THE BIG ONE

The recent Los Angeles earthquake has everyone thinking about earthquake preparedness. Here is some information to help you educate and prepare yourself.

It may start with a swaying sensation, a sudden noise or a roar. Next there could be vibration, quickly followed by rolling — up, down, sideways, rotating.

It will be scary. It may last a few seconds or go on for a few minutes.

Depending upon the intensity and the duration, what you may be experiencing is The Big One that earthquake experts have been forecasting for some time.

It is impossible to say where and when the big quake will come. But the evidence in the shifting of continental plates points to such an earthquake causing major damage on the west coast of North America.

The Provincial Emergency Program, in one of many brochures and booklets available on the subject, warns that we live in a region where some of the largest earthquakes in the world occur.

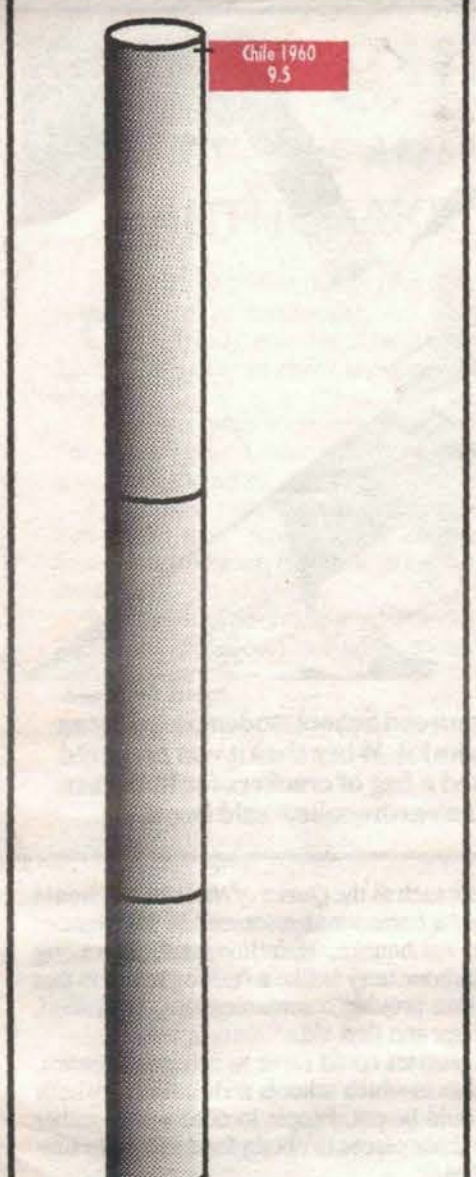
There are only three areas in Canada that seismic experts say are at major risk of earthquake damage. Two are small pockets in Atlantic Canada. The other is the entire western third of British Columbia and much of Yukon.

The devastation caused by last month's earthquake in Los Angeles has renewed concerns about The Big One and when and where it may strike.

In the pages that follow, then, we focus on what such an earthquake could mean to Gulf Islanders and offer advice on how to be prepared.

Some of the information would prove useful in the event of any major disaster, such as a major snow or windstorm, flooding, a hazardous materials spill or an airplane crash.

Says Salt Spring emergency program coordinator Chuck Hamilton: "If you're prepared for an earthquake, you're prepared for anything."



Quakes in S.W. B.C. and N. Washington

On the Richter scale, each whole number indicates a quake that's 10 times stronger than the number before.

COVER PHOTO: Fernwood School students practising earthquake drill are, from left, Katie Parsons, Sara Pearson and Samantha Speller.

Earthquake effects could be disastrous

The hill above St. Mary Lake — St. Mary Highlands — would come down over North End Road.

Walker Hook Road would go in those places where slippage has been occurring.

And Stewart Road would go "for sure."

According to emergency program coordinator Chuck Hamilton, those are just three areas on Salt Spring Island that could experience disastrous effects in a major earthquake, a quake that seismologists say could cause major damage on the B.C. coast.

With the possible loss as well of the bridge over Fulford Creek, traffic movement on Salt Spring could face major disruptions, with catastrophic effects when one considers the potential aftermath of a major quake.

After the Los Angeles quake, he purchased another gallon of white gas.

Among the effects:

• Loss of electrical power. While the source of hydroelectricity on the mainland could be affected, there is also the possibility that submarine cables would be damaged, and trees would come down on power lines. Furthermore, the B.C. Hydro substation on Atkins Road is built on swampy ground. Hamilton says that liquefaction could put the station out of commission.

• Loss of water. Water district mains and water lines could be ruptured.

• Fire and injury. The severe danger of fire and the possibility of serious injury would be acute. But emergency vehicles may not be able to negotiate damaged or obstructed roads, presuming that personnel would be available to operate them.

• Starvation. Older people in particular could be at risk of starvation without adequate food supplies.

All these and more are among the possible scenarios here should a major earthquake — The Big One — occur, a disaster that no one is forecasting, but many are issuing warnings about.

Hamilton is among those who take the warnings seriously, the only approach for the person responsible for helping islanders be prepared for earthquakes and other disasters.

For example, Hamilton has a cache of emergency supplies in a shed near his home. "I've put my gear into big rubber tubs . . . in a locked garden shed." Clothing, kitchen utensils, hand tools, emergency light, alternative heat sources and drinking water will provide short-term but immediate service to Hamilton and his family in case of a major disaster.

And they're kept away from the house to ensure accessibility. "If the house comes down on my stuff, how do I get at it?"

After the Los Angeles quake, Hamilton went out and purchased another gallon of white gas — "That's my light."

For an alternative cooking source he recommends a propane barbecue, and suggests a lot of people will be having barbecues in the event of a large earthquake.

Most of the published information on earthquake preparedness advises that people should be prepared to look after themselves and their needs for at least 72 hours. But Hamilton thinks that may not be enough in the islands.

Photo by Tony Richards

COMPLETE WITH CRACKERS: Fernwood School student Boyd Sloan displays contents of his class's earthquake kit. When the kit was prepared it was a friend of Boyd's who contributed a bag of crackers for it. "When I saw the crackers, I hoped we'd have an earthquake," said Boyd.

"I suggest we're going to be on our own for more than 72 hours."

For one thing, an earthquake's effect on ferry service, while difficult to determine in terms of damage to docks, will be to shut it down until coast guard divers have inspected the sea bottom in the vicinity of terminals.

Hamilton said a quake could cause the sea bed to heave, and ferries could run aground as a result. He said it could be some time before inspections are carried out on smaller routes such as those in the islands.

The danger of a tsunami or tidal wave affecting the islands or the ferries is minimal, Hamilton noted, because of their sheltered location.

The ferries — particularly the larger vessels such as the *Queen of Nanaimo* — would be "a tremendous resource" in the event of an earthquake, Hamilton said. The Long Harbour ferry is like a floating town, in that it can provide communications, heat, food, water and first aid.

Ferries could serve as reception centres, a use to which schools and community halls would be put. People in need would gather at those places to obtain food and other supplies.

Following an earthquake, the Emergency Program anticipates closing stores that sell essential goods until an assessment of needs is completed. Fuel, groceries and hardware could be needed for emergency purposes, so their sale might have to be restricted.

Readying for earthquake would cost $530,000

Gulf Islands schools are half a million dollars away from being safe in an earthquake.

A study done in 1990 estimated upgrading existing schools would cost $530,200. But no money for the work has come from the provincial government.

"One of the problems that we face, with budget limitations, is spending money on something that may never happen versus our current needs," school district secretary-treasurer Ken Starling says.

According to the 1990 study, upgrading Gulf Islands Secondary would cost $238,150. Problem areas include two classroom wings, one built in 1965 and one built in 1968, and the gymnasium.

Salt Spring Elementary requires $191,000 worth of upgrading. Starling noted the school is old — the original three-story building was built in 1940 — and now includes five levels. The school district hopes eventually to close the building.

Upgrading is also required for Mayne School ($41,300), for Pender ($18,750), for Galiano ($11,000) and for Saturna ($30,000).

Starling pointed out that local schools are comparatively safe. Most are wood-frame construction and are newer — the best combination to withstand an earthquake.

Following the 1985 earthquake in Mexico City and a 1989 quake in San Francisco, school districts began focusing on the need for earthquake readiness.

Schools throughout the province were assessed for their ability to withstand earthquakes. Most at risk were older, brick buildings which would crumble under the impact of a large quake.

Starling said the final bill to upgrade all the schools in the province was too high for the financially-strapped Ministry of Education. With no money coming in to earthquake-proof schools, Starling said, the school district now incorporates seismic upgrading when schools are renovated.

"Whenever you are doing an addition or a renovation to a school you incorporate earthquake proofing into that," he said. When the current Gulf Islands Secondary is converted into Salt Spring Middle School next year, seismic upgrading will be part of the renovation budget, Starling said.

New schools, like the new Gulf Islands Secondary, are built to a code which now includes strict requirements to ensure the building is safe in an earthquake. "That one is done to the latest requirements of the B.C. Building Code," manager of plant services Rod Scotvold said. He hoped the district would be able to upgrade other schools within the next two to three years.

New schools like the new Gulf Islands Secondary are built to a code which now includes strict requirements to ensure the building is safe in an earthquake.

The district established an earthquake policy early in 1989, based in part on a school earthquake safety guide book issued by the Ministry of Education in 1987.

According to that policy, schools should conduct regular earthquake drills at least twice a year, teaching students to curl up in a "crash position" under their desks or under tables. The policy also spells out staff requirements, including responsibility for ensuring students are safe, that the school is evacuated once the earthquake has subsided and that all power, fuel and water mains have been shut off.

The district is now planning meetings with parent groups to outline contingency plans for each school should an earthquake occur. The school board is considering purchasing a special type of film which would keep glass windows from splintering apart during an earthquake. But the film would cost almost $50,000 to cover both sides of every window in the district.

Geology lesson explains quakes

There is no solid ground to rely on when trying to plan for the impact of an earthquake.

An earthquake in B.C. is not the same as an earthquake in California. And an earthquake in California is not the same as an earthquake in Mexico. Even a magnitude 4 earthquake on the B.C. coast may be very different from another magnitude 4 earthquake on the B.C. coast.

Welcome to the great geological guessing game of earthquakes.

To understand the difference between earthquakes in California and in B.C. requires a quick lesson in geology.

It took undersea mapping of the ocean floor during the second world war to prove a "crackpot" theory advanced by astronomer and meteorologist Alfred Wegener 30 years earlier. Wegener had suggested all the earth's continents had once been a single land mass which had broken apart, and were slowly shifting position on the earth's crust.

Maps of the ocean floor confirmed Wegener's theory. The continents and oceans of the earth rest on plates of rock, which slide over the softer rock of the inner mantle. Like pieces of a puzzle trapped within the finite space of the earth, these tectonic plates jockey for position on the globe.

Where two plates meet, the edges either grind against each other or one slides under the other — a process known as subduction — as each changes position. It is this movement of the plates which causes earthquakes.

For people on the west coast of North America, the significant tectonic players are the Pacific plate, the Juan de Fuca plate and the North American plate.

Between some of these plates are spreading ocean ridges — long cracks through which molten rock from inside the earth wells up into the ocean, forming new rock and forcing the plates apart. The spreading ocean ridge where the North American plate meets the Eurasian and African plates is pushing North America slowly to the west.

Meanwhile, the spreading ocean ridge where the North American and Pacific plates meet is pushing to the northeast on the North American plate, either directly in some places or, in our piece of the coast, by pushing on the Juan de Fuca plate. This small plate lies between the Pacific plate and along 1,000 kilometres of the pacific northwest, from northern Vancouver Island to northern California.

Since the Pacific spreading ocean ridge runs at a southwest angle along the North American continent, it is now roughly 200 kilometres west of Vancouver Island but directly under the state of California. Therefore, earthquakes in California are more frequent and occur at ground level — so smaller shakes have more impact.

Where two plates meet, the edges either grind against each other or one slides under the other — a process known as subduction.

As the North American plate moves west it is sliding over the San Juan plate. The resulting pressure sometimes creates cracks in the San Juan plate, leading to small earthquakes.

Retired geologist Tom Wright of Salt Spring notes that some larger earthquakes could be expected, caused by the friction of the San Juan plate sliding under the North American plate. For the past 29 years there has been no such quake in the area.

Wright said the absence of such earthquakes in recent years could indicate the San Juan plate is sliding smoothly under the North American plate — the rock melts as it is forced downward into the earth — or it could mean the San Juan plate is not moving at all.

Over the past 10 years scientists have collected evidence that the Juan de Fuca plate and the North American plate are currently locked at the point where the Juan de Fuca plate slides under the North American plate. (See diagram 1).

Indications that the plates are locked come from the minute movement of mountains to the northeast and the slow tipping of Vancouver Island to the east.

Eventually, some scientists predict, increasing pressure will break the lock with a cataclysmic wrench, resulting in an earthquake measuring eight or more on the Richter scale. In seconds, the Juan de Fuca plate is expected to slide 10 to 20 metres further underground, unleashing tremendous forces.

Based on eight years of research, U.S. geologists first announced in 1991 that pressure was building towards a "megathrust" quake in the Pacific northwest. They predicted the earthquake would last for three minutes, coastal areas could instantly drop by two metres and huge waves would surge along the coast.

Megathrust quakes have hit the area in the past. Scientists believe native legends about shaking earth refer to a major earthquake which occurred in the area about 300 years ago. Grass and fossils found in tidal marshes bordering the Juan de Fuca plate suggest subduction quakes occur every 200 to 700 years.

Unlike the California quake, which was at ground level and over within seconds, a subduction quake would occur about 30 kilometres below ground level and last for several minutes.

The largest earthquake ever recorded — magnitude 9.5 — occurred in Chile in 1960.

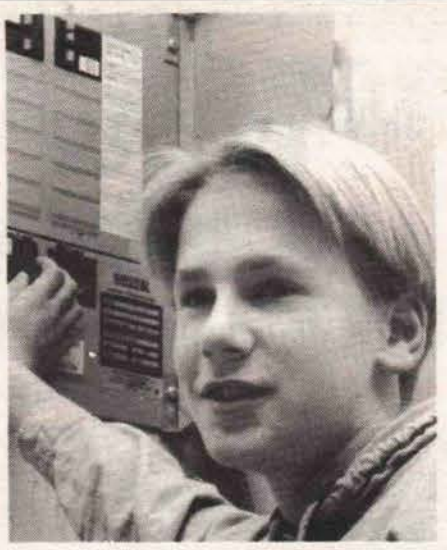


Photo by Tony Richards

THROWING THE BREAKER: Fernwood School student Chris Cade goes to the circuit breaker during a classroom earthquake drill. Turning off the power is one of the first things to do in the event of an earthquake.

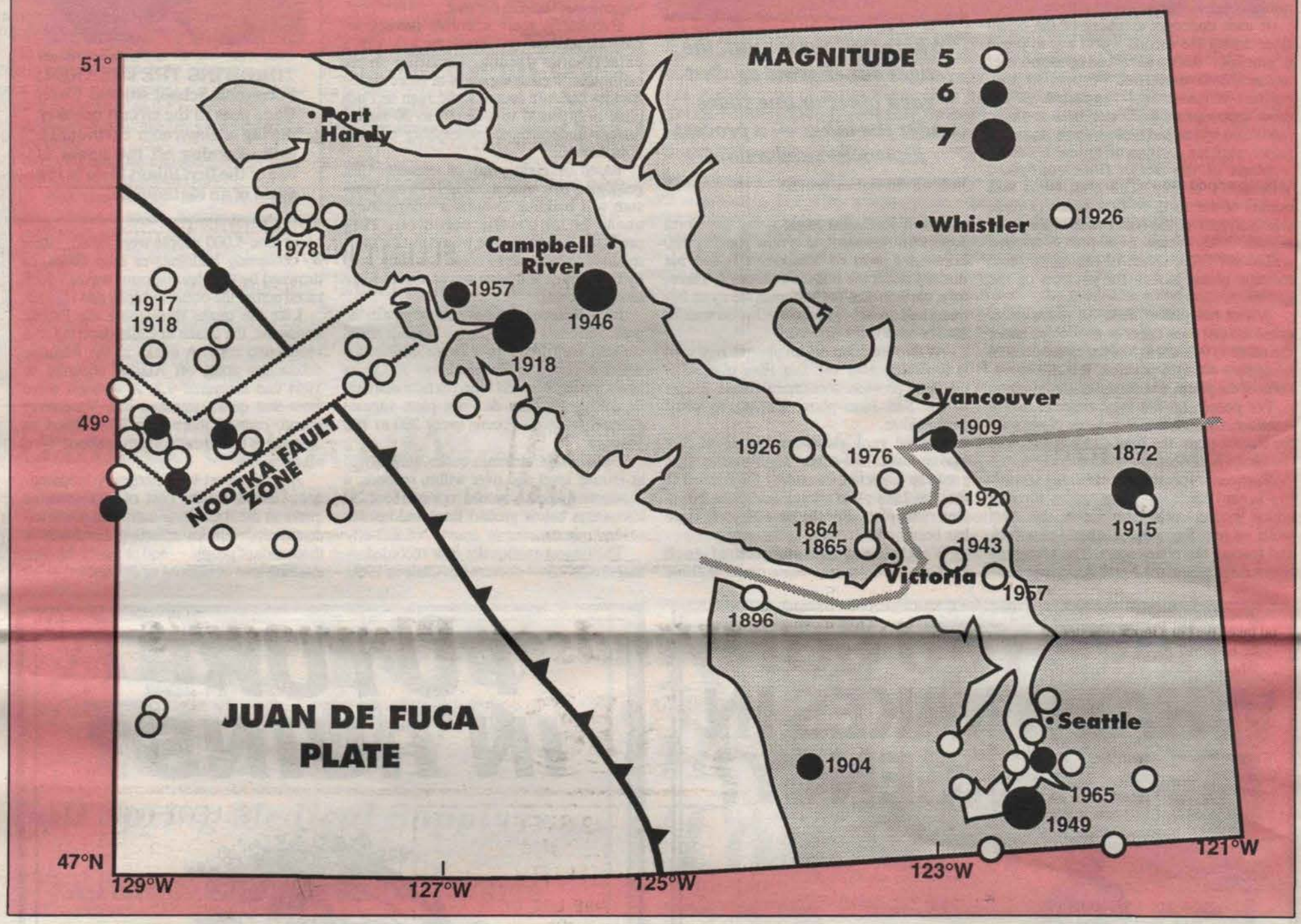
More than 5,000 people were killed, either by collapsing buildings or mud slides, or drowned by the giant tsunami waves which raced across the ocean to Japan and Hawaii.

Like the quake threatening the Pacific northwest, the quake in Chile occurred in a subduction zone. A quake in the Aleutian subduction zone, off Alaska, occurred in 1964 and measured 9.2. A tsunami wave from that quake smashed into Vancouver Island, causing more than $20 million in damage. The quake lasted about five minutes.

A 1990 report by Emergency Preparedness Canada on the cost of a megathrust quake in the B.C. lower mainland predicted deaths and injuries affecting hundreds to thousands of people — and property damage totalling tens of billions of dollars.

How close have they come?

Nearby earthquakes ranging from 5 to 7 on the Richter Scale are indicated on this map from the Pacific Geoscience Centre in North Saanich. Two of the closest epicentres to the Gulf Islands occurred in 1864 and again in 1865. The closest ever was in 1976.



Tom Wright figures odds are on his side

Preparing for a major earthquake in southwestern B.C. is a bit like preparing to win the lottery — it's probably going to happen to someone but not necessarily you.

Retired geologist Tom Wright says he plays the odds when considering the likelihood of a major earthquake — and those odds are on his side.

Given that a major quake measuring eight or more on the Richter scale might occur in this area only once every 1,000 years, and that a human lifespan is approximately 70 years, the chance of being alive during a big shake are, at best, one in 13.

And even if the big one occurs during your lifetime, the impact on your community will depend on how close you are to the epicentre of the shake: if you're far enough away the impact will be reduced to a ripple and will merit a mention on the evening news.

"The whole thing is a bit of a lottery. There are more questions than answers," Wright observes. "I don't ever expect to see a force 8 earthquake in my lifetime."

Even the active earthquake zone in California has only produced three quakes which measured over eight on the Richter scale in recorded history: one in 1857 in southern California, another in 1872 in the Owens Valley and the third in 1906 in San Francisco.

The chances of being caught in a force 6 or 7 earthquake in B.C. are much higher — but Wright notes a force 6 earthquake on B.C.'s coast would probably do less damage than a force 6 quake in California, in part because the area is less populated. (The January 17 quake in Los Angeles measured 6.6 on the Richter scale.)

Between 1980 and 1993 there were a host of tremors measuring two or less on the Richter scale.

Earthquakes in B.C. also tend to be well below the surface while earthquakes in California tend to occur at ground level. California lies directly over a spreading ocean ridge — which causes the earthquakes in the state. (See related story).

In B.C. this ocean ridge is 200 km west of Vancouver Island. Many earthquakes occur along the ridge but the settled land masses of Vancouver Island, the Gulf Islands and the B.C. mainland are protected by their distance from it.

Since North America is slowly shifting to the west, Wright predicts the spreading ocean ridge will be under the Gulf Islands in about six million years. "That's when real estate values will plummet or it will at least be a shakier place," he quipped.

There is evidence that the Gulf Islands have been shaken countless times in the past. The entire west coast is marked by dozens of faults, created by movement of the earth's plates.

On Salt Spring, Wright said, one fault can be recognized by a sudden dip on Baker Road. Another runs through Ganges Harbour and one lies on the north side of the Fulford valley.

Most shakes measure below 5 on the Richter scale and are not noticed by the majority of residents. A map from the Pacific Geoscience Centre showing earthquake activity on the west coast between January 1980 and January 1993 illustrates a host of tremors measuring two or less on the Richter scale — but only a few larger earthquakes.

This region is still the most active earthquake zone in Canada: more than 200 earthquakes are recorded annually in the lower mainland and on Vancouver Island.

Local earthquake rattled the dishes back in 1976

The ground in the Gulf Islands shook at exactly 1:35 a.m. on May 16, 1976.

It was, according to a newspaper report of the time, the largest earthquake registered in the Gulf Islands in 50 years.

Seismologist Bob Horner says the quake measured 5.4 on the Richter scale. It occurred in the Juan de Fuca plate, 50 km below Pender Island.

The quake was felt throughout the Gulf Islands and as far away as Mount Vernon, up the Fraser Valley and north of Nanaimo on Vancouver Island.

An intensity of 5.4 is enough to rattle dishes, shake pictures and give the impression of a muted explosion or something suddenly hitting a home.

"There's no damage but things may have been knocked off shelves," Horner noted.

Smaller earthquakes in the area are often caused by the bending of the Juan de Fuca plate as it sinks under the mantle of the North American plate.

"There's lots of earthquakes all through this area," says Horner, who tracks the quakes for the Geological Survey of Canada. Every 10 to 20 years there is usually a magnitude 6 or larger earthquake in the area.

The largest recent earthquake occurred in central Vancouver Island in 1946 and measured 7.3 on the Richter scale.

Other quakes measuring five or more occurred on Vancouver Island in 1864/65, 1918, 1926 and 1978.

Agencies ready with disaster plans

A major earthquake in the Gulf islands would do more than disrupt people's idyllic lifestyles. The power would likely go out, roads would be damaged, ferries put out of service and businesses closed. As most activities came to an abrupt stop, disaster plans would come into effect.

The *Driftwood* went to a number of agencies to ask what exactly people could expect from them immediately after a strong earthquake.

Lady Minto Gulf Islands Hospital, for instance, has a plan which staff would implement in the event of any major disaster, including a ferry accident, an airplane accident or something like an earthquake.

"We have made sure everything is strapped down," acting administrator Karen Davies said. "We have made sure all the heavy equipment and filing cabinets are bolted down."

In addition, the hospital has a back-up generator and as much food as it can store. After the San Francisco earthquake of 1989, shelving and storage areas, especially in the pharmacy, were fitted so that goods would not fly off easily.

The power would likely go out, roads would be damaged, ferries put out of service and businesses closed.

And every three years the hospital takes part in a mock disaster, as it did last March.

The first thing the Coast Guard and its auxiliary members would do is try to get to the boats, officer in charge Dave Howell said, but only after ensuring their own families' safety. Then they would assess their equipment.

"Our mandate is on the water and protection of life and property," he said. "In the event of a major disaster we will strictly deal with medical emergencies and people whose lives are in danger."

The boats are fully equipped with first aid equipment and most importantly the boats are their own communications centre. If phone lines are out, he said, Coast Guard radio, ham radio and radios on many islanders' boats would be primary communications links until phones were re-established.

The Salt Spring fire department's three paid staff and two dozen firefighters are prepared to do their part in rescue work and minimizing damage caused by fire after a major disaster.

The fire department has a list of important buildings to watch out for, from the schools to the hospital to apartment buildings. If a disaster occurred during school hours, for instance, the schools would be among the first places to which firemen would go.

Each of the three firehalls is equipped with life-saving equipment as well as chainsaws to clear trees from roads and pumps to get water from ponds, lakes and the ocean if necessary.

The new firehall at Central is earthquake-proof, Wagg said, and could be used to house people whose homes have been damaged.

The RCMP's role in a major disaster would not change, Ganges RCMP Const. Dave Simmons said. The police mandate is to "serve and protect."

"There are all kinds of things we have to do," Simmons said. How they deal with each incident is determined by its severity.

In accordance with the locally developed disaster plan, he said, the RCMP would help co-ordinate search and rescue operations on the island, set up an incident information centre and appoint a public information officer. Disaster sites would have to be cordoned off and casualties taken care of.

B.C. Ferry Corporation has already gone a long way to preparing for an earthquake by staging a mock disaster last November. In the confines of a boardroom and without disrupting the fleet schedule at all, ferry officials went through an earthquake scenario in Georgia Strait.

"We proved we could communicate," corporate environmental co-ordinator Rob Hamilton said. "Once we did that we proved we could do different jobs."

He was pleased with the results of the trial disaster and some equipment has been put into next year's budget to make the fleet's response to a disaster even more effective.

Damage to terminal structures would be the most obvious and costly effect of an earthquake on the ferry system, apart from the obvious disruption to normal service.

He said B.C. Ferries may be called to other service in the event of a disaster, such as floating casualty stations. The large ferries have their own power, heat, firefighting and safety equipment and could easily take on medical staff.

"The big vessels have an opportunity for serving as an emergency base for a lot of people," he said. "Small vessels have a role moving equipment."

But if an island's ferry was taken off, leaving islanders stranded, a water taxi would be contracted to take over the route, he said. Most people would probably stay pretty close to home after a major disaster.

B.C. Hydro has invested money and energy to work out a disaster plan for the Gulf Islands area. The utility's new Salt Spring headquarters is built to the highest seismic requirements in the building code and could be used as a post-disaster centre if necessary.

In addition, manager John Langston said, the Salt Spring office has sophisticated communications equipment and its own generator.

"One of the things we have is communications," he said, including VHF, UHF, and microwave and computer links.

"It gives us a better shot at having some line of communications," he said. "It is very unlikely we'd lose all of them."

Getting the infrastructure back in place is Hydro's main concern after a major disaster. There are a number of damage scenarios which would affect power on the Gulf Islands. The distribution station in Nanaimo might be knocked out, or either of the substations on Salt Spring and Galiano. Submarine cables could be damaged and trees could fall on the lines.

"The really strong message to convey is to stay away from downed wires," Langston said. "You only have to witness what an arc welder can do to see how much power there is in electricity."

Victoria Highways Maintenance Corporation would also be kept busy in the event of an earthquake in the Gulf Islands. Salt Spring foreman John Charlton said the first concern of the highways crew would be to locate and mark damage to roads and bridges and to make what repairs they could to main routes to ensure access, principally to the hospital and firehalls.

More quakes have helped beef up code

Making a building absolutely earthquake-proof may not be possible, but buildings can be designed and constructed with the powerful forces of an earthquake in mind, says an official with the municipal affairs ministry's building standards branch.

"There's a lot of disagreement about what will stand up and what will not," engineer Gerry Buydens said.

"After the Los Angeles earthquake there were a lot of people checking the buildings they built. Did it work? Didn't it work? Why? Why not?"

Ever since building codes were introduced in B.C. in 1941, he said, there have been design requirements for earthquakes. Between revisions to the code in 1985 and 1992, seismic requirements were beefed up 25 per cent.

"We've got more knowledge," he said. "There have been more quakes."

He said that through the years design philosophy has changed. Buildings used to be built solid and very stiff. Today, more steel is used, which gives buildings more flexibility.

"Buildings tend to move with an earthquake. They swing like a pendulum," Buydens said. "Stiff rigid buildings have no give in them. They break."

Seismic requirements are really only for large buildings. Residences, small offices and shops and light and medium industrial buildings do not have to follow stringent seismic design.

"On the whole there is enough inherent strength in residential homes," Buydens said. "Wood is a very forgiving material and usually has good lateral support."

The force involved in a steady, heavy wind can be as great as the forces involved in an earthquake, he said.

The kinds of features which need to be carefully designed include: large walls of windows, which are inflexible and apt to break; buildings with "soft storeys" — offices built over parking; and houses which sit on stilts or posts.

But, he added, engineers are often more concerned about ground conditions. Is there sand underneath? Or clay? If there is rock, how solid is it?

"The Pacific coast is much more cognizant of these problems than other parts of Canada," local building inspector Dick Stubbs said, adding, "The buildings we're most concerned about are schools and the hospital."

Schools, hospitals, restaurants and community halls are covered by a different, more stringent part of the building code, and their designs must be approved by an engineer.

One small example of a recent change to the building code for schools is that services such as electricity and water which run in space above ceiling panels must now be tied together and attached to the ceiling. This is the kind of "seismic restraint" which is becoming more and more a part of the building code.

In addition, Buydens said, public buildings like schools are given extra margins of safety by boosting the load requirements. Schools have what he calls an "importance factor" of 1.3, which means they must be designed for 30 per cent better loads than the standard demands. Post-disaster buildings have an importance factor of 1.5 and must be designed for 50 per cent better loads than the standard.

No one can predict when an earthquake will strike or how an earthquake will affect a particular building.

But the B.C. building code is trying to keep up with increased knowledge about earthquake damage.

EARTHQUAKE-PROOF: Ira Tepper of Salt Spring points to plastic latches he and wife Terra have installed on kitchen cabinets. Non- skid mats for shelves and a pail of emergency supplies in the bedroom closet are just two more precautions they have taken for earthquakes. Says Terra Tepper: "We'll probably be dead 100 years when the earthquake comes but we'll spend the rest of our lives struggling with cupboard hooks." However, they're ready just in case. Photo by Tony Richards

Damage estimate $14-$32 billion in major earthquake

According to a 1991 insurance study, a 6.5-magnitude earthquake in the lower mainland would cause $14 to $32 billion worth of damage.

A 1990 study predicted a megathrust quake would render 10 to 30 per cent of single-family homes uninhabitable, and destroy 50 to 100 per cent of non-reinforced masonry buildings, 10 to 20 per cent of high-rises and 60 per cent of older schools and hospitals.

On the Gulf Islands, most buildings are of wood frame construction, whose flexibility makes it better able to withstand the sometimes violent shaking of an earthquake.

Your guide to earthquake survival

BEFORE AN EARTHQUAKE

1. Prepare your own family plan of action in the event of an earthquake.

2. Each family member should pick one location of safety *in every room away from windows.*

3. Have a plan to reunite your family. Travel and communication may be difficult after an earthquake.

4. Families with school children should make sure their schools have emergency plans and consider these in developing a family plan.

5. Meet at least twice a year with your family and neighbours to discuss, update and rehearse your plans.

6. Know where and how to shut off electricity, gas and water at main switches and valves. Keep the appropriate tool near each shutoff.

7. Make sure your home is safe from potential earthquake hazards:

• Remove large and heavy objects from high shelves.

• Bolt shelves and other top-heavy cabinets securely to walls.

• Bolt and secure water heaters, gas appliances, refrigerators, heavy furniture, bookcases and shelves.

• Store bottles, china and other breakables in low places, so they won't fall off shelves.

• Secure cabinets with latching doors.

• Install curtains over windows to prevent flying glass, particularly in bedrooms.

• Remove objects from walls over beds, such as pictures, mirrors, and shelves, or bolt them to walls.

• Be aware of objects hanging from ceilings, e.g. fans, plants or light fixtures. Fasten ceiling objects.

• Check the structure and foundation of your building. Contact your building inspector for advice.

• Have a contractor repair all hazards and reinforce any weaknesses.

• Purchase rechargeable plug-in emergency lights for each room

• Investigate earthquake insurance.

8. Prepare an emergency supply kit. Have enough supplies to last at least 72 hours for each family member.

• Portable radio

• Flashlights

• Extra batteries

• Fire extinguisher Class "ABC"

• First aid kit and handbook

• Bottled water stored specifically for an emergency, in plastic bottles, not glass

• Canned food or dehydrated foods, powdered milk and canned juices, dried cereals, fruits, unsalted nuts

• Eating and cooking utensils and mechanical can opener

• Alternate source for cooking; fuel and outdoor stove or barbecue

• Heavy work shoes and gloves; keep near your bed

• Sleeping gear, camping equipment such as sleeping bags, tents, lanterns

• Special items, medicine and extra eyeglasses, if needed

• Tools for turning off gas and water mains; a pipe wrench and a crescent wrench are recommended.

DURING AN EARTHQUAKE

1. Stay calm — put your plan of action into effect immediately.

2. If you are indoors — get to your designated *safe location*, which should be under a table, desk or bed, and hang onto the support legs, or brace yourself in a strong doorway, making sure your fingers are safe from door jambs. Stay away from windows, glass dividers, bookcases, cabinets, mirrors and shelves.

3. If you are outdoors — move to an open area away from buildings and trees, power lines and poles, brick or block walls, chimneys, glass windows and other areas where objects could be falling. If you are on a street, watch for moving cars shaken from their parked position.

4. If you are in a car — stop the car and stay in it until the shaking stops. Do not stop near trees, power lines, utility poles, underpasses and overpasses.

5. Do not panic. Stay calm.

6. Do not run outside. Debris may be falling, vehicles may be out of control.

7. If you are outside, do not run into the street, under trees, power lines, overpasses or underpasses.

AFTER AN EARTHQUAKE

1. Put on heavy-soled shoes immediately to avoid injury from stepping on glass and other debris.

2. Check for injuries. Provide first aid if necessary. If someone has stopped breathing, give mouth-to-mouth resuscitation. To stop any bleeding injury, apply direct pressure over the site of the wound. Do not attempt to move a seriously injured person unless they are in immediate danger of further injury. Cover injured persons with blankets to keep them warm. Be reassuring and calm.

3. Inspect your home:

• Check for, and extinguish any fires.

• Check for gas leaks *by smell only.* If you smell gas, shut off the main valve and open all the windows and doors. Do not turn on any electrical appliance, since any spark can ignite gas from a broken line.

• Check for water leaks and shut off at main valve if any exist.

• Check for electrical damage and turn off system at main circuit breaker or fuse box if you detect any frayed wires, sparks or the smell of hot insulation.

• Check outside the home for damage or hazards such as cracked foundations, dislocated chimneys, downed power lines. If your home appears severely damaged, get your family outside to a safe and open area. Do not approach any structure or chimney you think might have been damaged; they could topple.

• Check your water supply — if water is off, emergency water supplies may be all around you, in water heaters, melted ice cubes, toilet tanks, canned vegetables. Do not eat or drink anything from open containers near shattered glass. You can purify contaminated water by first straining the water through a napkin or clean cloth, then adding household chlorine bleach at the rate of two drops per quart. *Note*: Water may also be purified by bringing it to a rapid boil.

• Turn on the radio (portable, if the power is out) and listen for public safety advisories. Locate light source, if necessary.

• Clean up potentially harmful materials. Use protective gloves.

• Check emergency supply kit.

• Open closets and cupboards carefully.

• Cooperate with public safety officials. Be prepared to evacuate, if necessary.

• Be prepared for aftershocks.

DO NOT . . .

1. Do not light a match if you smell gas.

2. Do not touch downed power lines.

3. Do not use the telephone except for genuine emergencies.

4. Do not drive except in an emergency.

5. Do not crawl under the house to check the foundation.

Take reasonable precautions is all you can do

The best time to earthquake-proof a home or building is before it is built.

Salt Spring architect Hank Schubart, who has lived and designed homes on Salt Spring for 25 years and has also lived in California, is well aware what reasonable steps can be taken to build a safer home. Earthquakes are at the back of his mind whenever he designs a building.

Ever since the 1906 earthquake in San Francisco, engineers, planners and government have been extremely conscious of the damage earthquakes can cause, he said. The size of that quake — 8.3 on the Richter scale — helped set the benchmark standard for earthquake design.

In 1933 there was an earthquake at Long Beach which set the stage for building codes for all schools in the state.

"They are all designed very much on a rigid earthquake code and they are carefully supervised," Schubart said of California schools. "People are still very conscious of earthquakes."

In recent times, there have been some improvements in certain design features to help keep down the damage after an earthquake. In 1906 in San Francisco most of the damage was caused by fires which could not be put out because water lines had burst.

Today, there are large cisterns under major intersections in the city, Schubart said.

Another major problem after an earthquake is ruptured gas lines, which also cause fires. One fairly simple answer was to redesign valves so that during an earthquake the lines are blocked at the main.

After a major quake engineers from all over the world converge to learn what they can from the damage, Schubart said. But islanders should keep one important thing in mind: the average single-family home is usually pretty safe.

They are often no more than one storey tall, are built on good foundations and are built of wood, which is flexible.

"You don't ever earthquake-proof the house," he said, but added, "good nailing, good cross-bracing and securing independent structural members goes a long way."

Houses should be securely bolted to strong foundations, support posts bolted and cross-braced and walls securely attached to one another and to the roof structure.

In the old days, Schubart said, piers were not cross-braced and in an earthquake they would just lift away and then collapse with the house on top of them.

Chimneys pose a problem, being heavy and inflexible and they tend to tear apart from the house.

"A box with no holes in it is a good earthquake-proof design," Schubart said. A box is rigid. A sphere with a flat base is also earthquake-resistant. But who wants to live in a windowless, doorless house?

"I'm the last one to recommend you cut down the size of windows, but you want to build as rigidly as possible."

The provincial building code takes earthquakes into account in its requirements. "It's much more prescriptive than it used to be," Schubart said. "There is a whole section in the code on earthquakes now.

For his part, Schubart said it was very difficult to evaluate how the forces at work during an earthquake will affect a building. The motion up and down, from side to side and in waves causes complex stresses.

"All you can do . . . is take the most reasonable precautions," he said, adding, "There is a greater hazard from poor soil conditions than poor housing construction."

Homeowners should be aware of the possibility of subsidence and the effect of an earthquake on the land around them. Is there clay underneath, or shale or sand? If the house is built on rock, will the rock fracture? Is there surface water affecting the foundation drains?

Schubart always recommends a geologist's report when designing for a rocky site. It is just another of those small precautions he believes every homeowner should take.

Islands a pile of debris

The conditions which could unleash a giant quake on the Pacific coast are also responsible for the creation of the Gulf Islands.

Retired geologist Tom Wright, who lives on one of Salt Spring's ripples of rock, says the Gulf Islands are the result of debris piled up against the North American tectonic plate.

For centuries this plate has been moving slowly to the west. Meanwhile, the adjoining San Juan plate has been shifting slowly northeast. Where the two plates meet is the subduction zone, where the Juan de Fuca plate slides under the North American plate, rather like a conveyer belt slipping under a solid floor.

The rocks and earth this Juan de Fuca plate "conveyor belt" has carried over centuries to the junction with the North American plate has been scraped off as the "belt" slid underground. This material has built up on the North American plate, creating a significant part of the British Columbia coast and the islands.

The debris which formed the Gulf Islands is being pushed from both sides by the moving plates, a pressure which Wright suggests rumples the islands up like a rug.