Intergovernmental Oceanographic Commission

Manuals and Guides 37

POST-TSUNAMI SURVEY FIELD GUIDE
(First Edition)

1998 UNESCO

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INTRODUCTION

This Guide has been prepared to assist Member States of the Intergovernmental Oceanographic Commission (IOC), scientists, authorities and community leaders in organizing and conducting post-tsunami field survey reconnaissance investigations.

Although previous efforts were done 16 years ago (Curtis, 1982; Loomis, 1981; Pararas-Carayannis, 1982; and Wigen & Ward, 1981), the process of the formulation of this Guide began in Tokyo, Japan in 1993 during the Fourteenth Session of IOC/ITSU. At that time it was decided to form an *ad hoc* Working Group to develop standards for tsunami survey measurements of tsunami runup and damage. The Document IOC/ITSU-XV/13 Standards for Tsunami Surveying was prepared and presented at ITSU-XV held in Papeete, French Polynesia in 1995 as a preliminary document, and it was agreed and recommended that a Field Guide for Post Tsunami Surveys should be developed. This Field Guide was prepared by a new *ad hoc* Working Group, headed by Mr. Salvador Farreras, former Associate Director of ITIC. The documents used as a basis for the preparation included the preliminary one (IOC/ITSU-XV/13), former earthquake and tsunami field survey guides and reports from recent tsunami field surveys (see References). Comments provided by several members of the tsunami community and the recommendations of the International Tsunami Measurements Workshop held in Estes Park, Colorado, USA in 1995 were incorporated into the Guide. The draft of the Guide was presented at ITSU-XVI held in Lima, Peru in 1997 and the final version with revisions and comments from the National Contacts of the ITSU Member States was adopted for publication in the series of IOC Manuals and Guides.

ADVICE

Read this Guide well in advance, while preparing the survey and before going to the field, and distribute enough copies among the members of the survey team.

PURPOSES

1. OF THE SURVEY

Observe and document the effects of tsunamis, collecting readily available and perishable data as soon as possible, so as to learn about the nature and impact of the phenomenon, and be able to make recommendations on the need for further research, planning and preparedness.

2) OF THIS FIELD GUIDE

Establish the guidelines to conduct post-tsunami field reconnaissance investigations, and the standards for the observations, measurements, and assessments, so as to properly collect the data in a consistent and timely manner, and be able to decide on the specific type of data to be collected.

STRUCTURE OF THIS GUIDE

Subjects examined in this Guide are grouped as:

I. - procedures before the field survey,
II. - procedures while in the field survey, and
III. - procedures after the field survey

Section I deals with recommendations for the make-up of the team, pre-travel arrangements and co-ordination, and basic equipment, documents, personal effects and supplies to be gathered.

Section II deals with the logistics at the field, the type of information to be collected and the way to do it.

Section III deals with gathering, distributing and reporting of post-tsunami data.

Information topics targeted are:

- Tsunami source type;
- Tectonic and seismic parameters;
- Earth landslides and submarine slumps;
- Effects of earth deformation;
- Arrival sites configuration;
- Tsunami approach and arrival parameters;
- Tsunami effects, damage and casualties;
- Public and authorities response;
- Additional observations, comments and recommendations.

A prototype Eyewitness Interview Questionnaire (**Annex A**), as well as suggested formats for Field Investigation Forms to be filled during the survey (**Annex B**), covering the topics mentioned above, are included at the end of this Guide.

Make as many photocopies as needed of the Questionnaire and the Forms to survey different sites affected by the tsunami, before going to the field. Have the prototype Eyewitness Interview Questionnaire translated to the local language, before going to the field.

METHODS

The methods to obtain the field survey information can be classified as:

- Gathering of existing maps, charts, tidal records, etc.;
- Actual measurement of physical parameters;
- Graphic depiction and audiovisual recording;
- Interviews to eyewitnesses.

ACKNOWLEDGMENTS

To the members of the tsunami community whose valuable comments, suggestions and insights helped to improve and enrich the content of this document. A debt of gratitude is particularly expressed to: J. Bourgeois, G. Curtis, F. Imamura, V. Kaistrenko, T. Konishi, J. Lander, C. McCreery, M. Okada, E. Pelinovsky, J. Preuss, Y. Sawada, F. Schindele, N. Shuto, D. Sigrist, Y. Tsuji, H. Yeh, and the members of the ICG/ITSU *ad hoc* Working Group.

SECTION I: BEFORE THE FIELD SURVEY

Organize and dispatch the survey team as quickly and effectively as possible. It is better to conduct the surveys in the damaged areas one to two weeks (but not later) after the tsunami, to ensure that:

1) rescue operations are not disturbed;
b) transportation and work is safe;
3) immediate secondary triggered disasters do not interfere.

Make-up of the Survey Teams:

A selection of interested and capable persons, according to the specific needs of each case, should be made. Multidisciplinary composition (specialists in oceanography, engineering, land surveying, seismology, geology, soil liquefaction, sedimentology, sociology, urban planning, public health, and community leaders) is recommended.

It is highly desirable that at least one of the team members represents the affected country and speaks the local language of the survey area. The local scientist's and authority's expertise and invaluable knowledge should be recognized in their participation in the survey. The after event information is quickly perishable, and local scientists in particular have the opportunity for quick response surveys, before valuable field data may be lost. Every effort should be made to fully involve the host country in any post-disaster tsunami field survey.

Site Selection:

Select the location and size of the area to be surveyed and duration of the survey, according to:

1) preliminary scientific, official, or media (press, radio, TV) information on the severity and spatial distribution of the effects of the tsunami attack;

2) suggested more severely inundated areas as shown by early computer numerical simulation of the event;

3) accessibility to the affected areas;

4) availability of field personnel;

5) availability of funding; and

6) availability of time.

IOC Sponsorship:

For an IOC sponsored post-tsunami survey to take place under its auspices and partial financial help, it is strictly necessary that an official letter of request and an invitation be addressed by the Representative to IOC/UNESCO of the affected country to the Executive Secretary of IOC/UNESCO, as soon as possible. The issuance of this document should be co-ordinated through the National Contact to ICG/ITSU of the host country.

If IOC funding is allocated, it should in particular be made available to enable participation of scientists without direct access to funding in their own countries, as well as to ensure that the necessary expertise be represented in the survey.

Training:

Unprepared observers may not easily recognize the traces left by the tsunami. Training sessions for the inexperienced members of the team may be needed, before departing to the field.

Communication, Transportation and Co-ordination:

The e-mail Tsunami Bulletin Board, "tsunami@itic.noaa.gov", should be used as the primary means of communication for the pre-survey preparation. A national authority or member of the tsunami research community of the country to be surveyed should be named and made available through a real-time accessible address (e-mail, telephone, fax) to co-ordinate the main aspects of the survey. Establish also the necessary links with the academic and operational community of the affected nations, who will be involved in the surveys, to help recruit local members for the team, help translate the prototype eyewitness interview questionnaire to the local language, agree on how the information to be obtained will be shared, and eventually develop joint research activities. Those participating international experts should work hand-in-hand with the local survey experts.

Determine also the communication and logistical support needed from local sources, like: photocopiers, fax and telephone lines, Internet accessibility, modems, cellular telephones, etc. Select a common meeting site adjacent to the stricken area. Establish which ground, maritime and aerial vehicles will be used for transportation of the team to reach the accessible and inaccessible areas. Co-ordinate with other groups who are performing similar surveys in the same place, so as to minimize or eliminate duplication of efforts and to share the information. This co-ordination should not be aimed at excluding any individual from the effort, but rather at maximizing the effectiveness of the survey.

Pre-Travel Procedures:

Consider the ways to facilitate the legal and healthy access of the teams to the survey area. Visa arrangements, immunizations, letters of introduction or other identification documents, permits to access the affected area, transportation, accommodation and food for the team **should be arranged in advance**. Accident, health, and life insurance should also be arranged. Life-style, culture, religion, public state, and other background information should also be obtained before departure. Contact with international organizations, consular officers, relief agencies, etc. may be helpful. Agreement should be reached in advance on the procedures for admission of the teams and customs clearance of the survey equipment and sediment samples, as well as other logistical matters. Authority procedures should be arranged beforehand, so that sediment samples returning to the surveyor's country are not disturbed during quarantine inspections.

Sensitivity:

The period of time immediately following a destructive tsunami can be an agonizing ordeal for local communities and their citizens. People have been killed or lost, buildings and homes are damaged, transportation and lifeline infrastructures may be wiped out and people are in a state of shock. Clearly the first order of business for any country and affected community following a tsunami is a period of grieving and rehabilitation. Recognizing these important human needs, post-disaster tsunami surveys must be conducted with sensitivity to these cultural requirements and with complete co-ordination with the host country. Local authorities should not be overwhelmed with requests of visas, invitations, databases or reports at a rather inopportune time. If the area to be studied is in a region or country under a strained national or international political climate, develop rules of conduct for the survey team members and adhere to them.

Existing Instrumentation:

In advance to the survey, identify the existing water level measuring instruments (i.e., tide gauges or others) in the site, and request their information to be collected.

Survey Equipment:

Identify and select the most suitable, portable, and easily accessible instruments for the parameters to be measured. Field equipment should be as simple and effective as possible for rapid surveying. A hand-held Global Positioning System (GPS) should be one of the primary equipment required for the survey. Optical survey equipment, hand levels with sighting arrangement (carpenter's level), stadia rods (surveyor's staff), synchronized chronographs, inclinometers, long (100 m) measuring tape, compass, and a small scale may be essential. Hand pushable piston cores to take sediment samples, and a shovel to dig. A digital survey fathometer coupled to a GPS may needed, although it is rarely used in the survey. Consider the use of photographic, audio, and/or video recorders, and carry enough rolls of film, cassettes, tapes and battery supplies.

For remote locations, portable seismographs may provide valuable aftershock data.

Include portable lightweight energy sources (i.e., solar panels to recharge batteries, small natural gas tanks, or generators, fuel) as required by the survey equipment and camping needs (stove, lamp, tent, sleeping bag, etc.). Flashlights with extra batteries and lamps, matches in waterproof containers. A portable radio, portable (laptop) computer, pocket calculator, papers or notebook, pens, erasers, portable telephones, clipboard, pocket knife, and waterproof packaging for documents should be carried.

Survey Documents and Preliminary Information:

Gather information from local, national and international news media and preliminary data from local emergent survey teams. Collect information on tectonic setting, faulting mechanism and seismicity of the generating earthquake and its source area. Collect information from previous tsunamis and their effects in the general area. Assemble bathymetric charts and topographic-geologic maps at a scale of 1:25,000 or finer, aerial photos, tidal gauge locations, and tide tables (or computer tide programmes) to correct runup measurements for the areas subjected to the tsunami attack, in advance. Enlarge the maps by photocopying before embarking, to aid field note taking. Do not forget to carry enough copies of this Tsunami Survey Field Guide, the Questionnaire (**Annex A**) and the Field Forms (**Annex B**).

Miscellaneous Baggage:

Include in the pre-departure travel checklist:

1) personal effects (toilet articles, tissues, Wash 'n Dry, toilet paper, shaver, soap, toothbrush, toothpaste, comb, towel, shampoo, safety pins, scissors, sunglasses, alarm clock, sewing kit, etc.);

2) non-perishable emergency food and water supplies to survive (canned meat, poultry, fish, fruit, vegetables, and beverages; dry milk, cereals, coffee, tea, creamer, salt, pepper, sugar; disposable plates, cups, and napkins, a can opener, and pills to purify water;

3) first aid kit and prescriptions: adhesive tape, band-aids, sterile cotton, antiseptic solution (alcohol, hydrogen peroxide, Merthiolate), aspirin, prescribed antibiotics, bandages, diarrhea medication, ear drops, eye drops, laxative, petroleum jelly, rubbing alcohol, toothache remedy, snake

bite kit, malaria pills, sun-screen and insect repellent lotions, thermometer, etc.;

4) personal documents: passport, visa, airplane ticket, immunization records, letters of reference or invitation, cash and credit cards, foreign currency and dictionary (if you survey outside your country), etc. Make personal information cards for each participant containing: name, passport number, address, phone and fax numbers, blood type, contact point during the survey, and contact person name, address, phone and fax numbers in the home country. Each member should carry his (her) own individual card, and the leader of the team should have copies of all the cards for emergency situations.

e) clothing (jacket, sweater, raincoat, pants, shirts, underwear, etc.), hat, and shoes or boots appropriate for the climate and season of the year.

SECTION II: WHILE IN THE FIELD SURVEY

Overall Policies:

Outside the international waters and the Antarctica, the visiting researcher is working in a foreign country that is the home and principal study area of other scientists. He or she has an obligation to plan and conduct research with that firmly in mind.

A visiting scientist must respect not only the sovereignty, laws and environment of the country in which he or she conducts research, but also the dignity and intellectual rights of its scientists, and indeed the well-being of all its inhabitants, resources and natural environment. The goal for interaction with scientists of the host country should be unselfish cooperation in research and enhancement of that country's science base.

Official Obligations: Many countries have strict legal requirements for foreign scientists seeking permission to conduct research in their territory. There may also be limitations on the importation and exportation of instruments and specimens. Copies of geophysical data and field notebooks may need to be retained by the host country. The science attaché at the embassy or consulate of the country in question should be consulted at an early stage in planning.

Unofficial Obligations: The onus is on the intending visitor to determine whether or not someone is already studying the problem or area of interest. This can be done either through personal contacts, or through an organization such as a learned society or national academy of sciences. Whether or not someone is already involved in an overlapping study, and especially if that is the case, every effort should be made to establish a collaborative programme with one or more scientists of the host country. True collaboration involves intellectual exchange, acknowledgment of previous work and help by others, attendance at local congress and symposia, joint publication, and help with the training of local students. In particular, visitors should be encouraged to give lectures of interest to both the general public, students and colleagues and to provide brief reports to be published in local newsletters.

Logistics and Generalities:

Hold a pre-survey meeting at a local agency. Set operational procedures in the field, task, role, expectations and responsibility assignments to each specialist according to his/her expertise. The team should spend a reasonable time in training before breaking up into field parties. Each field party should include at least one local scientist/representative, as well as at least one person with prior surveying experience. Determine the means of transportation to be used for the easy as well as the inaccessible areas to reach (boats, helicopters, four-wheel drives).

It is very important that all the items described in the Eyewitness Interview Questionnaire and the Field Survey Forms are well understood in advance, by the surveyors. The most experienced surveyors should preferably record the items in the forms. For all kinds of measurements, the field surveyors must know how to evaluate and report on the quality of the collected data. All physical measurements should be located as precisely as possible on maps and/or air photos.

Use the forms attached to this Field Guide *(make the necessary copies and re-number the pages)* to record **all** the data collected, and use free space for sketches, diagrams, additional notes and comments on unusual observations. Nothing should be trusted to memory. Use the prototype Eyewitness Interview Questionnaire, previously translated into the local language, to conduct eyewitness interviews.

Site Selection:

Select specific sites, like small bays, stretches of open coast, estuaries, beaches, to document a complete case history of all the tsunami effects, trying to obtain sets of coherent stand-alone data of the parameters to be measured. If possible, capture a broad overview of the area with photographs.

Ancillary *in situ* Information:

Obtain more detailed maps of the zone form local authorities before proceeding to the survey. Collect local newspaper reports, radio, TV or other press releases, and photographs or videos taken during the event.

Measurements:

The parameters selected should be simple and fast to measure or estimate, so as to make them easily comparable and valid for subsequent surveys and research applications (various measurements should be coupled to enhance their usefulness). Always show with what degree of precision the measurements were taken. It is suggested that at least the information and parameters which follows, should be covered.

Horizontal Positioning:

Check to see if GPS sites had been established before the earthquake and tsunami.

Determination with enough accuracy by means of GPS or map location is necessary. Absolute map locations are preferred if GPS positions do not plot accurately due to signal errors or datum irregularities.

Water Upper Vertical Reach:

Measurement by standard line of sight levels, GPS, or other methods to, if possible, 25 cm accuracy. As many measurements as possible should be made, with precise locations of measurements plotted on maps or air photos, and preferably with sketches of the measurements, as well as photos. Use of GPS technology may help in more timely and efficiently collect the tsunami runup data and to identify land subsidence or uplifting due to the earthquake. Where traditional surveying techniques using measuring tapes, parallax distance finders and bubble levels produce satisfactory results, they are not necessarily the most efficient in time and manpower. Traditional techniques are, however, relatively inexpensive. While GPS technology has shown dramatic improvements in accuracy and cost, the equipment remains relatively expensive for the high accuracy systems.

Determine or identify at least the following:

1) Reference Datum and Tidal Correction:

Agree on a unique reference level, i.e., Mean Sea-Level, or Mean Lower Low Water if referred to a chart datum, or Local Tide Level at the time of arrival or during the tsunami. Runups heights measured relative to the local tide level (shoreline elevation) at the place and time of each particular measurement should be corrected to the common Reference Datum selected.

For the above mentioned correction, it is essential that all hand watches used by the surveying personnel should be synchronized and set to a standard time signal, and each runup measurement time be recorded. Find out if standard or daylight savings time was locally used at the time of the tsunami occurrence, during the survey, in the local tide gauge records, and in the tide tables. Get the nearest tidal gauge records available for the site.

Be aware that a proper correction to a common Reference Datum and a standard time is a critical and important issue for further interpretation of the data.

2) Bench Marks

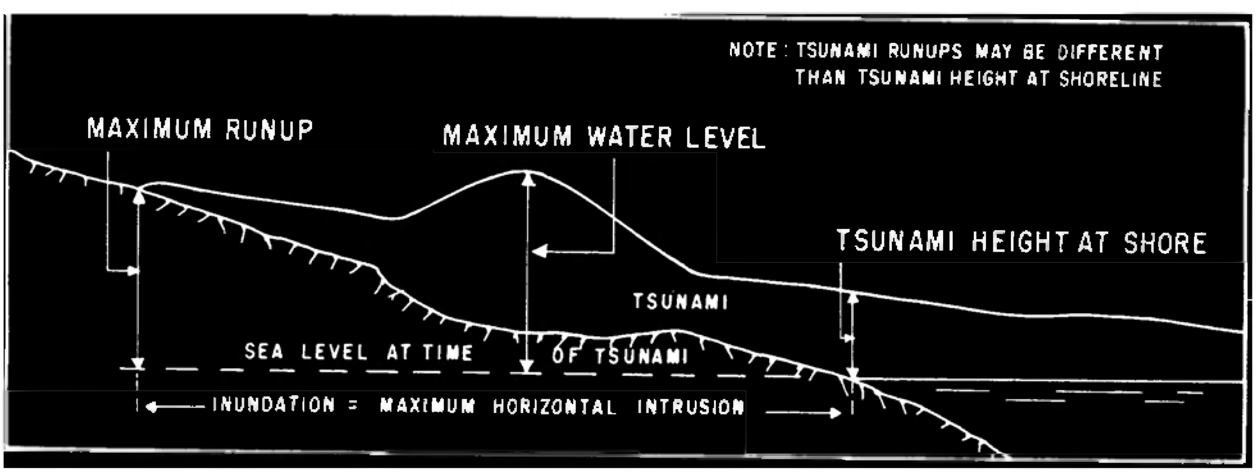
Locate existing benchmarks in the area and use them as reference to check datum and measurements. Obtain GPS corrected vertical positions of the benchmarks to detect possible land uplifting or subsidence due to the earthquake.

3) Runup

Whenever and wherever possible (but at least in one site), a surveying cross-section transect should be measured and drawn between the maximum horizontal inundation watermark and the shoreline (or even into the surf zone). At least, at each site, the **maximum runup** and the **maximum water level** (which may in some cases be the same measurement), as defined below, should be measured. The two kinds of data should be plotted and distinguished by different symbols in a diagram. Definitions agreed by the scientific community during the 1995 Estes Park's Tsunami Measurements Workshop, for these two magnitudes are as follows:

1. **Maximum runup** is the difference between the elevation of maximum tsunami penetration and the elevation of the shoreline at the time of tsunami attack (i.e., corrected for the difference in shoreline elevation between the time of measurement and the time of tsunami attack).

2. **Maximum water level** is the difference between the elevation of the highest local water mark and the elevation of the shoreline at the time of tsunami attack (i.e., corrected for the difference in shoreline elevation between the time of measurement and the time of tsunami attack).



See Figure below.

Be able to identify localized extreme runups due to "funneling" in narrow valleys, channels, and creeks, or "seiches" in semi-enclosed bays. Agree on a criteria when to: a) perform averaging of runup values on beaches of complex topography, where randomness of the flooding process occur, to obtain a single representative value; or b) avoid averaging of runups, but rather report crude observed data.

4) Markings:

Markings help identify maximum horizontal and vertical runup. High water marks ("bathtub rings") on walls and structures are reliable, as well as marine-origin objects or vegetation locations. Lines of landward limit of sea grass, debris, sediment, or floating garbage deposition (distinguish from deposition due to normal high tides), horizontal boundaries between vegetation killed or damaged by saltwater and surviving vegetation (discoloration after a few weeks is a good indicator), amounts of bark stripped from trees, and levels of seaweed or debris caught in screens or other structures, are also good indicators. Look for additional debris lines indicative of the arrival of several waves. Notice if upper, middle or lower parts of houses (windows, roofs, etc.) or structures are damaged, semi-destroyed, or intact, and identify if this was due to earthquake shaking or tsunami arrival. Clothes, dead fishes, dead cattle, and/or other objects or animals caught and/or hanging in upper branches of trees. Other indicators may be: large blocks of corals deposited by the waves, boats destroyed or washed ashore, wood buildings floated off their foundations and deposited elsewhere. Scratch marks on tree trunks caused by collision of water-born objects may be an indicator too. Be able to distinguish real runup marks from splashes and from damage marks produced by high floating objects or debris. Always draw sketches if possible. Trees broken, bent, uprooted, or overturned. Vegetation destroyed and transported. Debris transported and deposited inland. Its type, size (boulders, rocks, driftwood, sand, etc.) and weight (or density) should be measured if possible. Overtopping of coastal structures and destruction of existing tide stations may be an indicator, too.

Mark high-water marks with tags, tape, dye pens, spray or brush paint, or stakes, for later surveys reference. When there are no traces of tsunami runup, the positions pointed out by inhabitants who saw the tsunami attack may be acceptable indicators (with cautions of possible errors) instead of giving no account at all.

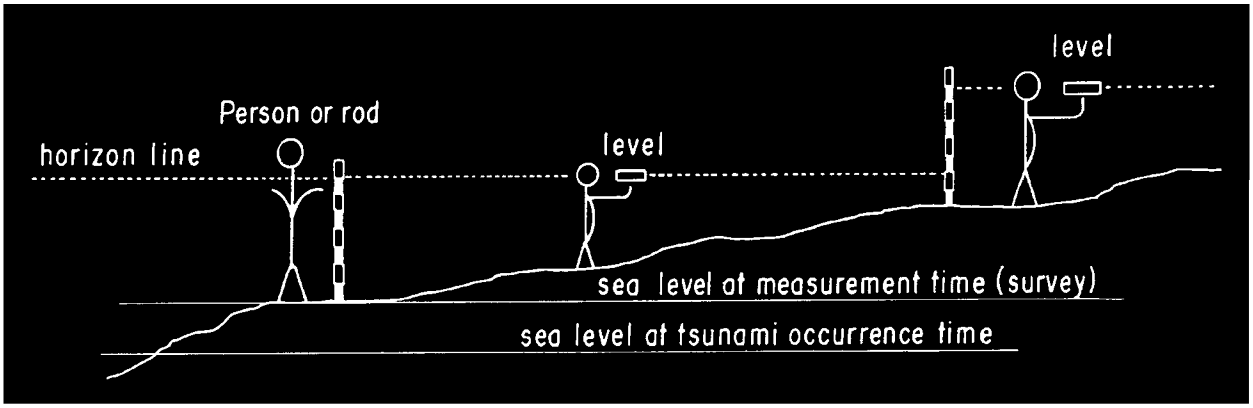
Horizontal Flooding (Intrusion):

As a conventional definition, **inundation** is the maximum *horizontal* penetration, or intrusion, of the tsunami from the shoreline (see Figure below). Determine this maximum intrusion inshore from MLLW line or other reference line. Delineate in a map, and estimate distances by means of tape, laser, radio frequency equipment, or by visual range (parallax) finder, or exceptionally, if no other instruments are carried, with a car odometer, a photographic camera telemeter, or counting paces.

Emergency Measurement Procedures

Maximum runup and inundation limits can be established by a succession of measurements of horizontal distance and vertical elevation from the sea water shore-line to points on the line of maximum water incursion.

In case no instruments are carried, use the height of one person's head, neck, waist, knees, etc., as a stadia rod. A person can determine the elevation of the point where he/she stands with respect to sea-level, using a hand carpenter's level or by "reading" the intersection height of the sea/sky horizon line with the rod (or companion person) standing at the sea level shore-line. Leap-frogging by subsequently re-positioning the rod at the so positioned points, and the observer at new upper unknown ones, until the highest water mark is reached, its elevation will be determined. See Figure below (adapted from



Japanese Meteorological Organization, 1990).

Currents:

Document evidences of flow direction and/or flow strength. Estimate the magnitudes through their effects (drag, inertia) on fixed sizable objects and structures, and in floating objects (boats, ships) carried inland. Flow direction can be inferred from geometrical orientation patterns of debris accumulation or from the direction of tree falls. Measure grain size and density of the sediments being transported.

Geological Information:

Identify, locate and estimate the extent of possible coastal uplift or subsidence and its influence in the tsunami runup. GPS vertical positioning of existing benchmarks, as mentioned before, may be useful. Submerged vegetation or presence of green leafy plants growing in the inter tidal zone, or uplifted barnacles, may be also an indicator of subsidence or uplifting, as well as changes in the level of high tides reaches after the tsunami.

Presence of cracks, liquefaction, tilting or warping in the ground should be noticed and documented, as well as evidences of fault creep and direction of the motion.

Observe and detect the presence of sand, silt, gravel or mud sheets eventually deposited by the tsunami beneath tidal marshes, in flat "meadows" shoreward of ponds, above the height of barrier beaches, or in coastal lagoons. Take vertical core samples with plastic tubes on lines perpendicular to the shoreline, across the surfaces of transport and deposition, till the reach of maximum incursion. Dig trenches and photograph the sediments. Measure the thickness and horizontal extent of the sand layer deposits, and their vertical distribution of grain sizes inside them (use settling tube analysis for fine resolution in a range of 1.5 micron to 2 mm, roughly, if it is possible); and detect the presence of wood detritus and rooted plants as evidence of sudden sand coverage by the tsunami. Identify the areas of eventual erosion, motion and settlement of the sediments by the tsunami waves, but distinguish between beach erosion caused by the tsunami itself from long-term ones (appeal to eyewitnesses).

Identify the presence and eventual influence of landslides of earth or ice in water bodies, in the generation of the tsunami.

Seismological Information:

During the survey, at remote areas, obtain aftershock data from portable seismographs.

Profile:

Estimate beach slopes with hand-held inclinometers, or other optical survey equipment. To save time, do the profiles in conjunction with other field observations.

Bathymetry:

With the help of a fathometer coupled to a GPS or to UHF radio links for positioning, perform a survey of the near-shore bottom of those coastal areas not covered with enough resolution by the available charts, or where substantial changes due to sediment transport by the tsunami may have taken place. A small boat or vessel will be needed. Annotate this surveyed depths in your original bathymetric chart.

Timing and Other Characteristics, through Eyewitness Interviews:

Interviews can be invaluable in helping distinguish actual effects of the events (earthquake, tsunami) from pre-event conditions and post-event changes like damage clean-up.

Whenever possible, interviews should be conducted by local representatives, as interviewers should be sensitive to the emotional condition and cultural practices of interviewees. Obviously, a native-language speaker will facilitate the process. Non-technical language should be used, and leading questions that suggest the wording of an answer should be avoided, i.e., interviewees should be asked to indicate physical location of water levels, rather than to state numerical elevations of water. In general, questions asking eyewitnesses to describe observations **in their own words** will elicit more reliable information than yes/no questions, or questions where certain words are suggested to the interviewee, or where the answers are steered by the interviewer.

A prototype Eyewitness Interview Questionnaire, following guidelines given by Y. Tsuji and V. Kaistrenko at the June 1995 Estes Park International Tsunami Measurements Workshop, is included at the end of this Guide (**Annex A**).

Hand written Questionnaire replies should be read and transcribed as soon as possible. Try to allocate a pool of funds and assign the proper people for this task as early as possible.

Document through eyewitness interviews, measurement of instruments, or local press reports, the times of arrival and periods of the tsunami waves, their number, tsunami arrival time after earthquake shaking, and the total duration of the tsunami. Did the water receded before the arrival of the first wave or not? Were there "noises" heard? Were the waves of a bore type or not? What was the approach direction of the incoming waves? Be aware of eyewitness responses varying significantly in reliability.

Document the eventual propagation of tsunami bores upstream in estuaries. Detect or identify the influence of any local basin resonance amplifying the tsunami response, and the influence of existing islands, offshore rock formations, or other local bathymetric features present in the continental shelf. Consider the width of the continental shelf. Notice any influence of local topographic geometry in the runup patterns, and damping due to bottom friction.

Audio-Visual and Non-Traditional Survey Methods:

Photos, video, and audio should be considered, but only to augment and not to replace field note taking. Photogrammetry, aerial videos, side scan bottom profilers to assess sea bottom ground deformation, and other methods, should be considered if there is a need, and a financial support. Aerial photographs and satellite images may help locate the affected areas to be surveyed, and are a valuable adjunct in areas where ground observations are not possible due to inaccessibility.

For aerial photographs, it is recommended to fly at about 150 to 300 meters altitude to avoid high altitude haze and light scatter, and far enough offshore so that oblique shots at 45° below the horizontal would include the waters edge as well as the inundation boundary occupying the central portion of the picture. Shoot often enough so as to have about 50% overlap. If the plane is flying low, under 150 meters, shutter speed of 1/500 second or faster should be used. At higher altitudes, 1/250 or 1/125 second would be satisfactory.

Black and white, colour and infrared films should be used. Black and white inherent high resolution allows identification of small features. Colour can see coral chips, logs and stones deposited, vegetation torn loose, swash marks, and debris caught in bushes. Infrared clearly identifies areas of inundation delineated by living and death vegetation.

The dimensions of local reference points (e.g., of a remaining house) should be measured in order to calibrate air photographs. Stereoscopic view of overlapping plates facilitates runup measurements.

Damage Assessment:

Rough (non specialized) classification; estimate of nature and category of the damage, and to what apparent cause is due:

1) primary agents:

hydrostatic (pressure, buoyancy);
hydrodynamic (surge, drag), or

b) secondary:

impact by debris or driftwood;
fires from electrical vaults or oil ignition;
explosions;
contamination from hazardous materials or toxic fume releases;
lack of ground support by scouring torrent of receding waters, etc.

Document the overtopping of breakwaters, docks, or other coastal structures, and the sand erosion or deposition in beaches. Distinguish earthquake from tsunami damage.

Social Impact:

Rough estimate towards gaining an overview of the impact of the tsunami on: human behavior, public services, communication lifelines (roads, rail lines, airport runways, utilities, etc.), disruption of everyday activities, casualties and injuries, performance of emergency management agencies and the degree of effectiveness of the response plans in effect, homeless and displaced persons due to the tsunami.

Response of different segments of the population (elderly, disabled, minors, etc.) to the warnings. Reasons for lives lost: inadequate warning?, inadequate evacuation?, inadequate preparedness? Make general recommendations, if possible.

SECTION III: AFTER THE FIELD SURVEY

Local Meeting:

Have a brief meeting with the local country authorities and related organizations, immediately after the survey, to write a brief preliminary report of the results and make recommendations for future tsunami disaster mitigation measures. Include in this report the mailing and e-mail addresses of the survey participants and organizations from the country and abroad, and the WWW sites related to the surveyed earthquake and tsunami.

Report:

Write down the basic general information, with enough detail as it might be needed, and report it to the sponsoring agency (IOC) and the International Tsunami Information Center (ITIC). Participants in the surveys are expected to voluntarily, upon request, contribute with brief reports for the Tsunami Newsletter edited by the ITIC. Comprehensive reports may be required by sponsoring institutions or for presentation at international meetings and symposia. Brief reports submitted on the electronic Bulletin Board can be helpful for other members of the tsunami community, and should be posted as soon as possible after the return of the survey teams.

Gathering, Processing, Sharing and Distribution of Post-Tsunami Data:

Adopt as a policy to share the information for the benefit of all parties (broad dissemination and accessible storage are the key issues).

Establish uniform procedures and guidelines to standardize the collection, formats, processing, archiving, distribution, dissemination and availability of the data through existing Centers (ITIC, NGDC, JMA, WDC-A and -B) or new ones.

Send a copy of all survey material to the ITIC Library and Archives.

Examples of data to be managed: a) bibliographic, b) marigrams, c) tables, d) charts and graphics, e) photos and videos, f) audios. Options of media to store it: publications, reports, cassettes, diskettes, CD-ROM's, etc.

The e-mail Tsunami Bulletin Board, "tsunami@itic.noaa.gov", should be used as the primary communication means for the post-survey report.

Use classical (photocopies, mail, fax) as well as most advanced electronic superhighway technology to distribute and give access to the community to the information, i.e., World Wide Web for digital images, graphs, interactive maps, and computer generated animations ; and e-mail Bulletin Board via Internet for text and tables, etc.

Photographs, charts and other forms of visual data should specifically be posted on World Wide Web sites, and the Web used to point the links to data repositories. Photographs should also be included in the printed reports to help understand the survey operations, particularly those showing:

1) samples of tsunami runup traces;
b) use of survey instrument/equipments;
3) houses and infrastructure damaged or destroyed; and
d) effects on the ground and vegetation.

Where as some potentially affected countries (or parts thereof) do not have broad access to these new electronic superhighway technologies, concise written reports should also be made available.

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ANNEX A

PROTOTYPE EYEWITNESS INTERVIEW QUESTIONNAIRE

(from guidelines given by Y. Tsuji and V. Kaistrenko at the June 1995 Estes Park International Tsunami Measurements Workshop)

I. BASIC INFORMATION

Interviewer's name____
Date and time of interview____
Interviewee's name____
Address____
____
Profession, gender, age____
Place name (town, village, colony, topographic)______________________(locate on maps or air photos)
Where was the interviewee during the earthquake and the tsunami? (a hill, a house, a boat, etc.)________
____

II. EARTHQUAKE INFORMATION

What was the estimated intensity of the earthquake at this place, as determined from the Mercalli scale? (consult MMI Table)____
If earthquake occurred during night, how many people were awake or awakened?____________________
How many people felt the earthquake?____
Local time of occurrence of main shock____
Local times of occurrence of possible fore- and/or aftershocks________________________________
Number of casualties from the earthquake(s)____
Main damage from the earthquake(s)____
____
Eyewitness accounts of liquefaction or sand blows? Cracks in ground? Landslides, rock falls, etc.?______
____
____
Did well water became muddy? Changed level?____
Were any precursors to earthquake noticed?____

III. TSUNAMI INFORMATION

What was the situation before the tsunami? (meteorological conditions, sea-level, light conditions, sounds or noise, etc.____

Arrival time of wave(s)?:____
Local time - from clocks, TV programmes, etc. ______________________________________
By feeling - time between main earthquake shock and wave arrival___________(note that an aftershock may come between the main shock and the tsunami arrival time)
Nature of first wave arrival? (interviewer may ask, e.g., if water went out first; but this can be a leading question - try to get witness to describe water behavior without leading them on)____
How many times did water rise? (how many waves were there?)___________________________
How much time between waves?____
Did the water completely withdraw and came back again?______________________________
What was the relative size of the waves? (which one was largest, etc.)? ______________________
{blank page for **Additional Comments**}

What did the wave(s) look like? e.g., calm, slow flooding (like a fast tide); like a river, like a swell (with white cap, like a breaking wave), like a wall (bore)____

____

From what direction did the water come?___________, In which direction did it go?_________________

Describe any sounds or noise associated with the tsunami waves before the arrival? and at the time of arrival? e.g., like a drum, like thunder, like an airplane, like rain, like a car, like a river, no sound.____

What changes in the land surface did the tsunami make? Places where there was erosion? (what did it look like before?), places where it left sediment (deposits)? (what did it look like before?) Identify rocks, debris, houses, ships, etc. moved by tsunami (where were they before?) (make a drawing if necessary)____

____

____

Casualties due to the tsunami:
Note: To avoid discrepancies in fatality number counting, it is agreed that we consider as Tsunami Fatalities ONLY those people who die as a direct or indirect action of the waves (i.e., trying to run away from the wave, being in a boat who rolled and plunged extremely, due to shifting cargo on a boat, drowned in the water, severely impacted by debris carried by the waves, from tsunami-induced heart attack). Do not count people who have been killed in the clean-up operations, or sickness from contaminated water or exposure, or other illnesses (i.e., washed away by the wave into a snow bank and died of exposure, evacuated to a cold hill side for the night and died from freezing, intoxicated by drinking polluted sewage water).

Number of: a) deaths______, b) missing_________, c) seriously injured______, d) minor injuries_______
Ages of victims__________________________Sex of victims: ______ % male, _____% female ______

House damage due to the tsunami:
Number: a) swept away_____, b) totally destroyed______, c) partially destroyed_____, d) flooded______
Damage to cars, ships, port facilities, roads, agricultural fields, etc.________________________________

____

____

Health effects since the events: diseases, changes in water quality/availability, etc.___________________

____

Area inundated by tsunami: Indicate physical points (e.g., on houses, trees, fences) to which water rose; maximum distance inland water reached (locate physically)_______________________________________

____

____

Precaution and evacuation:

Did you have knowledge/expectation that a tsunami would come, before the event?____________________

Experience of or knowledge of previous events?____
____
____

What preparedness actions have you taken well before the tsunami?________________________________
____

Actions during and after the tsunami?____
____
____

How did they escape?____
____

Were there obstacles?____

{blank page for **Additional Comments**}

IV. AFTERSHOCKS AND AFTERSHOCK TSUNAMIS

If these occurred, the same basic questions need to be asked, as above, about earthquake(s) and tsunami(s).

V. CRUSTAL MOVEMENT INFORMATION

These indicators may not be obvious or easy to distinguish in the time shortly following the event. Weeks to months will help clarify temporary changes (e.g., flooding) from actual crustal deformation.
Has sea-level changed since the event(s)?____
By how much ?____
Rocks or coral reefs emerged?____
By how much?______________________________________ (be careful to distinguish rocks or coral moved by the tsunami from bedrock or attached coral uplifted by crustal deformation).
Areas now submerged?____
By how much?______________________________________ (be careful to distinguish changes due to erosion or temporarily undrained flooding from indications of permanent land level change)

VI. OTHER INFORMATION/INFORMANTS

Knowledge of people who took photographs, videos, etc.:
Names:____
Addresses (reach them):____
Kind of information____
Knowledge of others who have collected interviews, data:
Names:____
Addresses (reach them):____
Type of data____

VII. FOR THOSE WHO WERE IN BOATS OR AT THE BEACH

Where were they before, during and after the event?____
____
What did the sea surface look like? (e.g., boiling, shaking, foaming ripples or waves)__________________
____
Was there damage to the ship/boat?____
Did they notice any other phenomena? (e.g., fish behavior, light, etc.)_______________________________
____
____

VIII. FOR OLDER PERSONS

Have you experienced any other events like this one in your lifetime, at this same or another place? when? where? (describe such events)____
____
____

Did your parents/grandparents experience any such events? When? Where? (give a brief description)____
____
____

Do you know of stories or legends of such events that have been handed down? Describe:_____________
____

{blank page for **Additional Comments**}

ANNEX B

FIELD SURVEY FORMS

FIELD SURVEY FORM 'A'

Name of surveyor____ Date_________________________

TECTONIC SOURCE INFORMATION

Name of fault____

Location: Lat________________Long.______________ Geographical name_________________________

Type of fault mechanism (strike)(slip):________________________Dip___________________________

Direction of movement:____

Dislocation (m): vertical________ horizontal__________________Rigidity_____________(N/m)

Presence of subsidiary faulting:____

Rupture: Length___________________ Width____

Additional information and/or drawings:

FIELD SURVEY FORM 'B'

Name of surveyor____
Date________________________

EFFECTS OF EARTHQUAKE DEFORMATION

Coastal Uplift__________(m) and/or Subsidence_____________(m)

Describe measured or observed indicators of evidence of sea-level or ground level changes attributable to the seismic event (i.e., mareographic records, GPS bench marks re-leveling, submerged or exposed vegetation, trees or structures, coral reefs emerged, etc.)____
____
____
____

Soil deformation (geometry)____
Tilting______________________
Warping____

Soil liquefaction____

Sand boiling with material ejected____

Type of soil: mud______
gravel_____sand________________silt_______________________________
loose______firm______ consolidated __________unconsolidated _____________________

Ground cracking:
location___________geometry_____________________________
____
length____________width___________ depth___________
slope_____________
(determine with inclinometer and/or optical equipment)

Additional information and/or drawings:

FIELD SURVEY FORM 'C'

Name of surveyor____
Date________________________

EARTHQUAKE PARAMETERS

Date	Time (local/UTC)	Hypocenter Location Lat.	Long	Depth	Ms	mb Mw
Main Shock:						
______	______	______	______	______		______ ______
First Relevant After-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Second Relevant After-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Third Relevant After-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Fourth Relevant After-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
First Relevant Fore-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Second Relevant Fore-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Third Relevant Fore-Shock		(Tsunami observed: Yes or No):				
______	______	______	______	______		______ ______
Fourth Relevant Fore-Shock		(Tsunami observed: Yes or No):				

______________ _______________ ____________ _____________ __________ _______

____
_

Aftershock area: width_______________km length_____________km

Mercalli intensity of main shock at each site surveyed:

Site name/location_______________ Intensity______ Site name/location_______________ Intensity________

Site name/location_______________ Intensity______ Site name/location_______________ Intensity________

Site name/location_______________ Intensity______ Site name/location_______________ Intensity________

Source of Information (USGS, Harvard, etc.)____

FIELD SURVEY FORM 'D'

Name of surveyor____
Date________________________

SURFACE-EARTH LANDSLIDES AND/OR SUBMARINE SLUMPS

Location: Lat.______________ Long____________ Geographical name___________________________

Area involved:__________m^2 Volume involved___________m^3

Movement: Direction:__________________ Rate____

Approximate time of failure respect to start of ground motion____________________________________

Material: Natural___ Man-made____

Sizes___________________________
Nature___________________________________

Initial Final
Slope orientation: __________ ______________________________________ ________

Ridge orientation: __________ ______________________________________ ________

Additional information and/or drawings:

FIELD SURVEY FORM 'E'

Name of surveyor____
Date_________________________

TSUNAMI SOURCES TYPE

Identify *all* applicable with a: **P** = Primary source, or/and
S = Secondary source (i.e., landslide triggered by the primary earthquake)

Earthquake____ Volcanic eruption/collapse____ Earth landslide into a body of water_________________

Meteorite______Nuclear explosion_____ Submarine sediment slump______________________________

Others____

Describe:____

____

____

____

____

____

____

____

____

____

____

____

____

FIELD SURVEY FORM 'F'

Name of surveyor____
Date________________________

TIDES AND DATUM

Bench-marks at or closest to the survey sites:

ID N°.	Location Lat.	Long.	Elevation as marked	Elevation at survey (GPS)
____	_________	_________	_________	_________
____	_________	_________	_________	_________
____	_________	_________	_________	_________

Tidal gauges at or closest to the survey sites:

Place name	Location Lat.	Long.	Elevation of stadia rod zero before tsunami	GPS re-leveled stadia rod zero at survey
__________	________	________	_________	__________
__________	________	________	_________	__________
__________	________	________	_________	__________

(locate bench marks and tidal gauges in maps and aerial photographs)

Tide elevation (with respect to: MSL___, MLLW___, or other ______) at tsunami wave arrival times:

First Wave______ Second Wave ________ Third Wave _________ Fourth Wave _________

Other Wave_______ Other Wave ________ Other Wave ________ Other Wave ________

Indicate if the above elevations were obtained or estimated from:

nearest tidal gauge record___________________, or tidal harmonic predictions________________

FIELD SURVEY FORM 'G'

Name of surveyor____
Date____________________________

SITE CONFIGURATION AND TSUNAMI ARRIVAL *(fill one form for each site surveyed, copy and re-number the pages)*

Site name____

Site location (GPS if possible): Latitude.__________________
Longitude__________________
____

(indicate in the map)

Type:
Harbour______ Beach______ Cliff______ Estuary______ Open Coast______ Bay______________

Other_____, describe____

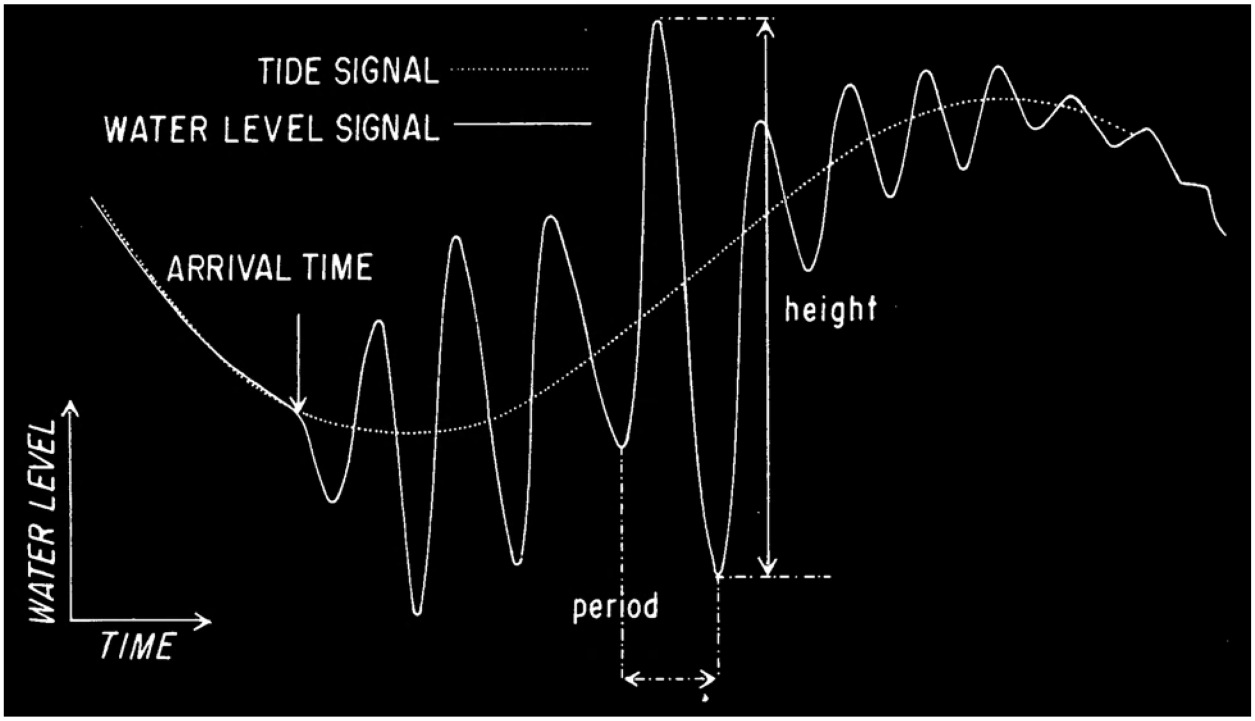
Direction of approach of tsunami waves ____

Documented (measured or estimated, if any) tsunami wave arrival times, periods, and heights at the shoreline:

	Arrival Time local/ UTC	Period min.	Height at shore m
First Wave:	____________	_________	__________
Second Wave:	____________	_________	__________
Third Wave:	____________	_________	__________
Fourth Wave:	____________	_________	__________
Other Wave:	____________	_________	__________
Other Wave:	____________	_________	__________
Other Wave:	____________	_________	__________
Other Wave:	____________	_________	__________

The Figure in next page shows how the get the above parameters from an analog tidal record.

Reference Time: Local time is + or - _______:_______ w/r 00:00 UTC



SITE CONFIGURATION AND TSUNAMI ARRIVAL *(continuation)*

Auxiliary Pocket-size Field Sketch Map

In the blank space below and in the next page, sketch approximately the coastline configuration, topographic and bathymetric contours, offshore and inland prominent features (islands, hills), and indicate, at least:

1) horizontal dimensions or scale;

b) North orientation;

c) location of bench marks and tidal gauges in operation, if any;

4) direction of approach of the tsunami waves;

e) location of straight transects surveyed (i.e. AA', BB', etc.) and lengthwise places where measurements were made (i.e. 1, 2, 3, 4, etc.); and

f) contour of maximum horizontal inundation reach according to water marks, vegetation, accumulated debris, etc.

SITE CONFIGURATION AND TSUNAMI ARRIVAL *(continuation)*

FIELD SURVEY FORM 'H'

Name of surveyor____
Date________________________

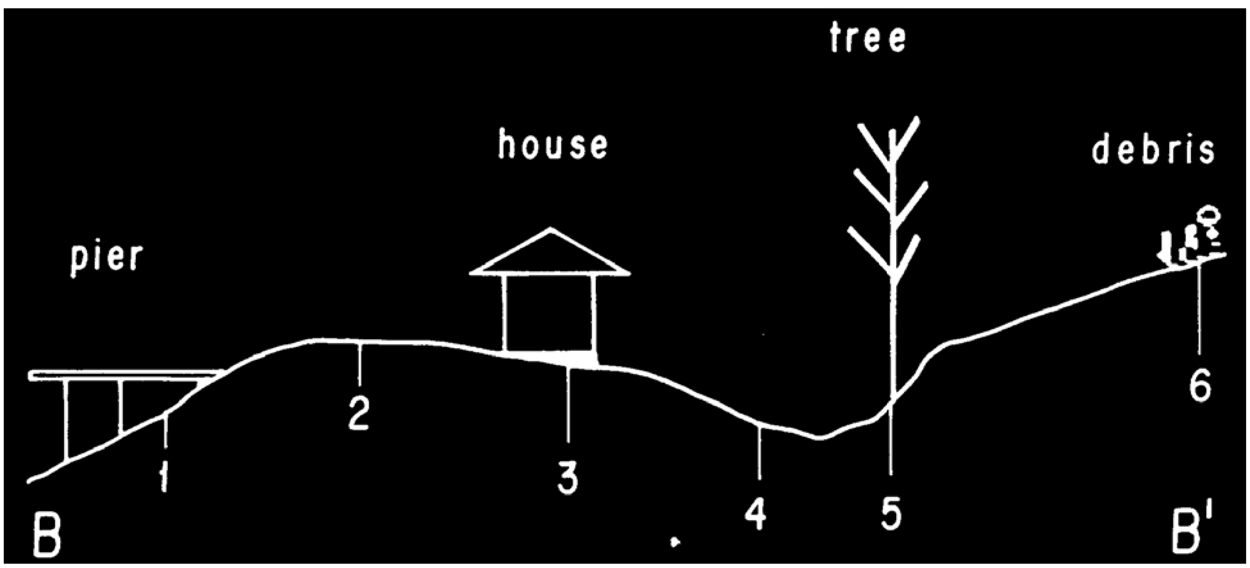
RUNUP/INUNDATION CROSS- SECTION TRANSECTS *(fill one form for each site surveyed, copy and re-number the pages)*

Site name______________________________
Weather____

Site location (GPS if possible): Lat.______________ Long______________ (indicate in the map)

	Time (local/UTC)	Tide elevation w/r____(datum)
Survey start:	______________	______________
Survey finish:	______________	______________

In next page blank space, draw a vertical profile of each surveyed transect between the shoreline and the maximum horizontal inundation watermark, indicating numbered places where measurements were taken, sediment core samples extracted,



and presence of trees, houses, structures, debris, etc.
Example: transect BB', measurements or cores at 1, 2, 3, 4, 5, and 6.

RUNUP/INUNDATION TRANSECTS *(continuation)*

Transect sketches:

RUNUP/INUNDATION TRANSECTS *(continuation)*
(fill one form for each transect surveyed, copy and re-number the pages)

Transect Measurements:

Transect __________ (i.e. AA', BB', CC', etc.)

Vertical datum (zero elevation) selected for water elevation measurements: i.e. mean sea-level state measured at the shore during the survey ________, bench mark reference level at the site________, GPS vertical elevation w/r to MSL, MLLW _______, or other (describe)____

Place N°.	Horizontal distance from shoreline	Water elevation	Type of mark indicator/evidence
1	______________	___________	______________________
2	______________	___________	______________________
3	______________	___________	______________________
4	______________	___________	______________________
5	______________	___________	______________________
6	______________	___________	______________________
7	______________	___________	______________________
8	______________	___________	______________________
9	______________	___________	______________________
10	______________	___________	______________________
11	______________	___________	______________________
12	______________	___________	______________________
13	______________	___________	______________________
14	______________	___________	______________________
15	______________	___________	______________________

Maximum water level____________________ Maximum runup_______________________________________
(the above, after tidal correction)

Shore slope_____________Maximum horizontal inundation reach_____________________________________

FIELD SURVEY FORM 'I'

Name of surveyor____
Date________________________

TSUNAMI TRANSPORTED SEDIMENT AND DEBRIS *(fill one form for each site surveyed, copy and re-number the pages)*

Site name____

Site location (GPS if possible): Latitude.____________ Longitude___________
(indicate in the map)

Length_____________ Width____________
Height____

of the: Erosion_____ or
Deposition____

Type of material: Sand___ Silt___ Mud___ Gravel___Other
(describe)____________________________

Range of grain: Size_____________ Volume__________________
Density__________________

Estimated or measured location:

before the
tsunami____

after the
tsunami____

Sediment vertical core samples obtained:

location N°.:	1	2	3	4	5	6	7	8	9
max. depths:	____	____	____	____	____	____	____	____	____
location N°.:	10	11	12	13	14	15			
max. depths:	____	____	____	____	____	____			

(indicate location numbers in the sketch map of **Form G** and/or the transects of **Form H**)

Type of debris moved inland (sand, driftwood, rocks, boulders, others)
____
____
____

How far inland it was moved _____________________ (meters)

Additional information and/or drawings:

FIELD SURVEY FORM 'J'

AUDIO-VISUAL RECORDS

J.1 PHOTOGRAPHS *(make as many photocopies as needed of this form, copy and re-number the pages)*

For each relevant picture give: place, date, time, who took it, and what shows

Roll N°.________ Brand_____________ ASA__________ Exp: 24/36, slides or negatives

1____

2____

3____

4____

5____

6____

7____

8____

9____

10____

11____

12____

13____

14____

15____

16____

17____

18____

19____

J.2 AERIAL PHOTOGRAPHS *(make as many photocopies as needed of this form, copy and re-number the pages)*

For each relevant picture give: place, date, time, who took it, and what shows

Airplane altitude__________m Airplane speed____

Obliqueness angle____________ Sun location____
_

Roll N°.________ Brand___________ ASA_______ Exp 24/36, slides or negatives

Black & White_______ Colour________ Infrared_________________
____

1____
_____

2____
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18____
_____

J.3 VIDEOS *(make as many photocopies as needed of this form, and re-number the pages).*

For each filmed scene give: place, date, time, who took it, what shows, and approximate duration

Reel N°.______ Brand_____________Type____________
Extension____________________________________

Scenes:

1____

2____

3____

4____

5____

6____

7____

8____

9____

10____

11____

12____

13____

14____

15____

16____

17____

18____
_____

19____
_____

20____
_____

J.4 AUDIO-CASSETTES *(make as many photocopies as needed of this form, and re-number the pages).*

For each audio record give: place, date, time, who record it, content, and approximate duration

Cassette N°.________ Brand______________Type___________
Extension________________________________

Side: A or B

1____

2____

3____

4____

5____

6____

7____

8____

9____

10____

11____

12____

13____

14____

15____

16____

17____

18____

19____

20____

FIELD SURVEY FORM 'K'

Name of surveyor____
Date__________________________

TSUNAMI DAMAGE AND CASUALTIES *(fill one form for each site surveyed, copy and re-number the pages)*

Site name____

Site location (GPS if possible): Latitude_____________ Longitude _____________(indicate in the map)

Note: To avoid discrepancies in fatality number counting, it is agreed that we consider as Tsunami Fatalities ONLY those people who die as a direct or indirect action of the waves (i.e., trying to run away from the wave, being in a boat who rolled and plunged extremely, due to shifting cargo on a boat, drowned in the water, severely impacted by debris carried by the waves, from tsunami induced heart attack). Do not count people who have been killed in the clean-up operations, or sickness from contaminated water or exposure, or other illnesses (i.e., washed away by the wave into a snow bank and died of exposure, evacuated to a cold hill side for the night and died from freezing, intoxicated by drinking polluted sewage water).

Number of people: dead ______ missing______ seriously injured_______slightly injured______________

Ages of victims______________________________ Sex of victims______%Male ______%Female

	N°. of houses or buildings	Type of prevalent building material
swept away	________	___________________________
totally destroyed	________	___________________________
partly destroyed	________	___________________________
flooded	________	___________________________
undamaged	________	___________________________

Nature of damage:
Primary (wave/water induced): Flooding_____ Buoyancy_____________

Pressure______ Overtopping_________ Drag/Inertia Forces_____________

Secondary (triggered effects): Fire____ Explosion_____ Impact_____ Ground scouring______________

Contamination_____ Other (describe) ______________________________

TSUNAMI DAMAGE AND CASUALTIES *(continuation)*

Describe the tsunami effects and damage on:

a) **Nature:** (vegetation partially or totally destroyed, trees broken, overturned or uprooted *(indicate approximate diameter)*, small limbs broken, sediment transported, coral reefs exposed, etc.)____________

b) **Man-made Infrastructure:** (destruction and/or damage to houses, roads, port facilities, power systems, utility services, water delivery and treatment, communication lifelines, storage tanks, describe foundation damage, how old was the structure, type of soil beneath, leveled, sloping or steep ground, was the damaged structure in the water, at the shoreline, or inland, and how many meters above high-tide shoreline, indicate any structural damage to bridges and overpasses, indicate what percentage of buildings and structures were damaged by the waves, etc.) ____________

FIELD SURVEY FORM 'L'

Name of surveyor____
Date__________________________

PUBLIC AND AUTHORITIES RESPONSE

Were tsunami watches or warnings issued and timely received?_____________________________________

How effective were response planning, operation, and evacuations?__________________________________

Response of different segments of the population (elderly, disabled, minors, etc.)______________________

Reasons for lives lost: ____

Additional comments:____

FIELD SURVEY FORM 'M'

Name of surveyor____
Date__________________________

ADDITIONAL TSUNAMI EFFECTS AND OBSERVATIONS

Examples of what to document: Sea water appearance before, during, and after the tsunami (boiling, foaming, etc.) , Did the water receded or not before the first tsunami wave arrived?, Sounds (noise) before or during the arrival of the tsunami and of what type, Presence of: tsunami excited seiches in semi-enclosed bays, tsunami generated bore waves traveling up-rivers, trapping, refraction or diffraction of tsunami waves around islands and edge waves along the continental shelf, coastal water piling due to intense hurricane or typhoon winds simultaneous to the arrival of the tsunami, Evidences and effects of tsunami induced flows and currents (estimate magnitude and direction if possible). *Indicate to which location does each commentary applies.*

ADDITIONAL TSUNAMI EFFECTS AND OBSERVATIONS *(continuation)*

FIELD SURVEY FORM 'N'

Name of surveyor____
Date____________________

RECOMMENDATIONS FOR FURTHER RESEARCH

What else is needed to be done?, for what purpose?, where?, when?, how?, and by whom?