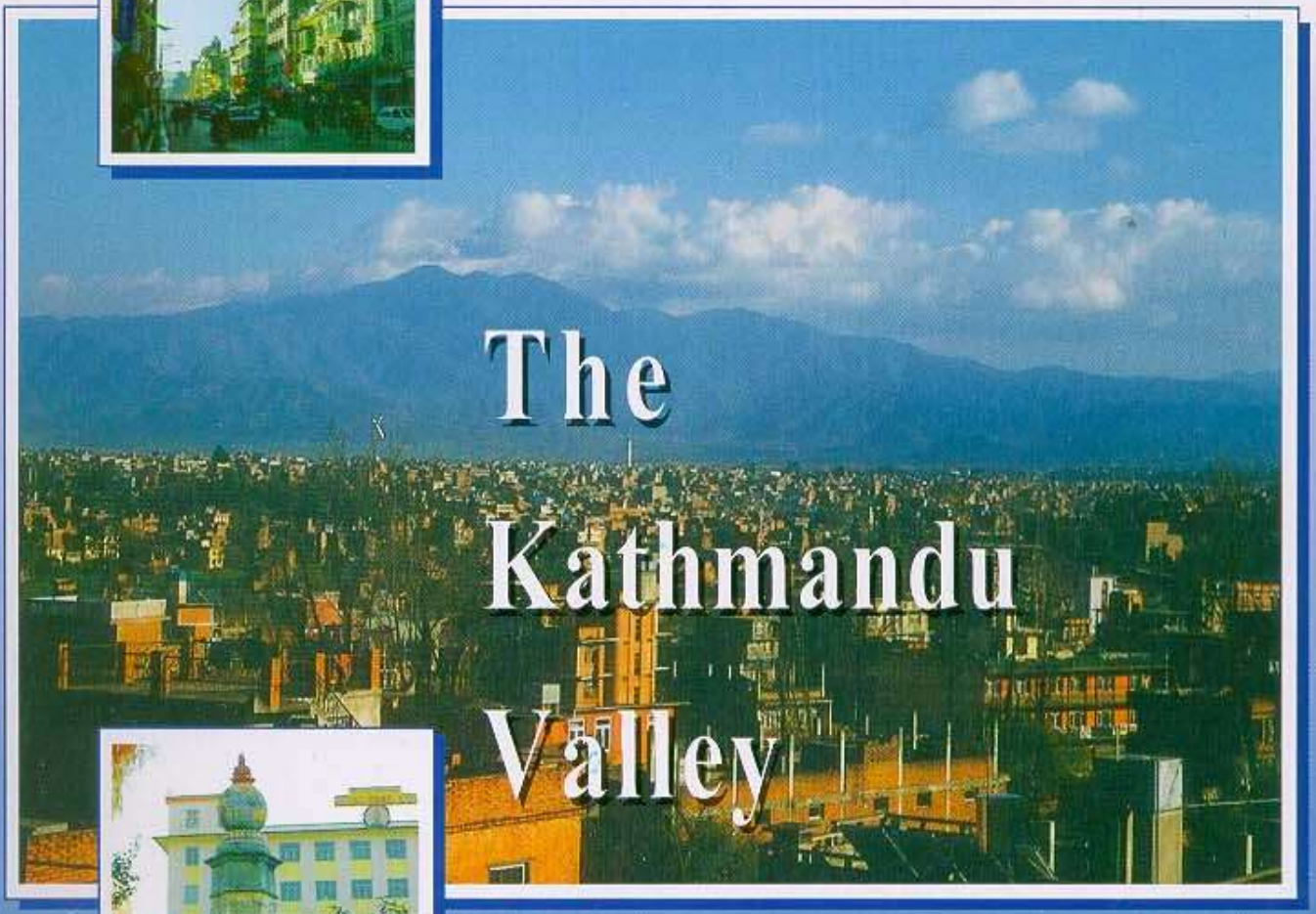

The Kathmandu Valley

Earthquake Risk Management Action Plan

A product of the Kathmandu Valley Earthquake Risk Management Project implemented by

National Society for Earthquake Technology – Nepal (NSET-Nepal)

GeoHazards International, USA (GHI)

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sf7df8f}pkTosf / eSDk

sf7df8f}pkTosfn]eSDksf]7h"f]/ lg/Gt/ a9bf]hf]lvd efu/x\$sf]5 . eSDk kl|jlw /fli6o ;dfh- gLfn / lhof] xfhf8{\OG6/g}zgn4f/f sf7df8f}pkTosf eSDkLo hf]lvd Joj:yfkg cfof]hgf cGtu{ xfn}ul/Psf] ;Defljt lfltsf]cWoogn]!(() ;fnsf]h:t}csf]7h"f]eSDk cfPdf sf7df8f}pkTosfdf bzf}xhf/sf]d[o'xg]/ s/Lj Ps nfv JolQm 3fO{]xg] ;s]t lbPsf]5 . cfjf; lfq, Jofkf/, ;fj{hlgs ejg, blgs pkefuIsf ;]fx? / oftfoft kfffnLdf To; eSDkn]kfg]lflt csNkgLo ?kdf a9L xg ;Sg]5 . tyflk ljZjsf c? ;dbfox?af6 kKt cgbejn] s]kbflOft u/\$f 5g\eg] ;Lldt ;[t / ;fwgx?af6 klg eSDksf]hf]lvd 36fO{;dbfonfO{7h"f]lfltaf6 ;s]Dd hfufpg w]}sfd ug{;lsG5 . t;y{ sf7df8f}pkTosfn]o;sf afl;Gbfx?sf]:jfy{f eSDksf]hf]lvd Golgs/0f ug]klqmof cf/De ug{tTsfn h?/L 5 .

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- eSDkLo hf]lvd tyf hf]lvd Joj:yfkg;u+ ;DalGwt ljleGg klf af/]r]tgf clej[4
- gofFgdf{f k|qmofdf eSDk k|t/f]ys pkfox? ;dfj]z
- ljBfno ejg / ljBfyL{?sf];/lff Joj:yfdf ;Wf/
- eO{x\$f ejgx?df eSDkLo ;/lff k|4g
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ofhgf sfof{jogsf] /0fgLlt

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o; ;+efdf o; sfo{ ofhgf sfof{jogsf nflu eSDk kljlw /fli6« ;dfh-g]kfnaf6 ul/g]kxn lgDg cg';f/sf] xG]5g\-

- o; sfof{hgf k|lt, tyf ;fdfGotof eSDkLo hfl/vd Joj:yfkg sfo{k|ltg}Jofks ;xof]u efj h6fO ofhgf cGtu{sf sfo{?sf];+fngsf nflu lgDg ljlwåf/f alnof]cfwf/ lgdf{0f ug{]
  - kf/bzL{/ u|Xo k|qmofsf]k|of]u
  - olQm;+rt lg0f{o
  - vhf tyf cg'zf;g ;lxtsf]cfly{s Jojxf/ tyf n]vf
  - c? ;DalGwt ;+yf ;dfx?;+rt kf/:kl/s ;xof]udf cfwfl/t ;DaGw :yfkgf
  - ;fdfGo hgr]tgfdf clej[4
  - r]tgf clej[4 k|of;af6 gLlt lgdf{0fx?nfO{;xof]u k|of]g
  - eSDkLo ;'lff clej[4 ;DalGw vNnf a}sx?sf]cfofhgf
  - ;/sf/ ;dlf ofhgfsf]cfwfl/s k|ltlt
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- sfo{qmd ljz]ifnfO{;xof]u k|of]g
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  - kljlws ;xof]usf]kbaGw Pj+kl/rfng
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  - sfo{qmd ljz]if ;+rfng ug{];+yfsf nflu jfxb ;]tsf]v]hL
  - ;kmn k|of; tyf sfo{qmd sfof{jogaf/]k|rf/÷k|;f/

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-v_ ;DalGwt ;j}; yfx?nf0{cfktsfnLg sfo{Joj:yfkg of]hgf tof/ ug{lgb]zg

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$_ o; ;yfn]k|sf] Joj:yfkg ;ldltx? u7g ug{pkTosfsf gu/kflnsfx? / lhNnf ljsf; ;ldltx?;u sfd ug]5 / o:tf ;ldltx?n]ug]{hg r]tgf clej[4 nufotsf eSDkLo ;'/lff clej[4 sfo{qmdx?sf]9fFf tof/ ug{;xof]u ug]5 .

%_ of];yfn]lgDg sfo{?sf nflu >L % sf];/sf/, cfjf; tyf ef]hts of]hgf dGqfno ;dIf cg'/f]w ug]5 -

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^_ o; ;yfn]ejg ;lktf cg?k g}3/x?sf]l8hf0g tyf lgdf{0fsf]cEof; a;fNgsf nflu ejg hfFsL, 8sdL{ Ol@hlgo/ cflbnf0{cfjZos tfnLd lbg / To;sf nflu rflxg]tfnLd ;fdfu|x? tof/ ug{cfjf; tyf ef]hts of]hgf dGqfno tyf dftxtsf ljefux?;u ldn] sfd ug]5 .

&_ o; ;yfn]æljBfno eSDkLo ;'/lff cfof]hgfÆ sf]Joj:yfkg / ;dGjo ug]5 - h; cGtu{ lgDg sfo{? kg]{ 5g\-

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v_ ljBfno ejgx?nf0{eSDksf]hf]lvdaf6 ;'/lft kfg{ljBfno ljz]if of]hgf th{f ug]{.

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*_ c;/rgfTds hf]lvd eg]sf]s]xf]/ g]kfnL 3/ tyf sfof{nox?df To:tf hf]lvdx?nf0{36fpg s]ug{k5{eGg] af/]o; ;yfn]cfjZos hfgsf/Ldns ;fdfu|x? pTkfbg ug]5 .

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!)_ o; ;yfn] Ol@hlgol/ª cWoog ;yfgx?nf0{ Ol@hlgo/x?sf nflu eSDkLo Ol@hlgol/ªsf l;4fGt / k|qmofx?af/]cNksfnLg kf7bqmdsf]ljsf; ug{/ To:tf]slIff ;fnfng ug{k[];flxt ug]5 .

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Introduction and Executive Summary

Earthquakes are an unavoidable part of Kathmandu Valley's future, just as they have been a part of its past. However, a large earthquake near the Kathmandu Valley today would cause significantly greater human loss, physical damage, and economic crisis than caused by past earthquakes. With the valley's burgeoning population of almost 1 1/2 million people, uncontrolled development, and a construction practice that has actually degraded over this century, the valley is becoming increasingly vulnerable to earthquakes with each passing year. Despite this growing risk, there is no organized approach to managing earthquake risk in Kathmandu Valley, Nepal's political, economic, administrative, and cultural capital. This plan begins the process of managing that risk.

The purpose of this plan is to assist His Majesty's Government of Nepal, concerned agencies, and the municipalities in Kathmandu Valley to reduce Kathmandu Valley's earthquake risk over time by identifying, coordinating and focusing risk management activities. This document outlines objectives, strategies, and specific initiatives to fulfill this purpose. It also provides background information on Kathmandu Valley's risk from earthquakes, the current status of earthquake risk management in Kathmandu Valley, and the development process of this plan.

The National Society for Earthquake Technology – Nepal (NSET) has taken responsibility for creating and implementing this plan. NSET, a multidisciplinary professional society, promotes awareness of earthquake risk and implementation of seismic risk reduction projects in Nepal. NSET is the national member of the International Association of Earthquake Engineering and has developed close working relationships with several international professional and academic institutions. NSET is associated with the United Nations International Decade for Natural Disaster Reduction as the implementer of the RADIUS project in Kathmandu Valley, a project examining seismic risk in over 70 cities around the world. In addition, NSET's work has been used as a model by the RADIUS project for in-depth case studies in nine cities around the world. NSET is a member of the Nepal National Committee for the IDNDR and has worked actively with numerous national and local government institutions. NSET's national and international relationships are an important resource in its ability to develop and implement this plan.

NSET's non-governmental, non-profit status as a professional organization is an asset in managing earthquake risk. Organizations similar to NSET have successfully coordinated earthquake risk management in other countries. This role for NSET is in accordance with the declared policy of His Majesty's Government, Nepal (HMGN) to develop collaboration between governmental and non-governmental organizations in the area of disaster management. NSET has no political alliances and is able to provide the long-term stability and focus that is necessary to manage a long-term problem such as earthquake risk. As a non-profit, NSET is pledged to publicize its financial dealings related to this plan. NSET will not benefit financially from money raised to support the projects of other institutions included in this plan. As a professional organization, NSET's management committee and members include many of Nepal's foremost experts in earthquakes, in disciplines ranging from earth science to engineering to public information. All of these factors place NSET in a uniquely qualified and objective position to coordinate Kathmandu Valley's earthquake risk management efforts.

Each of the topics discussed in this plan are summarized below.

Kathmandu Valley and Earthquakes

Kathmandu Valley faces a large and growing risk from earthquakes. A recent loss estimation study, conducted by NSET and GeoHazards International, indicates that the next major earthquake to affect Kathmandu Valley could cause tens of thousands of deaths and nearly a hundred thousand injuries. Damage to the housing stock, businesses, public buildings, utilities, and transportation networks will also be devastating. Experience from other communities proves that many things can be done to reduce a community's earthquake risk, even with limited resources. Kathmandu Valley needs to begin the process of managing its earthquake risk now to ensure its survival and to protect its residents.

Current Responsibilities for Earthquake Risk Management in Kathmandu Valley

In every community, responsibility for earthquake risk management is diffuse, requiring effort from every organization and each individual in the community. The various responsibilities can be categorized into the three stages of the "disaster cycle": mitigation and preparedness (prior to an earthquake), emergency response and relief (immediately after an earthquake), and reconstruction and rehabilitation (lasting several years after an earthquake). For each of these stages there are important actions for which no group is clearly responsible.

How the Plan Was Created

This plan depends upon the trust and understanding of the Kathmandu Valley community to be implemented successfully. The process of developing the plan is an important vehicle for building that trust and understanding. This plan was developed as part of the Kathmandu Valley Earthquake Risk Management Project (KVERMP) with the participation of many organizations in Kathmandu Valley.

Objectives

The purpose of this plan is to assist His Majesty's Government of Nepal, concerned agencies, and the municipalities in Kathmandu Valley to reduce Kathmandu Valley's earthquake risk over time by coordinating and focusing risk management activities. The specific objectives that this plan will focus on to achieve that purpose are

- Improve emergency response planning and capability.
- Improve awareness of issues relating to earthquake risk.
- Integrate seismic resistance into the process of new construction.
- Improve the safety of school children and school buildings
- Improve the seismic performance of existing buildings.
- Improve the seismic performance of utility and transportation systems.
- Increase experts' knowledge of the earthquake phenomenon, vulnerability, consequences and mitigation techniques.
- Prepare for long-term community recovery following damaging earthquakes.

Implementation Strategy

NSET is responsible for implementing this plan, or in other words, conducting activities that increase the likelihood of success of the specific initiatives included in this plan. The specific initiatives will be implemented by other local institutions. NSET's activities to implement this plan include the following:

- Building Support for the Plan and Earthquake Risk Management in General
  - *Using transparent and inclusive processes*
  - *Making decisions rationally*
  - *Using open financial policies*
  - *Building relationships with other groups*
  - *Raising general awareness*
  - *Educating decision makers through awareness efforts*
  - *Conducting regular public hearings*
  - *Formally presenting plan to government*
  - *Informing the international community of Kathmandu Valley about the plan*
- Supporting Individual Initiatives
  - *Coordinating initiatives*
  - *Planning initiatives*
  - *Arranging technical support*
  - *Conducting peer review of initiatives*
  - *Seeking external funding for organizations implementing initiatives*
  - *Publicizing successful initiatives*
- Keeping the Plan Current
  - *Monitoring the initiatives annually*
  - *Evaluating the objectives and strategies periodically*
  - *Creating a new edition of the plan periodically*

Initiatives to Start Now

This section includes a short list of initiatives which are urgent to implement now. These initiatives focus on the plan's objectives. NSET will actively aid and promote the implementation of these initiatives as described in the previous section. These initiatives are

1. NSET will request HMGN to (1) constitute the National Disaster Management Council (NDMC) headed by the Prime Minister; and (2) direct the NDMC to define an integrated national disaster management system.
2. Once constituted, the National Disaster Management Council should (1) provide guidance for the preparation of new (or revision of existing) integrated emergency response plans and (2) direct all relevant organizations to prepare emergency response plans.
3. NSET will work with the Ministry of Science and Technology to develop a comprehensive program to raise public awareness about earthquake risk and mitigation options.
4. NSET will work with the municipalities and districts in the valley to create Disaster Management Committees, and to design a program of activities, including public awareness programs, for these committees.
5. NSET will request the Ministry of Housing and Physical Planning to (1) constitute the Building Council and direct it to draft the rules and procedures for implementing and enforcing the building code, and (2) formally adopt requirements to implement and enforce the building Code.
6. NSET will work with the Ministry of Housing and Physical Planning and others to prepare training materials and provide training for building inspectors, masons and engineers on applied aspects of design and construction of buildings to conform to the Building Code.
7. NSET will manage and coordinate the "School Earthquake Safety Project" which will (1) inform selected communities about the vulnerability of their schools and what can be done to reduce the risk; (2) prepare school-specific plans for improvements in seismic safety; and (3) mobilize community support and resources to improve the safety of the school buildings.
8. NSET will create information products to explain what non-structural hazards are and how to mitigate them in typical Nepali homes and offices.
9. NSET will encourage the Nepal Telecommunications Corporation to assess the vulnerability of its system to earthquakes, identify the most vulnerable elements, and develop a program to improve its performance after earthquakes.
10. NSET will encourage engineering institutes to develop and offer short courses for practicing engineers on earthquake engineering principles and procedures.

More Endorsed Initiatives

This section includes a longer list of actions that are very important to reduce earthquake risk. Due to limited resources and a need to focus, NSET will not be actively aiding the implementation of these initiatives in this plan, but does endorse them.

Kathmandu Valley and Earthquakes

Nepal has a long history of destructive earthquakes. In this century alone over 11,000 people have lost their lives in four major earthquakes. A 1934 AD earthquake produced strong shaking in Kathmandu Valley, and destroyed 20 percent and damaged 40 percent of the valley's building stock. In Kathmandu itself, one quarter of all homes was destroyed. Many of the temples in Bhaktapur were destroyed as well. This earthquake was not an isolated event. Three earthquakes of similar size occurred in Kathmandu Valley in the 19th Century: in 1810, 1833, and 1866 AD. The seismic record of the region, which extends back to 1255 AD, suggests that earthquakes of this size occur approximately every 75 years, indicating that a devastating earthquake is inevitable in the long term and likely in the near future.

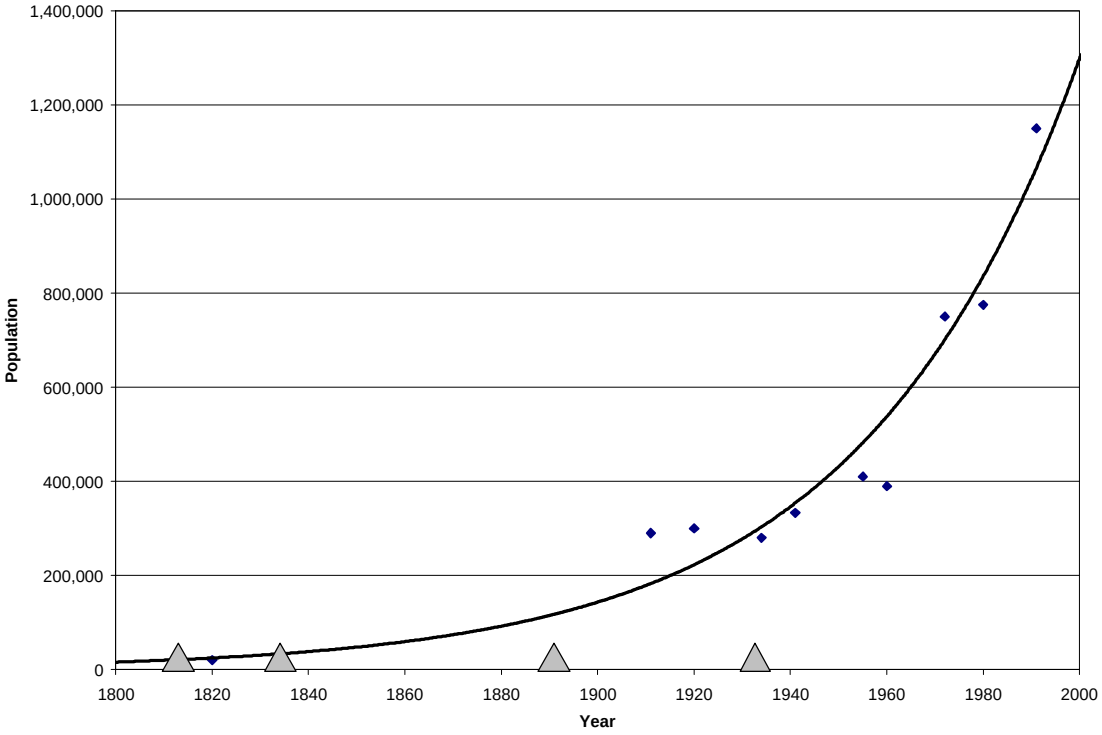


Chart showing Kathmandu Valley's population growth since 1800. The triangles indicate major earthquakes in that time period.

A simple loss estimation study for Kathmandu Valley was conducted as part of the Kathmandu Valley Earthquake Risk Management Project (KVERMP). KVERMP is an 18-month project focused on building institutions and processes to manage Kathmandu Valley's earthquake risk, involving Nepalese and international experts, implemented by NSET and GeoHazards International, administered by the Asian Disaster Preparedness Center and funded by the United States Agency for International Development. This loss estimation study examined what the consequences would be if the 1934 earthquake shaking were to occur in modern day Kathmandu Valley. The next earthquake to severely damage Kathmandu Valley will not have the same magnitude and location as the 1934 event. However, it is quite reasonable to assume that the next large earthquake to affect Kathmandu Valley will have approximately the same shaking pattern within the valley due to soft soil beneath the valley's surface.

Some results of KVERMP's loss estimation study are presented below to help clarify the extent of the problem that faces Kathmandu Valley. This loss estimation is *not* a forecast of what will happen in the

future, and should be viewed only as a tool to help make decisions about reducing Kathmandu Valley's earthquake risk.

The Loss Estimation

The shaking observed after the 1934 earthquake is shown in the accompanying map (see **Figure 1**), as it was documented immediately after the event. This shaking is shown according to the Modified Mercalli Intensity (MMI) scale which indicates the amount of damage observed in each location. MMI is different from the commonly known Richter magnitude scale. The relevant definitions of the MMI scale are:

- X: Most well-built masonry and frame structures are destroyed. Many wooden structures and bridges are destroyed. Landslides occur in sloped areas. People are thrown to the ground.
- IX: Poorly built masonry structures collapse. All structures are damaged. Underground pipes break. General panic occurs.
- VIII: Damage occurs to masonry structures. Chimneys and elevated water tanks collapse. Heavy furniture moves or overturns. People are frightened and have difficulty standing.

The loss estimation study indicates that massive damage can be expected to Kathmandu Valley's buildings, structures and population if the shaking of 1934 were to repeat. The amount of damage expected is strongly influenced by the quality of the valley's soil. Kathmandu Valley is located on the site of a prehistoric lake which has been filled with the soft sediments that make up the floor of the valley today. These soft sediments tend to amplify earthquake shaking, like a bowl of jelly when it is shaken. In addition, there is a high probability of liquefaction in many of the valley's urban areas, especially near rivers (see **Figure 2**). Liquefaction is a phenomenon in which water-saturated soil changes from a firm material to a semi-liquid material when shaken and loses its ability to support structures. Liquefaction was widely observed after the 1934 earthquake.

Damage to Buildings

A rough estimation of damage to buildings was conducted by KVERMP using information about typical construction types found in Kathmandu Valley which was collected and analyzed while developing the Nepalese building code. As many as 60 percent of all buildings in Kathmandu Valley are likely to be damaged heavily, many beyond repair. Bhaktapur, which suffered the worst damage in 1934, has historically suffered more than the rest of the valley in earthquakes, possibly because of its soil conditions. As many as 75 percent of all buildings in Bhaktapur are likely to be heavily damaged.

Damage to Transportation Network

In addition to building damage, it is estimated that almost half of the bridges in the valley could be impassable, and that 10 percent of paved roads will have moderate damage, such as deep cracks or subsidence. In addition, many of the narrowest streets in the valley will be blocked by debris from damaged buildings. The city of Bhaktapur may not be accessible from Kathmandu or Lalitpur because of road and bridge damage. The bridges connecting Kathmandu and Lalitpur to each other are also at risk of liquefaction induced damage. Tribhuvan International Airport is surrounded by liquefaction prone areas. This means that the airport may be isolated from the rest of Kathmandu Valley, limiting emergency aid from outside of the valley (see **Figure 3**).

Damage to Utilities

Approximately 95 percent of water pipes and 50 percent of other water system components (pumping stations, treatment plants, etc.) could be damaged seriously. Almost all telephone exchange buildings and 60 percent of telephone lines are likely to be damaged, requiring significant to moderate repair to be operational. Approximately 40 percent of electric lines and all electric substations are likely to be damaged. It could take one month after an earthquake for electricity and telephone utilities to be operational. Water systems will require much more time to repair (see **Figure 4**). It is estimated that most parts of the valley will be without piped water supply for several months and several areas could remain without service for over one year.

Deaths, Injuries, and Homelessness

Death and injury expectations are similarly shocking. Simply applying the percentage of the population killed or injured in the 1934 earthquake to the population of the valley today results in an estimate of 22,000 deaths and 25,000 injuries requiring hospitalization. Applying more recent earthquake casualty figures from cities comparable to Kathmandu Valley results in an estimate of 40,000 deaths and 95,000 injuries in Kathmandu Valley's next major earthquake.

An additional 600,000 to 900,000 residents of Kathmandu Valley are expected to be left homeless by the earthquake due to damaged buildings or fear of being in their homes. The existing government medical facilities in Kathmandu have a total of about 2,200 beds, most of which are full under non-emergency conditions. An additional 3,500 patients could be accommodated on floors or outside space around hospitals. In California and Japan, earthquake shaking on MMI IX are generally believed to make at least 50 percent of hospital beds unusable, due to structural problems (building collapse) or non-structural problems (e.g. fallen bookshelves or loss of electrical power). There will be a major shortage of space for medical treatment in Kathmandu Valley.

The exact amount of damages or numbers of deaths, injuries, and homelessness are not needed for planning. Kathmandu Valley's current facilities cannot cope with even a small fraction of the estimates that are presented here. However, this level of devastation and suffering does not need to occur. There are many things that can be done to reduce the amount of risk that this community faces.

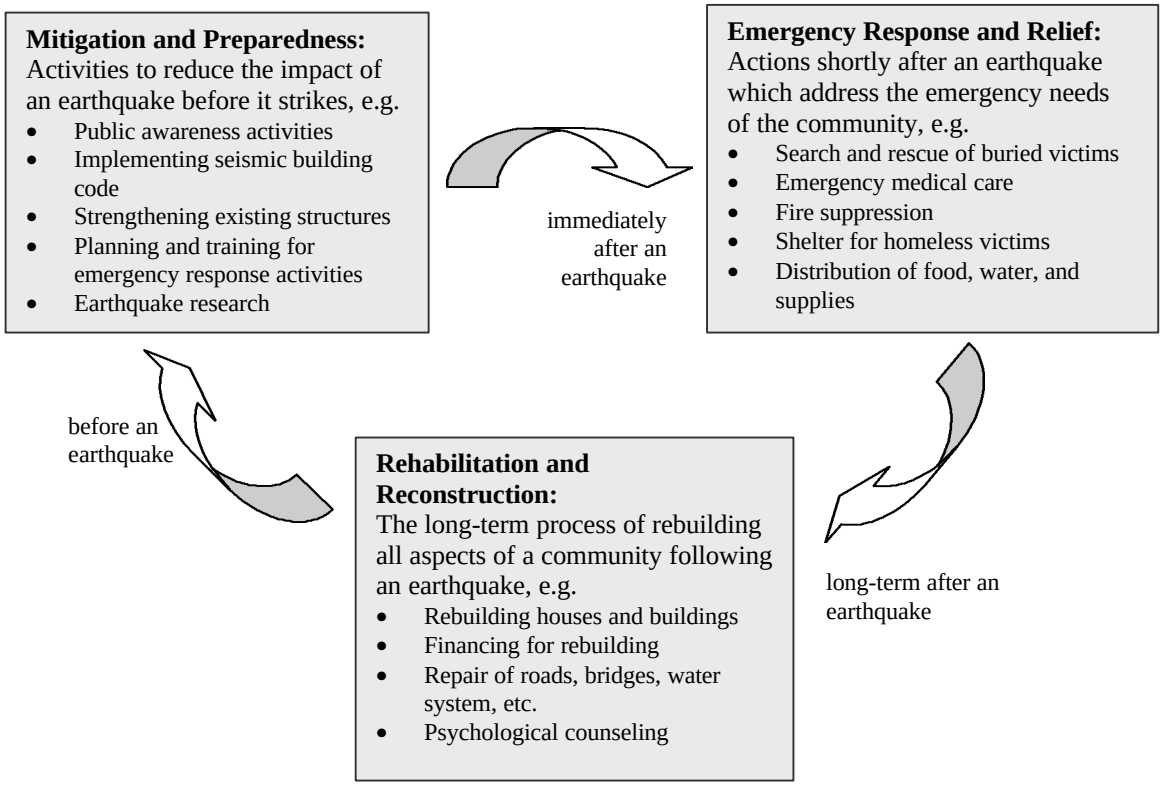
Earthquakes do not kill people: building collapses do. Although earthquakes are natural phenomenon that cannot be avoided, or even accurately predicted at this time, the seismic safety of buildings, utilities, and transportation networks and the capability of institutions to respond to an earthquake can be greatly improved. Although the problem facing Kathmandu is large, if work begins now, this problem can be controlled and reduced with time. This plan describes how to begin the process.

Current Responsibilities for Earthquake Risk Management in Kathmandu Valley

Earthquakes affect everyone and everything in a community, and it is not possible for any one agency, or even the government as a whole, to manage all aspects of risk. Responsibility for managing earthquake risk is diffused. All organizations and every individual in a community are responsible for managing some aspect of the risk. It is important for organizations and residents of Kathmandu Valley to understand what their responsibilities are so that each related organization and individual knows beforehand which actions need to be taken, when and by whom.

Earthquakes, like all natural disasters, are recurring events and can, therefore, be described in terms of a disaster cycle. This section examines some of the major activities that a community must or should conduct during each stage of the cycle to reduce the impact of the disaster and identifies the groups responsible for implementing those activities.

The Disaster Cycle:



There are a number of institutions working in various aspects of earthquake risk management in Kathmandu Valley, as shown in the following tables. In particular, the Ministry of Home, as the national focal point on emergency response and disaster management for all types of disasters in the national scale, has been coordinating rescue and relief operations following a disaster; the Ministry of Housing and Physical Planning has implemented projects for the rehabilitation and reconstruction of earthquake-damaged buildings, has formulated the national building code, and is responsible for policy decisions on its implementation; and the Department of Mines and Geology has been working on seismological researches for many years. There are several institutions working in aspects of disaster management in the country and their activities cover areas of earthquake risk management also. However, for many important tasks, there is no organization clearly responsible. In addition, not all of the organizations listed below are well prepared to conduct the functions they have responsibility for. These tables are intended to be used to clarify earthquake risk management responsibilities, and are not definitive.

Mitigation and Preparedness Actions	Responsible Organization(s): Responsibility may be actual or presumed	Status of programmes and activities
Planning for emergency response activities, such as search and rescue, fire suppression, emergency communication, etc.	SDU[1] of MOH	No comprehensive planning currently exists.
Planning for comprehensive earthquake risk management for Kathmandu Valley	NSET	Planning is ongoing under KVERMP
Planning for emergency relief activities, such as establishing shelters, collecting and distributing supplies, etc.	SDU, RNA, NP, NRCS	Currently there is no specific planning except by NRCS
Planning for long-term recovery after an earthquake, such as rebuilding infrastructure, limiting economic losses, etc.	No clearly responsible organizations	
Recommending policy matters relating to disaster management to His Majesty's Government Nepal (HMGN)	IDNDR National Committee	The IDNDR National Committee so far has prepared the National Action Plan for Disaster Management, which has been endorsed by HMGN in principle.
Establishing and equipping an emergency operations center in an earthquake resistant building	No clearly responsible organizations	
Training emergency response personnel	No clearly responsible organizations	
Training professional builders, scientists, engineers, and planners	No clearly responsible organizations	
Stockpiling emergency supplies, such as tents, non-perishable foods, etc.	NRCS, NFC	NRCS has some relief materials stored for 40,000 people.
Raising awareness of decision makers about earthquakes	No clearly responsible organizations	Some work has begun by NSET, LWS, UMN, and DMU of KMC
Raising awareness of entire community about earthquakes	No clearly responsible organizations	
Establishing and enforcing the seismic building code	NBC	NBC is yet to be formed by the MHPP
Constructing new residences in a seismically resistant fashion	Individual homeowners, builders	Currently there are no resources to help homeowners and builders do this.
Constructing new government buildings in a seismically resistant fashion	HMGN, builders	
Constructing new lifelines in a seismically resistant fashion	Individual lifelines	
Assessing vulnerability of existing residences and retrofitting the most vulnerable	Individual homeowners	

[1] All acronyms used in these charts are listed and defined at the end of this section.

Assessing vulnerability of existing schools and retrofitting the most vulnerable	No clearly responsible organizations	
Assessing vulnerability of existing government buildings and hospitals and retrofitting the most vulnerable	No clearly responsible organizations	
Assessing vulnerability of existing lifelines and retrofitting the most vulnerable	Individual lifelines	No comprehensive earthquake risk assessments have been made
Researching the earthquake phenomenon	DMG, MHPP	DMG responsible for isoseismal mapping, seismological study, etc. MHPP responsible for developing damage assessment techniques and other research related to the built environment.
Monitoring seismic activity in Nepal	DMG	Currently there is a 17 station microseismic network which uniformly monitors M>= 2 Richter throughout the country. There are also two strong motion seismographs.

Emergency Response and Relief Actions	**Responsible Organization(s): Responsibility may be actual or presumed**	**Status of programmes and activities**
Conducting search and rescue activities	RNA, NP	No specialized search and rescue capabilities currently exist. The need for training is urgent.
Suppressing fires that occur after an earthquake	KFB	KFB has very poor institutional capability. Urgent attention is required.
Providing emergency medical treatment	Individual government hospitals	Existing capabilities are much less than potential requirements.
Investigating and containing hazardous materials spills, such as oil, toxic waste, etc.	No clearly responsible organizations	
Coordinating emergency response efforts of all involved agencies	CDRC, DDRC	The DDRC contains representatives of many local public sector groups. It is responsible for coordinating all aspects of the emergency response. The CDRC is made up of national representatives and provides guidance to the DDRC according to the need.
Coordinating foreign aid and supplies	UNDP	UNDP has been requested by HMGN for assistance in coordinating foreign aid and supplies in national scale disasters.
Establishing emergency shelters for homeless families	MOH, NRCS	
Collecting and distributing relief supplies (e.g. food, water, blankets, medical equipment)	NRCS, MOH, DO	MOH and DO provide monetary support in case of deaths and large disasters.

Conducting emergency repairs to lifelines needed for the emergency response effort, such as telephones, electricity, roads, etc.	Individual lifelines	This activity depends on availability of funds. There is a strong dependence on donor agencies. In-house planning and preparedness is non-existent.
Clearing debris that is hindering emergency response efforts	No clearly responsible organizations	
Informing the public about what to do and where to go, such as locations of emergency shelters and the status of relief supplies	No clearly responsible organizations	
Identifying the deceased and informing relatives.	NP	
Identifying and restricting use of and access to unsafe areas	No clearly responsible organizations	
Supplying and managing cremation timber	NTC	Timber supply, transport systems and cremation facilities are inadequate for the needs after a major disaster. Tradition inhibits other forms of funerals.
Collecting and compiling information about amount and locations of damage	NP	In past disasters, Nepal Police have collected information such as deaths, injuries, and damages to houses. There is currently no comprehensive damage assessment system.

Rehabilitation and Reconstruction Actions	**Responsible Organization(s): Responsibility may be actual or presumed**	**Status of programmes and activities**
Deciding which buildings are safe to reoccupy, which need repair, and which need to be demolished	No clearly responsible organizations	
Establishing long term temporary locations for homeless families, schools, government offices, etc. during the rebuilding or repair process	No clearly responsible organizations	
Clearing all debris	No clearly responsible organizations	
Planning and coordinating rebuilding efforts in a seismically safe way	No clearly responsible organizations	
Addressing planning issues such as widening streets, changing city layout, relocating families, etc.	No clearly responsible organizations	KMC is implementing municipal infrastructure development works but earthquake risk is not considered
Rebuilding or repairing damaged houses	Individual homeowners	After the 1988 Bihar-Nepal earthquake, most rebuilding of private homes occurred without consideration of seismic forces.

Figure 1. Modified Mercalli Intensity distribution from 1934 Earthquake

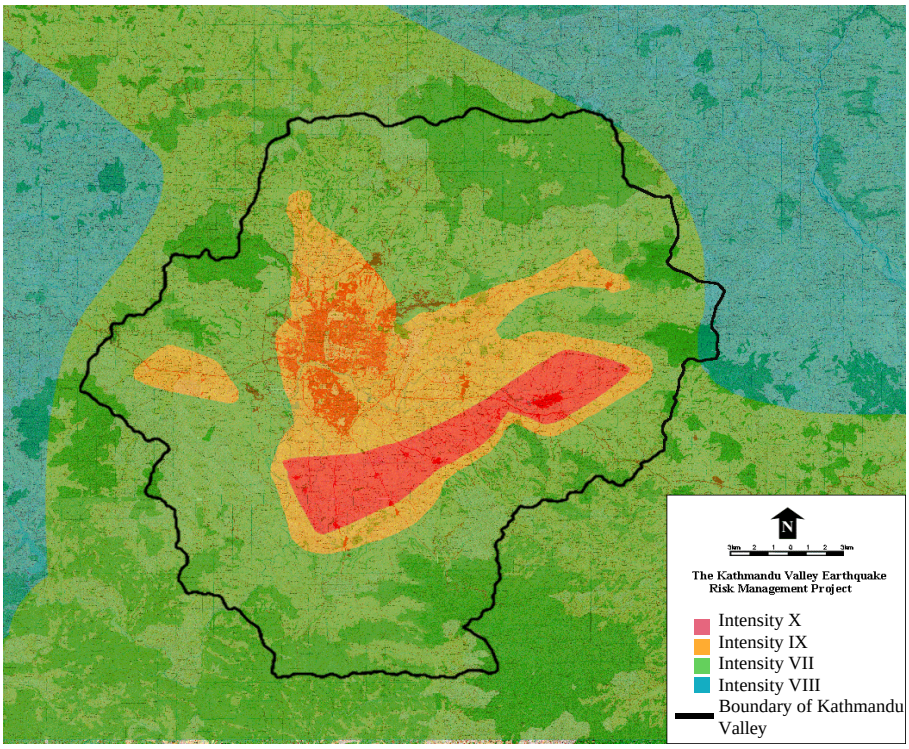


Figure 2. Liquefaction potential in Kathmandu and Lalitpur

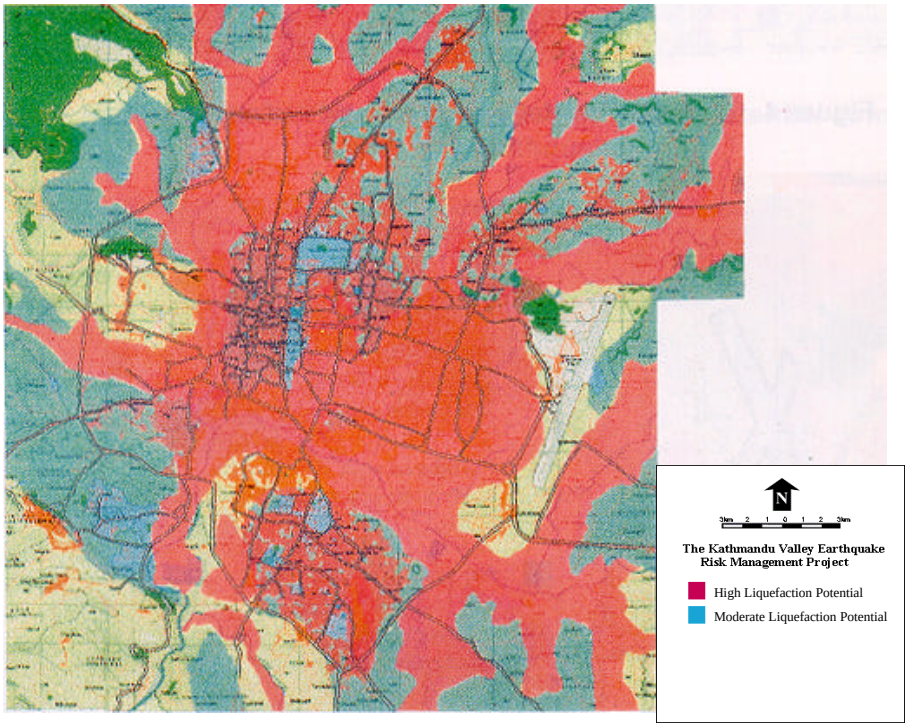


Figure 3. Kathmandu, Lalitpur roads/bridges and potential damage by scenario earthquake

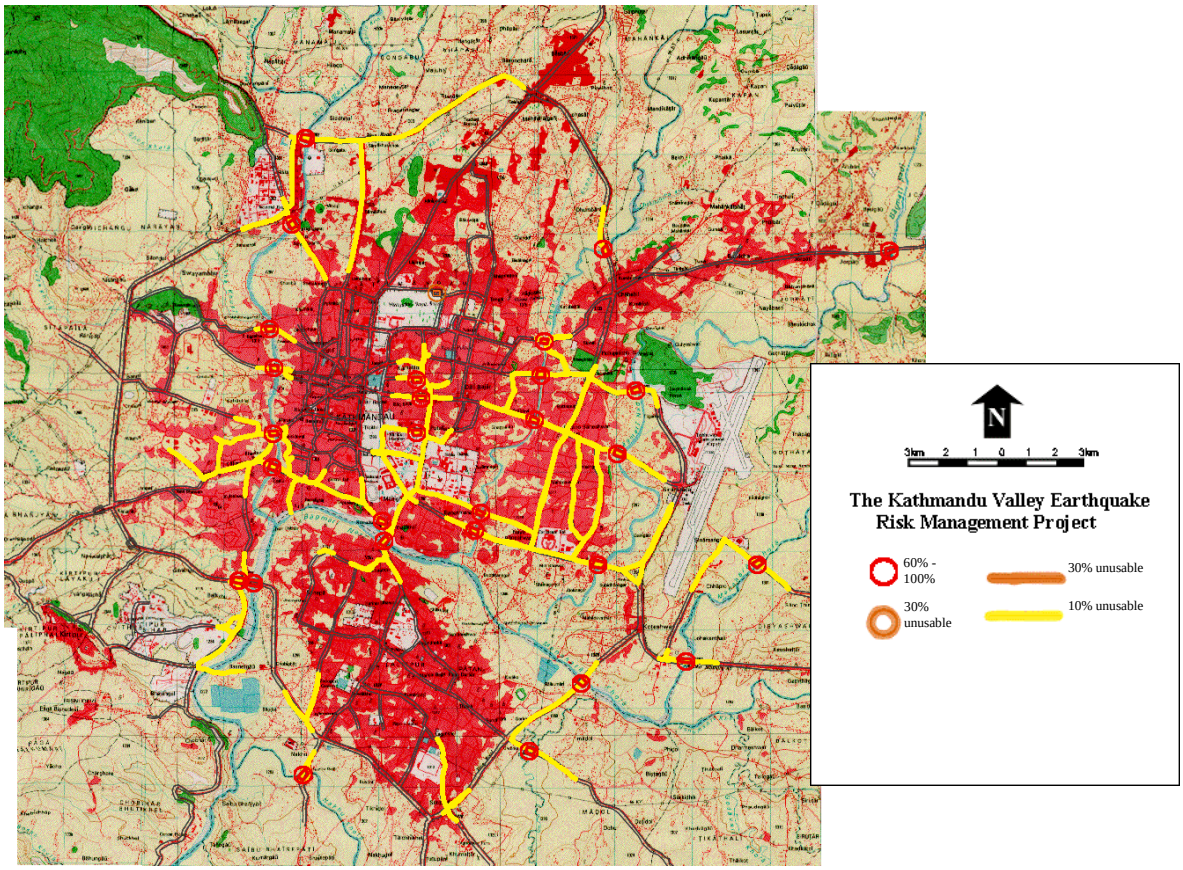


Figure 4. Kathmandu Valley airport and vicinity

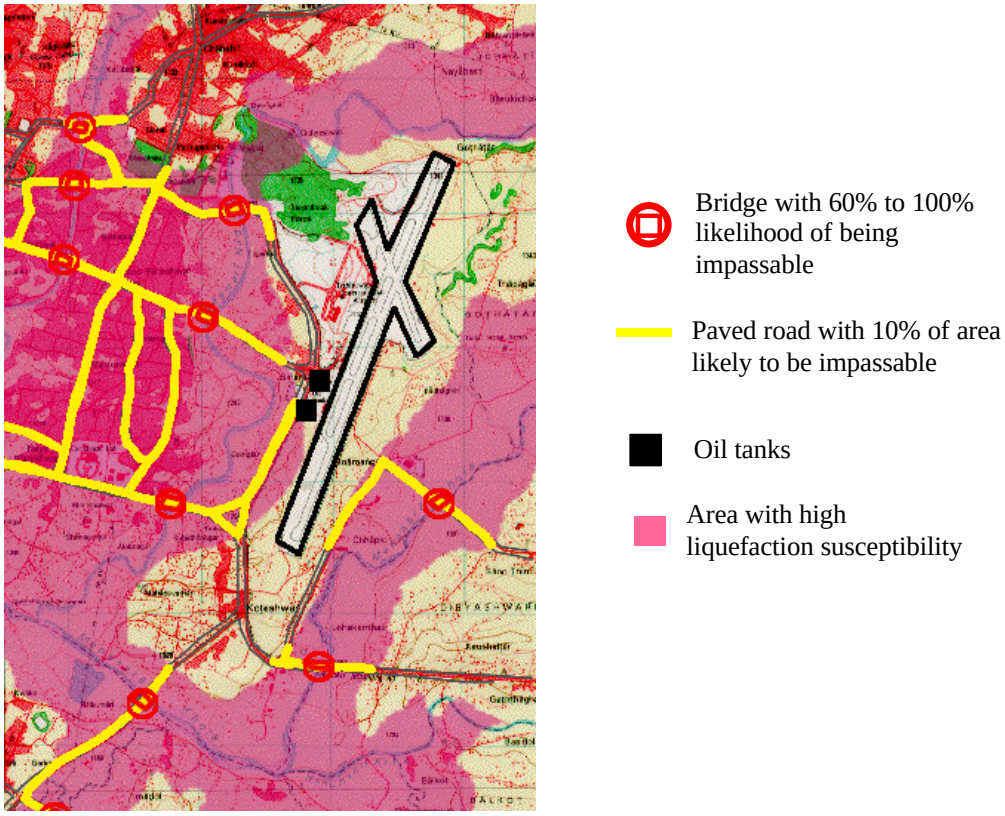


Figure 5. Kathmandu, Lalitpur telephone system and potential damage by scenario earthquake

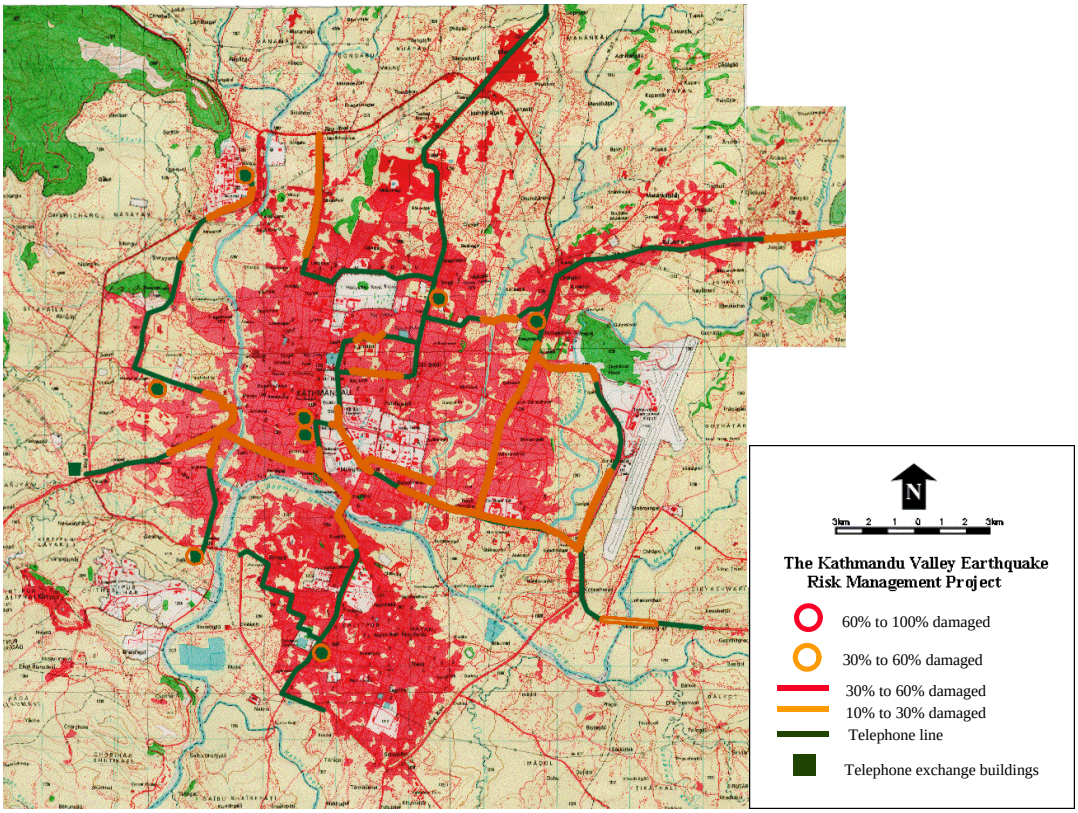


Figure 6. Kathmandu Valley electricity system and potential damage by scenario earthquake

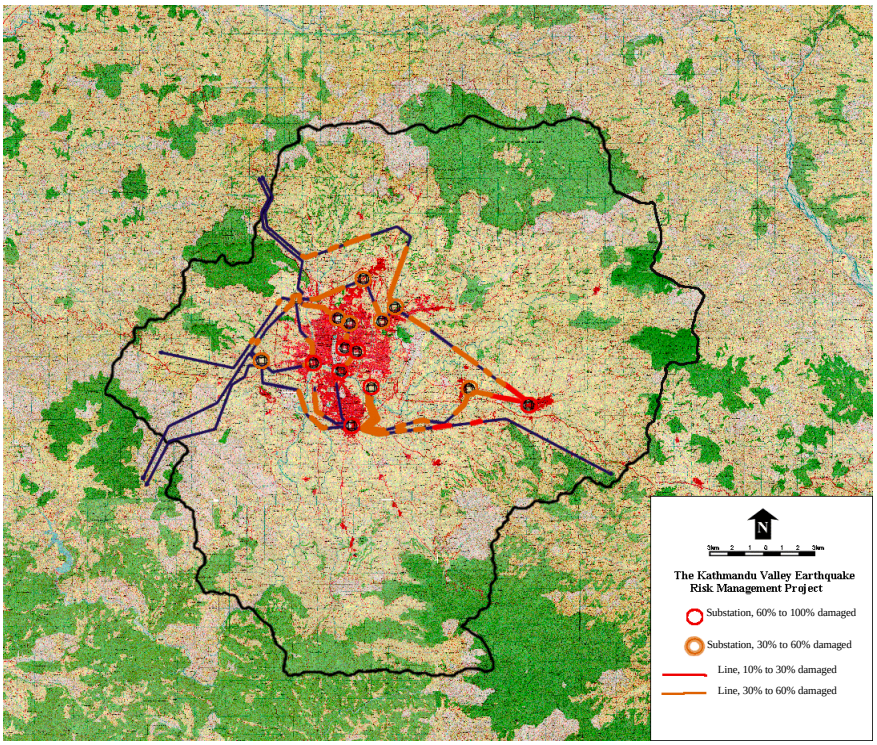
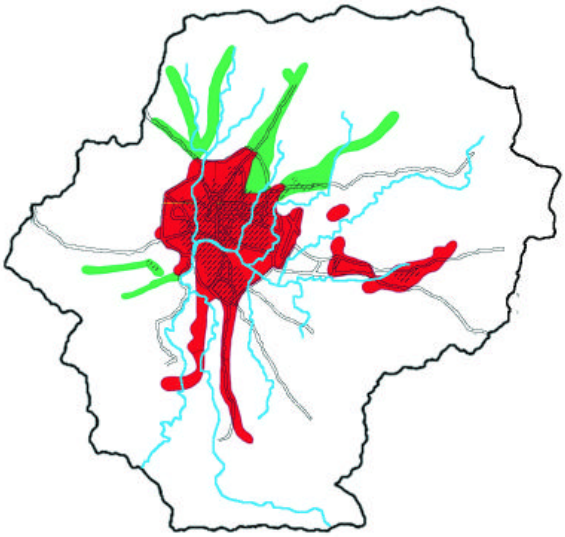
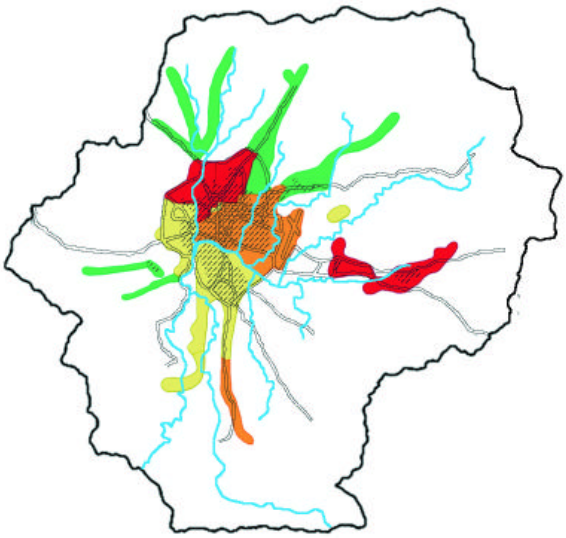


Figure 7. Water network recovery time

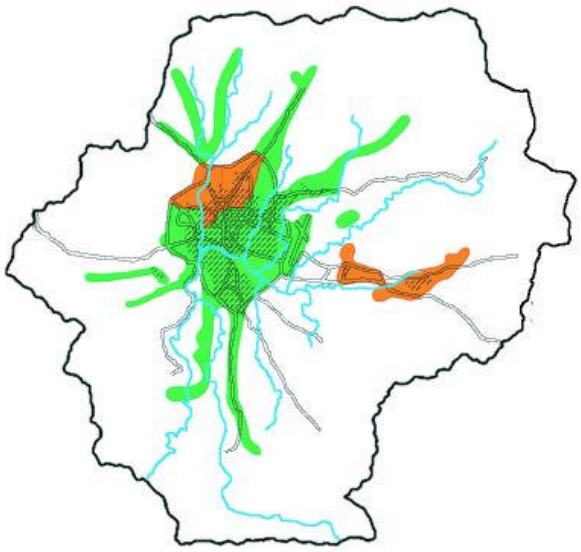
Six months after scenario earthquake

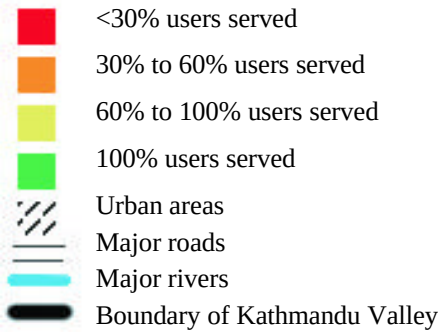


Six months after scenario earthquake



Six months after scenario earthquake





Rebuilding or repairing damaged lifelines, such as water, electricity, telephone, and roads	Individual lifelines	This activity depends on availability of funds. There is a strong dependence on donor agencies. In-house planning and preparedness is non-existent.
Rebuilding or repairing damaged government hospitals	Individual hospitals	This activity depends on availability of funds. There is a strong dependence on donor agencies. In-house planning and preparedness is non-existent.
Rebuilding or repairing damaged schools	No clearly responsible organizations	A separate World Bank project was implemented to rebuild schools damaged by the 1988 Bihar-Nepal earthquake
Rebuilding or repairing damaged cultural and religious sites	DOA	In-house planning and preparedness is non-existent with the DOA
Making available and distributing financial aid to affected citizens	No clearly responsible organizations	

Acronyms:

CDRC: Central Disaster Relief Committee
DDRC: District Disaster Relief Committee
DMG: Department of Mines and Geology
DMU of KMC: Disaster Management Unit of Kathmandu Metropolitan City
DO: District Offices
DOA: Department of Archaeology
HMGN: His Majesty's Government, Nepal
IDNDR: United Nations International Decade for Natural Disaster Reduction
KFB: Kathmandu Fire Brigade
KMC: Kathmandu Metropolitan City
LWF: Lutheran World Federation
MHPP: Ministry of Housing and Physical Planning
MOH: Ministry of Home
NBC: National Building Council
NFC: Nepal Food Corporation
NP: Nepal Police
NRCS: Nepal Red Cross Society
NSET: National Society for Earthquake Technology – Nepal
NTC: Nepal Timber Corporation
RNA: Royal Nepal Army
SDU: Special Disaster Unit of the Ministry of Home
UMN: United Mission to Nepal
UNDP: United Nations Development Programme, Kathmandu Office

How the Plan was Created

The implementation of this plan is only possible if Kathmandu Valley's leaders and residents believe that this plan was developed to serve their interests. The process of creating the plan is an important component of building trust. This section describes the steps to develop this plan.

Loss Estimation Study

Before deciding how to respond to Kathmandu Valley's earthquake risk, it is necessary to understand what that risk is. It is also necessary for many people, not just specialists, to understand the types and levels of risks faced by Kathmandu Valley so that they recognize that something needs to be done about it and begin thinking about the types of activities than can be done. A simple loss estimation study, summarized in a previous section, was designed to meet this need. The loss estimates were presented in a workshop in February of 1998 to representatives from thirty critical facilities in Kathmandu Valley (i.e. army, police, utility companies, etc.), Nepalese scientists and engineers, and international experts for their comments and critiques. Changes were made to the damage estimates based on the expertise of people at this workshop.

Vulnerability Assessment of Schools

The first step is being taken towards beginning earthquake risk mitigation in one sector, the public schools, to learn about implementing earthquake risk mitigation projects in Kathmandu Valley. A survey is being conducted of Kathmandu Valley's public school buildings to determine how vulnerable they are to earthquakes, what techniques could be used to strengthen the buildings, and how much it would cost.

This survey will be used to examine many important issues related to the implementation of mitigation work in Nepal. The issues include examining the following:

- the costs of conducting a survey of building vulnerability,
- the technical expertise required for this type of survey,
- the costs involved in strengthening existing vulnerable buildings,
- the types of techniques to use for strengthening typical Nepalese structures,
- the interest of the community in strengthening buildings,
- the ability to attract funds (local and international) to this type of work, and
- the levels of earthquake risk acceptable in Nepalese society.

The experience gained from examining these issues will benefit all types of mitigation projects in Nepal.

Identification of Initiatives

The initiatives in this plan were developed in coordination with many different institutions. It is important that these initiatives be tangible activities that are supported by an organization capable and willing to implement them, and that they are urgent and cost-effective actions to reduce Kathmandu Valley's earthquake risk.

An initial list of initiatives was created by combining three sources.

- *Ideas that came directly from the representatives of thirty critical organizations which attended the February 1998 Workshop*. Each participant was given the opportunity to suggest several initiatives that their organization should undertake to reduce earthquake risk, including an approximate budget, time frame, and responsible parties. The suggested initiatives were based on the information provided in the loss estimation study.
- *The National Action Plan on Disaster Management in Nepal*. This plan, developed by the National Committee for the IDNDR and endorsed by HMGN, includes risk reduction activities for all natural disasters and all of Nepal. The actions which relate specifically to earthquakes and Kathmandu Valley were identified and included.
- *Activities that other communities from around the world have conducted to reduce their earthquake risk*. These activities were researched by the plan development team and adjusted to suit Kathmandu Valley institutions.

Informational packets containing potential initiatives were sent to many different organizations to help them determine which activities were realistic candidates for the Action Plan. The plan development team met individually with many of these organizations to discuss which activities they could implement. The

final list of proposed initiatives included those most strongly supported by the organizations responsible for implementation, and the activities that seem most urgent to the plan development team.

Writing the Plan

The plan development team wrote a preliminary draft of all sections of the plan, including objectives, strategies and initiatives. The project team sought suggestions on priorities from local specialists and the NSET Management Committee during this process. Local and international experts provided guidance on the plan structure and components.

A draft plan was presented to the NSET Management Committee and the participants of a second workshop in October of 1998. Representatives from Kathmandu Valley's critical facilities and Nepalese experts participated. The purpose of this workshop was to collect the comments and proposed changes to the draft plan, including the "Initiatives to Implement Now" section, from the workshop attendees. Following all comments, the NSET Management Committee edited the plan, taking into account the opinions of the workshop participants. All key decisions were either made in public or reviewed in public. Efforts were made to provide all interested people and organizations with an opportunity to comment.

Objectives

The purpose of this plan is to assist His Majesty's Government of Nepal, concerned agencies, and the municipalities in Kathmandu Valley to reduce Kathmandu Valley's earthquake risk over time by identifying, coordinating and focusing risk management activities.

Eight long-term objectives define a comprehensive program for reducing the risk faced by Kathmandu Valley residents. These objectives incorporate the wide array of needs faced by Kathmandu Valley and recognize the importance of addressing all major aspects of risk

Objectives:

1. Improve emergency response planning and capability.

- Prepare an integrated series of emergency response plans. Plans should specify the responsibilities of each organization internally and externally, i.e. how they relate to other organizations and conditions. Each plan should address the equipment, facilities (new facilities and strengthening of existing facilities) and training needs to carryout the plan. Tasks should be explicitly assigned and there should be a list of succession for each task.
- Improve the seismic performance of existing facilities essential to emergency response, including:
  - Critical roads and bridges
  - Hospitals and other medical facilities
  - Critical sections of communications, electricity, and water supply networks
  - Airport
  - Essential police, fire, and army structures
- Create an earthquake-resistant emergency operations center(s)
- Develop emergency communications capability
- Train emergency response personnel through regular drills, formal classroom training, etc.
- Provide ward-level emergency response training to increase disaster self sufficiency.
- Periodically conduct emergency response exercises based on estimated damage and disruption, and use the experience to identify areas of weakness and to improve emergency response and loss reduction plans.

2. Improve awareness of issues related to earthquake risk.

- Develop earthquake risk awareness programs. Explain how to prepare for earthquakes, how to respond to earthquakes, how to recover from earthquakes, and the difficult choices which need to be made to manage earthquake risk. Focus on the following groups:
  - School administrators, teachers and children
  - Colloquium of HMGN ministers
  - Members of Parliament
  - Hospital administrators
  - Business owners
  - Engineers and building construction professionals
  - Public safety employees and emergency response officials
  - Non-governmental organizations and Community Based Organizations
  - Kathmandu Valley communities

3. Integrate seismic resistance into the process of new construction.

- Adopt and enforce a building code with seismic provisions for all new public and private buildings and infrastructure.
- Improve the knowledge and understanding of seismic principles among selected trades and professions:
  - Building contractors, masons and concrete contractors

Civil engineers and architects
National and city government engineers responsible for public works facilities
Officials responsible for enforcing seismic building regulations

- Develop incentives to encourage seismic resistant construction.
- Consider seismic hazards in decisions to plan and locate new development and infrastructure.

4. Increase the safety of school children and school buildings.

- Develop emergency plans for each school and practice these plans
  Conduct "duck and cover" and emergency exit drills with students and teachers
  Assign post-earthquake responsibilities to staff members at each school
- Identify the most vulnerable schools, and develop programs to retrofit the most vulnerable buildings, or to relocate classes in vulnerable structures to safer buildings.
- Inform parents about the risks faced by their children and how parents and children can help to reduce those risks.
- Incorporate earthquake risk concepts into the standard school curriculum.

5. Improve the seismic performance of existing buildings.

- Focus resources and energy on structures that house large numbers of occupants and that serve important functions in governing the nation.
  Government and private office buildings
  Residential construction
  Culturally important buildings
- Conduct inventories and vulnerability assessments of buildings by uses, structural characteristics and/or size.
- Provide materials explaining earthquake risk and offering advice on how to reduce earthquake risk to building owners and occupants.

6. Improve the seismic performance of utility and transportation systems.

- Conduct vulnerability assessments of systems
  Water
  Electricity
  Sanitation
  Telecommunications
  Radio and television
  Bridges, road beds and embankments
  Petroleum storage
  Airport control and communications facilities and runways
- Identify the most critical areas of these systems and focus on improving the seismic resistance of those sections first. Aim to gradually and continually increase the strength of the systems.

7. Increase experts' knowledge of the earthquake phenomena, vulnerability, consequences and mitigation techniques.

- Support seismological monitoring to better characterize the earthquake hazard in the Kathmandu Valley.
- Support identification and mapping of seismic hazards including shaking intensity and areas prone to seismically induced landslides and liquefaction.
- Support engineering studies on the vulnerability of buildings and other structures typical of the Kathmandu Valley, and on ways to correct deficiencies.
- Offer science and engineering courses on earthquake related topics at local universities for students and practicing professionals.
- Provide training for professionals in conducting vulnerability assessments and retrofit designs.

8. Improve long-term community recovery following damaging earthquakes.

- Prepare governmental recovery plans that address key decisions following a disaster.
- Encourage municipalities, ministries/departments and businesses to prepare recovery plans that are consistent with the plan for Kathmandu Valley.

Implementation Strategy

Reducing Kathmandu Valley's earthquake risk is a multifaceted task. It requires many organizations to implement specific activities directed towards earthquake disaster preparedness and risk management. This section describes the specific activities to be conducted by NSET for their role in this process. These activities range from building support for earthquake mitigation activities in general, to providing guidance for specific risk management initiatives. These activities are classified into three groups: Building Support for the Plan and Earthquake Risk Management in General, Supporting the Individual Initiatives, and Keeping the Plan Going.

Building Support for the Plan and Earthquake Risk Management in General

Any activities that increase the community's motivation to address earthquake risk, or which raise trust in the plan or in NSET, will help the plan to achieve its objectives. Therefore, part of the strategy of the plan is to build support in these areas.

Using Transparent and Inclusive Processes

The decision making for this plan has been done and will continue to be done in an open, public manner, not behind closed doors. NSET will ensure that the process remains open to build the understanding and trust of the Kathmandu Valley community in this plan. Efforts were made to inform and involve all "key players" in the development of this plan, in particular those people who are responsible for implementation of the initiatives, and experts from relevant professions and agencies. All interested parties, including the press, are welcome to observe the plan decision making process and comments from all parties are valued. In future editions of this plan, efforts to be transparent and inclusive will continue and expand.

Making Decisions Rationally

All decisions that were made for the plan can be justified rationally and were based on the advice of Nepalese technical experts. Although some of decisions were subjective, the decision making process and the information used to influence those decisions are documented and available for review.

Using Open Financial Policies

NSET is a not-for-profit organization and it will remain neutral so that decisions are being made solely considering the best interests of Kathmandu Valley. NSET and its members will not benefit financially from money raised to support the projects of other institutions. NSET will only benefit financially from this plan if money is raised specifically to support projects to be implemented by NSET which are described in this plan. NSET will annually make publicly available its financial activities related to this plan.

Building Relationships with Other Groups

NSET will build relationships with a variety of groups present in Kathmandu Valley, such as businesses, government organizations, other NGO's, professional societies, and international groups. These relationships will focus on building the ability to work together and building trust. It is expected that these relationships will help strengthen the plan, even if the interaction has no relation to the plan. In addition, NSET will present the Action Plan as a whole, and particularly the "Initiatives to Implement Now" section, to various groups as the opportunity arises. This will keep groups aware of the plan and its progress.

Raising General Awareness

Awareness of earthquakes in Kathmandu Valley is growing, but it is still low. It is important that people at all levels of society understand what the earthquake threat is, and understand how this plan can help in reducing that risk. When possible, NSET will conduct awareness raising activities, and it is expected that these will increase understanding of why this plan is required, and will therefore increase support for it.

Educating Decision Makers Through Awareness Efforts

NSET may offer study tours for government officials and professional leaders. These tours would consist of two types:

- *Examination of earthquake disasters striking other nations.* Visits to communities ravaged by earthquakes would increase the understanding of why Kathmandu Valley needs to address this problem. It will increase their motivation and commitment to work in this area.
- *Exposure to government and professional practices developed in other countries to address earthquake risks*. Examining how other societies manage earthquakes would educate leaders about how Kathmandu Valley can benefit and learn from other communities.

Conducting Regular Public Hearings

NSET will hold regular hearings to allow parties responsible for initiatives contained in the Plan to report on progress, to investigate interesting topics and to educate the NSET management committee and staff. These meetings will provide an opportunity for the NSET management committee to keep in touch on a regular basis, as well as providing an opportunity for the management committee to share information with others. The press will be encouraged to report on these hearings.

Formally Presenting Plan to Government Agencies

NSET will present this plan to the Council of Ministers, the National Planning Commission, and national and local government agencies. NSET will recommend that they adopt this plan as their official guide to managing earthquake risk and that they support the initiatives in the plan.

Informing the International Community in Kathmandu Valley About the Plan

Kathmandu Valley's international community is potentially a valuable asset in helping to reduce Kathmandu Valley's risk. NSET will present the plan to foreign embassies, missions, and other international groups present in the valley.

Supporting the Individual Initiatives

The individual initiatives are important for reducing future losses. This is the most tangible area of the plan in which success can be measured and change can be monitored. For the plan to be successful, the initiatives need to be successful. To that end, NSET proposes to aid each initiative in the "Initiatives to Start Now" section in a variety of ways which are explained below.

Coordinating Initiatives

It is important that all mitigation work be done in an efficient and effective manner. For this to occur, there needs to be a great amount of coordination to make sure that work is not repeated, knowledge is shared, and that plans of various different institutions fit together smoothly. As an example, there are many different types of emergency relief supplies that need to be stockpiled before a disaster. There are also many different government and private organizations that are storing or could potentially store these supplies. It is important that these organizations coordinate with each other to make sure that there are not surpluses of one type of supply and shortages of another. NSET will act as a link, as needed, between these organizations and a catalyst to get them working together. NSET will not be involved, unless requested, in implementing projects that are the responsibilities of other organizations.

Planning Initiatives

Upon request, NSET will work with organizations to help them determine which initiatives are most urgent, cost-effective, and feasible for them to implement. NSET will help organizations to analyze the costs and the benefits of the various earthquake risk mitigation options that face them. If it is helpful, NSET will collaborate with institutions to define a realistic scope of work, milestones, and schedule for initiatives that they will undertake.

Arranging Technical Support

NSET will arrange technical support for activities in the "Initiatives to Start Now" section of the plan in the form of publications or consultants. In most cases, NSET will not directly provide technical information or consultation, but will act as a referral service.

Conducting Peer Review of Initiatives

In some situations, expert guidance and support can increase an initiative's effectiveness and efficiency. Peer review is a process where expert professionals without an interest in a specific project are asked to review the concepts and methods at various critical stages of implementation and to discuss their observations with the professionals responsible for implementing the project. This process adds expertise to the project, builds the skills and confidence of professionals, and helps to assure that goals will be met. Peer review is a voluntary, structured approach to including expert technical input in a project. NSET can arrange for peer review by Nepalese and foreign experts for selected projects in the "Initiatives to Start Now" section.

Seeking External Funding for Respective Agencies

NSET will present the Action Plan as a whole to a variety of groups that may be interested in funding earthquake risk mitigation projects. NSET cannot be responsible for raising money for any specific project, but will work to increase the awareness of funding groups of the plan and the need for money to support the individual projects in the plan. NSET will not receive or administer any of the funds received through this process for initiatives to be implemented by other institutions. NSET will annually make available its financial activities related to this plan.

Publicizing Successful Initiatives

NSET will publicize successful initiatives and the responsible organizations to public groups and the press. This will be accomplished through workshops, lectures, press conferences, and future editions of this plan. NSET, as a neutral player in the plan, can credibly publicize the actions of institutions that have made a difference in Kathmandu Valley's earthquake safety.

Keeping the Plan Going

For the plan to be useful, it needs to be up-to-date and applicable to Kathmandu Valley as the community changes. Not only will the particular initiatives need to be monitored for their progress and then updated accordingly, but the goals and strategies of the plan will need to be continually reviewed to see if they are functioning as intended.

Monitoring the Initiatives Annually

The progress of each initiative which is listed in the section "Initiatives to Implement Now" will be monitored annually. The purpose of this process is both to identify which institutions deserve public praise, and to learn why some initiatives are more successful than others. The process will be conducted openly and will be summarized in the next edition of the plan.

Evaluating the Objectives and Strategies Periodically

The plan will be evaluated periodically. The plan development team recommends that this evaluation occurs every two years. The plan objectives will be thoroughly reviewed to make sure they remain

appropriate. The plan strategy should be thoroughly reviewed to determine if it has been effective. This process will result in recommendations to be used in creating the next edition of the plan.

Creating a New Edition of the Plan Periodically

A revised plan will be assembled, published and distributed at the same interval as the plan evaluation. The new version of the plan will be developed in an open fashion, allowing opportunities for all interested parties to comment on proposed initiatives, objectives, and strategies. The lessons from monitoring and evaluating the plan will be incorporated. Later versions of the plan will include reports on past successes and failures of the plan.

This section presents a starting point for reducing Kathmandu Valley's risk by identifying actions which can be implemented immediately and lead to the long-term objectives of the plan.

Each of the actions which appears in this section was analyzed in a three step process. The initiatives which met the criteria of all three steps appear in this section and will be actively assisted by NSET.

Step 1:

The first step for selecting the initiatives was to examine how well each potential initiative met the following subjective criteria:

- Does the initiative appeal to common sense? Does it obviously reduce earthquake risk?
- Is the initiative supported by the organization required for its implementation?
- Is the initiative easy implement?
- Does the initiative appear to be cost-effective?
- Is the initiative politically realistic to implement?
- Is the initiative technically practical to implement?

Step 2:

Initiatives that satisfied most or all of the above criteria were then analyzed to determine how they related to the plan's objectives. All objectives are important but, due to a need to focus, initiatives which address the plan's first four initiatives were given the highest consideration. The objectives are as follows:

- Improve emergency response planning and capability.
- Improve awareness of issues relating to earthquake risk.
- Integrate seismic resistance into the process of new construction.
- Improve the safety of school children and school buildings
- Improve the seismic performance of existing buildings.
- Improve the seismic performance of existing non-essential utility and transportation systems.
- Increase experts' knowledge of the earthquake phenomenon, vulnerability, consequences and mitigation techniques.
- Prepare for long-term community recovery following damaging earthquakes.

Step 3:

Initiatives were examined to determine how effective they were as a group to begin a comprehensive, lasting process of earthquake risk management in Kathmandu Valley. Attention was also given to keeping the list of initiatives as a whole short and achievable.

The initiatives below have not been prioritized and appear in no particular order. The descriptions and estimated costs of each initiative are preliminary. Detailed work plans, schedules and budgets need to be created by the organizations responsible for the implementation of the various initiatives.

The Initiatives

OBJECTIVE: IMPROVE EMERGENCY RESPONSE PLANNING AND CAPABILITY.

INITIATIVE 1:
NSET will request HMGN to (1) constitute the National Disaster Management Council (NDMC) headed by the Prime Minister; and (2) direct the NDMC to define an integrated national disaster management system that describes the roles and reporting relationships for each involved agency at the national, district, municipal or village, and ward levels of government. NSET will work with the Prime Minister's office and other concerned authorities to see that these steps are taken and to provide technical advice and assistance upon request.

Schedule:
By the end of the first year the NDMC will be created and the national disaster management system will be defined.

Cost:
The cost of forming the NDMC can be absorbed by government institutions. Defining an integrated national disaster management system will require outside funds to support the participation of an expert in emergency management and to cover the costs of a workshop or several meetings.

Preliminary estimate: NRs. 1,00,000 (US$ 15,000)

INITIATIVE 2:
Once constituted, the National Disaster Management Council should (1) provide guidance for the preparation of new (or revision of existing) integrated emergency response plans that identify internal and external relationships for every responsible organization including government and non government agencies, public and private utilities, hospitals and schools; and (2) direct these organizations to prepare plans according to the guidance and to assess communications equipment, facilities and training needed to execute the plans during an earthquake disaster. NSET will work with the Prime Minister's office and other concerned authorities to see that these steps are taken and provide technical advice and assistance upon request.

Schedule:
By the end of the first year the NDMC should issue the planning guidance to every responsible organization. Integrated plans and reports on equipment, facility and training needs will be submitted to the Prime Minister at the end of the second year.

Cost:
Expert assistance is required to provide guidance and a training session on preparing emergency response plans and to aid each responsible organization in preparing these plans.

Preliminary estimate: NRs. 1,085,000 (US$ 15,500)

OBJECTIVE: IMPROVE AWARENESS OF ISSUES RELATING TO EARTHQUAKE RISK.

INITIATIVE 3:
NSET will work with the Ministry of Science and Technology to design a comprehensive program to raise public awareness about earthquake risk and mitigation options. The program should involve marketing and communications specialists, and identify groups to conduct the awareness programs and to receive training. The amount of funds required for the program and sources for these funds should be identified while developing the program. This awareness program should focus on a wide range of groups in the valley, including the following:

- Ministers, Secretaries, and Members of Parliament
- Public safety employees and emergency response officials
- Municipalities and wards
- Hospital managers
- Businesses, Business groups
- Non Government Organizations (NGOs) and Community-Based Organizations (CBOs)
- International Non Government Organizations (INGOs) and the International Community
- Media

Schedule:
The comprehensive training program of the Ministry of Science and Technology should be outlined by the end of one year.

Costs:
Funds are needed to support the time of a communications and marketing specialist and the time of staff at the Ministry of Science and Technology and NSET.

Preliminary estimate: NRs. 250,000 (US$ 3,500)

INITIATIVE 4:
NSET will work with the municipalities of Kathmandu, Lalitpur, Bhaktapur, Madhyapur and Kirtipur and the three District Development Committees to create Municipal Disaster Management Committees and District Disaster Management Committees, and to design a program of activities, including public awareness programs, for these committees.

Schedule:
The Municipal and District Disaster Management Committees should be created within one year and should have programs outlined within one and a half years.

Cost:
The municipalities and District Development Committees can constitute the Disaster Management Committees with no additional costs. Funds are required to support meetings and training programs to develop realistic programs of activities.

Preliminary estimate: NRs. 476,000 (US$ 6,800)

OBJECTIVE: INTEGRATE SEISMIC RESISTANCE INTO THE PROCESS OF NEW CONSTRUCTION.

INITIATIVE 5:
NSET will request the Ministry of Housing and Physical Planning to (1) constitute the Building Council and direct it to draft the rules and procedures for implementing and enforcing the building code, and (2) formally adopt requirements to implement and enforce the building Code by municipal governments through the existing building permit process.

Schedule:
By the end of the first year the Building Council will be created and the implementation and enforcement rules and procedures will have been written and adopted by the Minister of Housing and Physical Planning. By the end of the second year the five municipalities and three District Development Committees of Kathmandu Valley will have in place the procedures and staff to enforce the building code on all new buildings.

Cost:
Redirecting existing employees can absorb the cost of forming the Building Council, drafting rules and procedures, and adopting them.
The cost of implementing and enforcing the building code by municipalities should be estimated by this council and the sources of funds for these activities should be identified.

Preliminary estimate: No outside funding required

INITIATIVE 6:
NSET will work with the Ministry of Housing and Physical Planning, Department of Building, professional societies, engineering colleges, and other organizations to prepare training materials and provide training for building inspectors, masons and engineers on applied aspects of design and construction of buildings to conform to the Building Code.

Schedule:
Training materials will be completed, and training sessions developed by the end of the first year when the legal framework for building code enforcement is in place. Training will be offered during the second and subsequent years according to the level of interest.

Cost:
These courses can be designed to be self-funding in the long-term, but funds will be required to plan the courses, prepare course materials and conduct pilot training sessions.

Preliminary estimates: NRs. 700,000 (US$ 10,000)

OBJECTIVE: INCREASE THE SAFETY OF SCHOOL CHILDREN AND SCHOOL BUILDINGS.

INITIATIVE 7:
NSET will manage and coordinate the "School Earthquake Safety Project" which will (1) inform school management committees, district education offices, parents, and teachers about the vulnerability of selected schools (based on a valley-wide school vulnerability assessment conducted by KVERMP), and what can be done to reduce the risk at those schools by using a specialist trained in working at the community level; (2) prepare school-specific plans for improvements in seismic safety (structural and non-structural) for those communities interested in improving their schools; (3) mobilize support and resources from the community and others to improve the safety of the school buildings; and (4) identify an affordable, replicable process to improve the safety of Kathmandu Valley's existing school buildings.

Schedule:
The project can complete work with one pilot community within two years.

Cost:
The costs for this activity include professional fees for one specialist in working with Kathmandu Valley communities, one structural engineer, and management oversight expenses. Funds to complete the structural and/or non-structural improvements to the schools should come from the local community in the form of donated labor and materials.

Preliminary estimate: NRs. 840,000 (US$ 12,000)

OBJECTIVE: IMPROVE THE SEISMIC PERFORMANCE OF EXISTING BUILDINGS.

INITIATIVE 8:
NSET will create handbooks, posters, handbills, stickers and other information products to explain what non-structural hazards are (such as furnishings, light fixtures, decorations that could fall and injure someone or important equipment that could be damaged and malfunction), and explain how to mitigate non-structural hazards in typical Nepali homes and offices. These materials will be aimed at both literate and non-literate Nepali audiences. NSET will develop a strategy to maximize the impact of these materials and to incorporate them into other awareness raising programs.

Schedule:
These products will be completed within two years.

Costs:
The major expenses for this item include printing costs for large numbers of public awareness materials. Additionally, funds are needed to cover the time of an engineer, a communications and marketing specialist and an artist to express the information in an easy to understand form.

Preliminary estimate: NRs. 2,100,000 (US$ 30,000)

OBJECTIVE: IMPROVE THE SEISMIC PERFORMANCE OF UTILITY AND TRANSPORTATION SYSTEMS.

INITIATIVE 9:
NSET will encourage the Nepal Telecommunications Corporation to assess the vulnerability of its system to earthquakes, identify the most vulnerable elements, and develop a program to improve its performance after earthquakes. This assessment will be used as a model for all of the other utilities in the valley to conduct similar assessments in future years.

Schedule:
NSET will begin working with the corporation during the first year with the objective of having the assessment underway by the end of the second year.

Cost:
The costs will include hiring a consultant to assist NTC in designing and implementing the vulnerability assessment.

Preliminary estimate: NRs. 2,100,000 (US$ 30,000)

OBJECTIVE: INCREASE EXPERTS' KNOWLEDGE OF THE EARTHQUAKE PHENOMENON, VULNERABILITY, CONSEQUENCES AND MITIGATION TECHNIQUES.

INITIATIVE 10:
NSET will encourage engineering institutes to develop and offer short courses for practicing engineers on earthquake engineering principles and procedures.

Schedule:
University-based short courses should be planned during the first year and be offered during the second and subsequent years according to the level of interest.

Cost:
The expenses associated with faculty preparing and offering lectures will need to be covered.

Preliminary estimate: NRs. 350,000 (US$ 5,000)

OBJECTIVE: PREPARE FOR LONG-TERM COMMUNITY RECOVERY FOLLOWING DAMAGING EARTHQUAKES.

No initiatives for this objective in this section.

More Endorsed Initiatives

There are many activities, large and small, that need to be undertaken to reduce Kathmandu Valley's earthquake risk. However, many of these important activities do not appear among the initiatives in the previous section. The initiatives listed below are important activities that will improve the situation in Kathmandu Valley. Responsible organizations are strongly encouraged to pursue them. NSET endorses these activities. However, due to limited resources and a need to focus, NSET cannot commit to actively promoting or aiding the implementation of these initiatives.

Screening criteria

NSET endorses initiatives which meet the following four subjective criteria:

1. Initiative obviously reduces Kathmandu Valley's earthquake risk
2. Initiative is feasible to implement
3. Initiative is supported by the organization required for its implementation

The initiatives below have not been prioritized and appear in no particular order.

Endorsed Initiatives

Improve emergency response planning and capability.

NSET will encourage the Royal Nepal Army and Nepal Police to train their staff in post-earthquake search and rescue techniques.

NSET will encourage all government and private hospitals to train their doctors, nurses, and staff in emergency medicine techniques.

NSET will encourage the Ministry of Housing and Physical Planning, the Department of Building, professional societies such as Nepal Engineers Association, engineering staff and students at universities, and others to receive training in post-earthquake damage assessment of buildings.

NSET will encourage all organizations associated with utilities and transportation to train their staff members in post-earthquake damage assessment of their system and emergency repair techniques.

NSET will encourage the Kathmandu Fire Brigade to receive training in post-earthquake fire suppression and to upgrade their fire-fighting equipment.

NSET will encourage all municipalities, wards, and districts in the valley to train employees in their emergency roles.

NSET will encourage the NDMC, or another appropriate organization, to make a Central Emergency Operations Center, located in an earthquake-resistant building with post-earthquake communications capabilities.

NSET will encourage all hospitals in the valley, the Ministry of Health, and the Department of Health Services to develop an earthquake-resistant communications system linking these organizations.

NSET will encourage the Nepal Telecommunications Corporation to design and construct the new cellular phone network so that it is likely to be operational after an earthquake.

NSET will encourage the Nepal Timber Corporation to examine alternatives, such as installing electric crematoriums, which could help manage mass human losses after an earthquake and to design a program to implement the best alternative.

NSET will encourage the Ministry of Information and Communication, radio stations, and television stations to design, implement and test regularly an emergency broadcast system.

NSET will encourage all relevant organizations to use emergency response plans to identify which elements of critical facilities are essential for emergency response, to assess the vulnerability of those elements to earthquakes and post-earthquake fire, and to determine which vulnerable elements are most important to strengthen first.

NSET will encourage the Ministry of Housing and Physical Planning and the Department of Building to prepare standard formats to assess damage to buildings after an earthquake and to determine which buildings are safe to occupy.

NSET will encourage all Ministries, Departments, businesses, and other organizations to make an emergency evacuation plan for their building and to conduct an evacuation drill with the staff.

Improve awareness of issues relating to earthquake risk.

NSET will encourage all critical facilities to establish a unit in their organization to focus on issues related to disaster management.

NSET will encourage all Ministries, Departments, businesses, and other organizations to educate their staff about earthquake preparedness measures and how to behave during an earthquake.

NSET will encourage the Ministry of Labor, the Ministry of Industry, the Ministry of Commerce, and other groups to create incentives for businesses to increase their earthquake safety.

NSET will encourage the Ministry of Science and Technology to conduct the public awareness event “Earthquake Safety Day” on or near Magh 2 each year.

Integrate seismic resistance into the process of new construction.

NSET will encourage the Ministry of Housing and Physical Planning, the Department of Building, and municipalities to enforce the building code as strictly as possible for critical buildings, such as key government buildings, schools, and high-occupancy buildings.

NSET will encourage the municipalities to enforce the building code for all new structures and to train all staff members who will be responsible for enforcing the building code.

NSET will encourage the Ministry of Parliament Affairs to ensure that the new Parliament building be designed and constructed to be as earthquake-resistant as feasible.

NSET will encourage the Ministry of Housing and Physical Planning, the Department of Mines and Geology, the Ministry of Land Reform and others to create and enforce a land use plan that considers seismic safety issues such as keeping open spaces in urban areas and not developing lands subject to liquefaction or earthquake-induced landslides.

NSET will work with the Ministry of Housing and Physical Planning, the Department of Building, professional societies and others to create and distribute a simple handbook explaining how to use to the building code and seismic design principles for typical Nepali structures.

NSET will encourage all organizations that fund or loan money for building construction in the valley to require adherence to the building code in design and construction as a term of all grants and loans.

Improve the safety of school children and school buildings

NSET will work with the Ministry of Education, District Education Offices, School Management Committees, individual schools and other groups to create an emergency plan for each school, including instructions for teachers and students.

NSET will aid and encourage each school to conduct annual "duck and cover" and evacuation drills with all students and teachers.

NSET will work with the Ministry of Education, District Education Offices, School Management Committees, individual schools and other groups to add earthquake preparedness into the standard school curriculum.

Improve the seismic performance of existing buildings.

NSET will encourage all Ministries, Departments, businesses, and other organizations to identify and reduce non-structural hazards in their buildings.

NSET will encourage the Ministry of Housing and Physical Planning and the Department of Building to assess the vulnerability to earthquakes of all existing government buildings which hold large numbers of people and/or have important functions.

NSET will encourage all building owners of structures which hold large numbers of people, such as cinemas or stadiums, to assess the vulnerability of these structures to earthquakes.

NSET will encourage the Department of Archaeology and other groups to assess the vulnerability to earthquakes of cultural and historical sites within Kathmandu Valley and to develop programs to strengthen the most vulnerable sites.

NSET will encourage all newspapers and television and radio broadcasters to assess the vulnerability of their systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage the Ministry of Housing and Physical Planning, the Department of Building, professional societies, engineering institutes and others to create and distribute literature that describes how to seismically retrofit typical Nepali buildings to increase their earthquake safety.

Improve the seismic performance of utility and transportation systems.

NSET will encourage the Nepal Water Supply Corporation and the Department of Water Supply and Sewerage to assess the vulnerability of their systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage the Nepal Electricity Authority to assess the vulnerability of its systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage the Department of Roads to assess the vulnerability of its systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage the Department of Civil Aviation and Tribhuvan International Airport to assess the vulnerability of their systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage all organizations which store or transport fuel, hazardous wastes, or highly flammable materials to assess the vulnerability of their systems to earthquakes, identify the most vulnerable elements, and develop a program to improve performance after earthquakes.

NSET will encourage the Department of Roads, the Nepal Telecommunications Corporation, the Nepal Water Supply Corporation, the Nepal Electricity Authority, and other organizations to train their staff in design, maintenance and repair techniques that reduce earthquake risk.

NSET will encourage the Department of Roads, the Nepal Telecommunications Corporation, the Nepal Water Supply Corporation, the Nepal Electricity Authority, and other organizations to develop earthquake-resistant standards for design and construction of new components to their systems.

Increase experts' knowledge of the earthquake phenomenon, vulnerability, consequences and mitigation techniques.

NSET will encourage engineering and science universities to strengthen existing or add new programs in subjects related to earthquakes such as geology, seismology, geotechnical engineering, and structural engineering.

NSET will encourage the Department of Mines and Geology to establish a strong motion network.

NSET will encourage the Department of Mines and Geology and others to study active faults in Kathmandu Valley and other faults which could affect Kathmandu Valley.

NSET will encourage the Department of Mines and Geology and others to collect, compile and disseminate earthquake hazard and collateral hazard maps.

NSET will encourage training programs for various audiences in disaster management skills.

Prepare for long-term community recovery following damaging earthquakes.

NSET will encourage the NDMC, or another appropriate organization, to prepare governmental recovery plans addressing key decisions which need to be taken after a disaster, such as changing city layout, relocating families, deciding which buildings to repair and which to demolish, and sites for long-term temporary housing.

NSET will encourage the government to investigate the option of insuring important structures such as government buildings and cultural sites.

NSET will encourage insurance companies which handle earthquake insurance to review and revise tariffs, underwriting guidelines, and reinsurance depth.

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