after a strong earthquake. Immediately after a damaging earthquake, the Town will need to deploy a rapid response team to ensure that evacuation routes are passable. The Town should empower and train the Public Works Department's existing volunteer emergency road crew for this purpose. The Town should retain, on a permanent basis for the team's use, necessary supplies and equipment, well-maintained and regularly updated.

The Town must anticipate the need for evacuation after a damaging earthquake and keeping the major routes open before assistance from another governmental unit can arrive. If the earthquake is regionally damaging, the Town should expect to survive on its own resources for a long time.

After any damaging earthquake, the rapid response team would deploy its resources to perform a quick inspection and damage assessment of the evacuation routes. It would clear the routes, temporarily repairing any damage or obstruction that could impede an evacuation for wildfire. The team would be authorized to act independently, in coordination with the Town's Public Works Department, until assistance arrives from WFPD and the County of San Mateo Department of Emergency Management.

5.2 Designate wildfire safety zones

To minimize loss of life in an earthquake-triggered wildfire, the Town of Portola Valley and WFPD should immediately designate safety zones throughout the Town for people unable to evacuate early. Life safety is the priority. Safety zones are an essential part of a comprehensive evacuation plan.

Safety zones for wildfire are pre-designated large, flat, open areas with minimal vegetation, selected to provide relatively safe places for residents to shelter from high-fire conditions. The Town will need several safety zones. In a large fire, WFPD will dynamically open additional temporary refuge areas to provide immediate fire protection.

Safety zones will be critically important after a large earthquake with or without fire because earthquake damage to homes—or the fear of additional damage from aftershocks—will drive many residents to seek safety away from home.

In July 2023, The National Institute of Safety and Technology (NIST) released its official findings for the disastrous 2018 Camp Fire in Paradise, CA, and surrounding communities. The two reports emphasize the importance of pre-designated safety zones and temporary refuge areas:

- Case Study of the 2018 Camp Fire (NIST TN 2252)
- WUI Fire Evacuation and Sheltering (ESCAPE) Report (NIST TN 2262)

5.3 Commission a seismic vulnerability study of the Town's evacuation routes and implement the recommendations

In preparation for the next earthquake, Portola Valley and San Mateo County should engage qualified highway, bridge, and geoengineering professionals for a detailed evaluation of the seismic vulnerability of the roads, bridges, and culverts on the Town's major evacuation routes. The study would complement work already completed or in progress, *i.e.*, the 2022 Wildfire Traffic Evacuation Capacity Study, the ongoing fire mitigation work, and the Caltrans I-280 bridge seismic restoration project. The Town should also develop a multi-year program to implement the recommendations from the study and strengthen the seismically vulnerable locations on the evacuation routes.