

C o u n t r y R e p o r t

S i n g a p o r e

*Natural Disaster Risk Assessment and
Area Business Continuity Plan Formulation for
Industrial Agglomerated Areas in the ASEAN Region*

March 2015

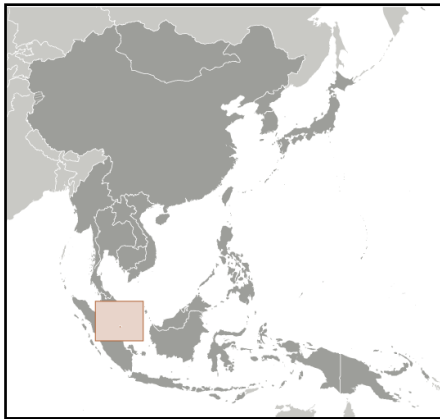
AHA CENTRE

Japan International Cooperation Agency

**OYO International Corporation
Mitsubishi Research Institute, Inc.
CTI Engineering International Co., Ltd.**

Overview of the Country

Basic Information of Singapore ^{1), 2), 3)}



Country Name	Long form : Republic of Singapore Short form : Singapore
Capital	Singapore (city-state)
Area (km ²)	Total: 716 Land: 700 Inland Water: 16
Population	5,399,200
Population density(people/ km ² of land area)	7,713
Population growth (annual %)	1.6
Urban population (% of total)	100
Languages	Malay (National/Official language), English, Chinese, Tamil (Official languages)
Ethnic Groups	Chinese 74%, Malay 13%, Indian 9%, Others 3%
Religions	Buddhism, Islam, Christianity, Daoism, Hinduism
GDP (current US\$) (billion)	298
GNI per capita, PPP (current international \$)	76,850
GDP growth (annual %)	3.9
Agriculture, value added (% of GDP)	+0
Industry, value added (% of GDP)	25
Services, etc., value added (% of GDP)	75

Brief Description

Singapore is a city-state consisting of Singapore Island, which is located close to the southern edge of the Malay Peninsula, and 62 other smaller outlying islands. Singapore is ranked as the second most densely populated country in the world, after Monaco. With four languages being used as official languages, the country itself is a competitive business district. Therefore, there are many residents other than Singaporean living in the country.

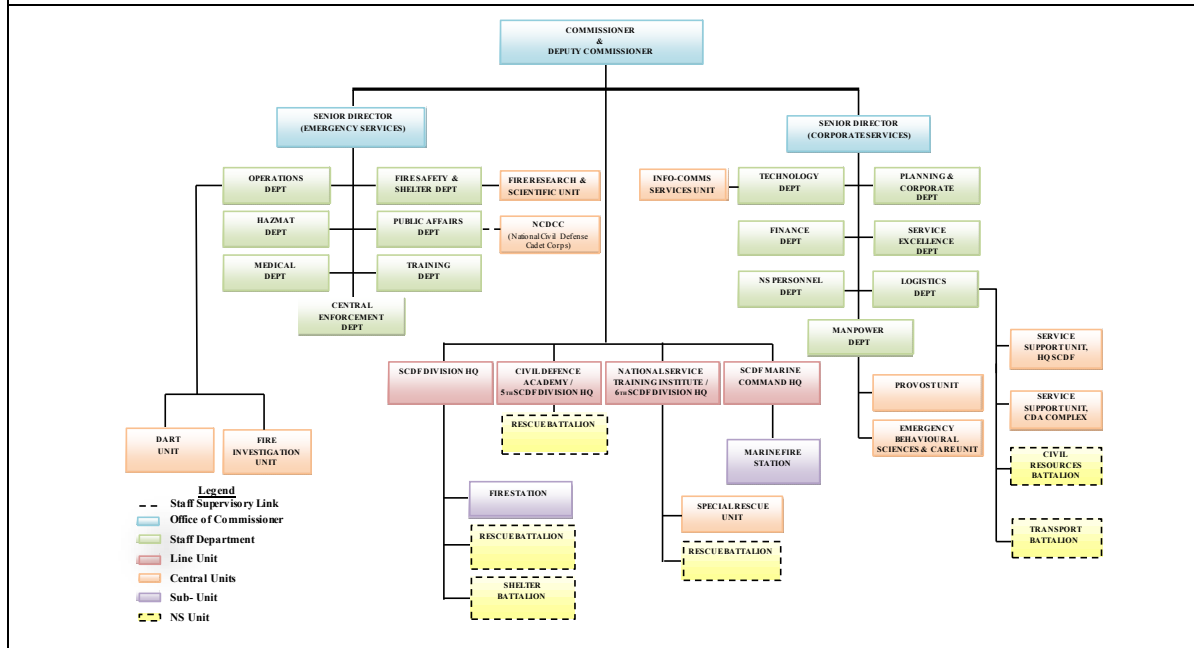
Singapore is one of the founding members of ASEAN (founded on August 8, 1967), and the leading economy in ASEAN. Cooperation with ASEAN countries is a basic diplomatic policy of Singapore. Singapore is part of the Commonwealth Nations, and has a constitutional republican government.

The current President of Singapore is Dr. Tony Tan. Since the founding of the nation, the politics of Singapore have been almost completely dominated by a single party, the People's Action Party, and its internal affairs are stable.

Natural Hazards

Singapore does not have tropical cyclone, earthquake nor volcano eruption. (Possibility of man-made disasters in urban area where various human activities concentrate.)

Disaster Management System ⁴⁾



References:

- 1) Central Intelligence Agency (CIA) website (2014): <https://www.cia.gov> (Accessed: October 15, 2014)
- 2) Ministry of Foreign Affairs website (2013): <http://www.mofa.go.jp> (Accessed: October 15, 2014)
- 3) The World Bank Data Bank website (2012, 2013): <http://data.worldbank.org> (Accessed: October 15, 2014)
- 4) Singapore Civil Defence Force (SCDF): http://www.scdf.gov.sg/content/scdf_internet/en/general/about-us/organisation_structure/our-people.html (The organizational chart as of October 31, 2013)

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1. Introduction

This report is the first version of the Country Report for Singapore, which gives information on natural disaster risks of the country, industrial parks, major traffic infrastructure and lifeline utilities, and legislative systems relating to disaster management and business continuity.

The country report is prepared as a reference document for individuals and organizations who are wishing to integrate disaster risk information for their decisions: such as investment to Singapore, preparation of a business continuity plan (BCP) or disaster management plan of their organization, preparation of an Area Business Continuity Plan (Area BCP) of their area, and simply knowing natural disaster risks of their area.

Information contained in this report is macroscopic covering the entire country at the same level. When detailed risk information is necessary, hazard and risk assessments for an area of interest are required.

Since the country report was prepared with limited data and information as one of the components of the project¹ of ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA Centre) and Japan International Cooperation Agency (JICA) with a limited data and information, a revision by national experts is required for further refinement.

The following are reference documents prepared by the project of AHA Centre and JICA.

1. AHA Centre and JICA (2015): Planning Guide for Area Business Continuity, Area BCM Took Kits, Version 2.
2. AHA Centre and JICA (2015): The Country Reports; Brunei, Cambodia, Laos, Malaysia, Myanmar, the Philippines, Thailand, Singapore and Vietnam.
3. AHA Centre and JICA (2015): The Risk Profile Reports; Karawang and Bekasi of Indonesia, Cavite, Laguna and the Southern Part of Metropolitan Manila of the Philippines, and Haiphong of Vietnam.

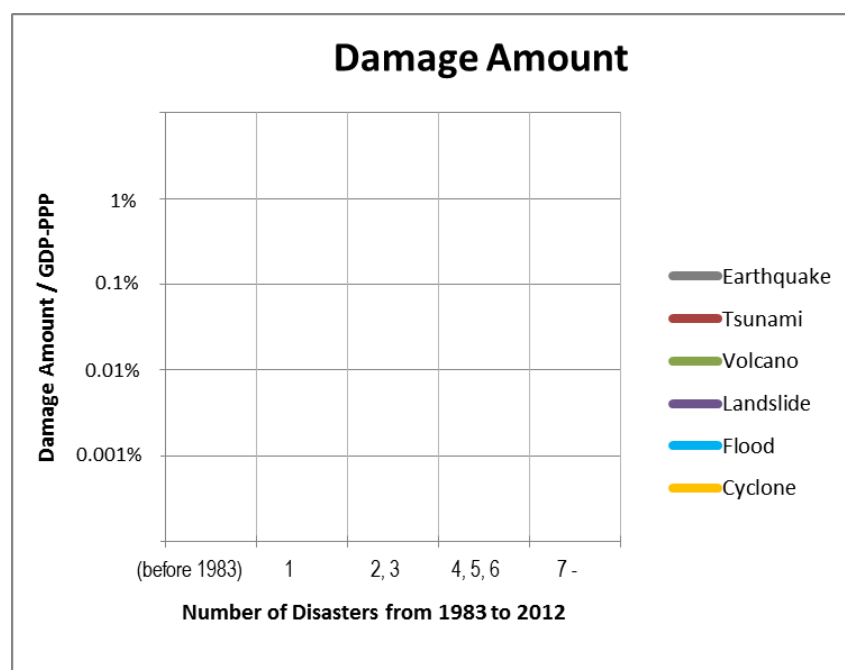
¹ Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Agglomerated Areas in the ASEAN Region, AHA Centre and JICA, 2013 to 2015.

2. Natural Disaster Risks

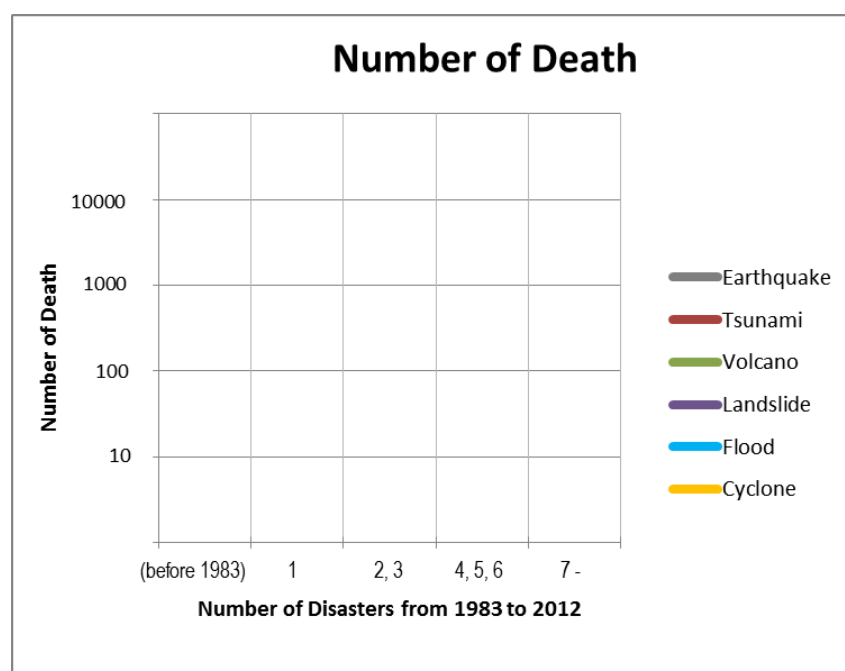
2.1 Predominant Hazards

Natural disaster risk of Singapore is low. No disasters that have caused significant damage or deaths have been recorded.

Descriptions of each hazard are given in Section 2.2 to Section 2.7.



Note: GDP-PPP, Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP, International Monetary Fund, World Economic Outlook Database, October 2012



Source of data and information:

EM-DAT, The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium: <http://www.emdat.be>.

Pacific Rim Coordination Center Disaster Data: <http://data.pacificrimnetwork.org/>.

Global Unique Disaster Identification Number:

<http://www.glide-number.net/glide/public/search/search.jsp>.

National Geophysical Data Center (NGDC), National Oceanic and Atmospheric Administration (NOAA): <http://ngdc.noaa.gov/hazard/hazards.shtml>

Dartmouth Flood Observatory, University of Colorado: <http://floodobservatory.colorado.edu/>

Figure 2.1 Impact of Natural Hazards in Singapore

2.2 Flood

Risks

In Singapore, there are storm rainfalls in the rainy season (from November to March), but there are no major flood events in the country. Torrential rains can cause local flooding in some low-lying parts of the country. The country is vulnerable to low levels of hazards from floods. The country does not suffer from flood disaster due to continuous drainage improvement work.

Inundation damages were caused by torrential rains. The torrential rains of June 2010 and June 2011 caused local inundation damage at shopping malls and underground parking lots in the city. The torrential rainfall amount on the morning of June 5 was 124 mm, which is about 80% of the monthly mean total precipitation in June.

Sources of Hazard and Risk Information

Table 2.1 Sources of Hazard and Risk Information: Flood

Ministry of Home Affairs (MHA)
http://www.mkn.gov.my/mkn/default/article_e.php?mod=4&fokus=17
Singapore Civil Defense Force (SCDF)
http://www.scdf.gov.sg/content/scdf_internet/en.html
Meteorological Service Singapore (MSS)
http://www.weather.gov.sg/wip/c/portal/layout?p_l_id=PUB.1001.4
National University of Singapore (NUS)
http://www.nus.edu.sg/
Nanyang Technological University (NTU)
http://www.ntu.edu.sg/Pages/index.aspx

Table 2.2 List of Reference Reports for Risk Analysis

Organization	Post	Title/ Web Address	Form
Asia Development Bank	Asian Water Development Outlook	Asian Water Development Outlook 2013: Asia-Pacific Water Forum	Report
		http://www.adb.org/publications/asian-water-development-outlook-2013	
World Bank	ASEAN Disaster Risk Management Initiative	Synthesis Report on Ten Asian Countries Disaster Risks Assessment: December 2012	Report
		http://www.unisdr.org/files/18872_asean.pdf	
The Nature Conservancy	ASEAN Disaster Risk Management Initiative	World Risk Report 2012: October 2012	Report
		http://www.ehs.unu.edu/article/read/worldriskreport-2012	
World Bank	Framework and Options for Implementation	Advancing Disaster Risk Financing and Insurance in ASEAN Countries: April 2012	Report
		https://openknowledge.worldbank.org/bitstream/handle/10986/12628/714530v20ESW0W0AN0appendices0June12.pdf?sequence=1	
International Development Research Centre	Economy and Environment Program for Southeast Asia (EEPSA)	Climate Change Vulnerability Mapping for Southeast Asia: January 2009	Report
		http://web.idrc.ca/uploads/user-S/12324196651Mapping_Report.pdf	
UNEP, GRID, UNISDR		Global Risk Data Platform	Web Map
		http://preview.grid.unep.ch/index.php?preview=map&lang=eng	

Studies on Hazard and/or Risk Assessment

Some useful studies on flood hazard, risk, and vulnerability are publicly available presenting assessment results, case studies of countermeasures, as well as different methodological approaches. There are a few types of methodologies to assess risks and vulnerability including, for example, risks involving exposure to flooding events and population density. Vulnerability can be defined as a function of exposure, adaptive or coping capacity, and land-use etc. There are slightly different combinations of these factors with different studies for use. Therefore, these concepts must be defined in advance to plan a methodology for an assessment, in terms of which definitions are to be used in a certain analysis.

Locations of existing investigations and studies on flood are shown in Figure 2.2. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.3.



Figure 2.2 Locations of Existing Investigations and Studies: Flood, Cyclone, Landslide

Table 2.3 Summary of Existing Investigations and Studies: Flood

Country/Region	Summary of Existing Studies and Reports
ASEAN	There are a few reports that study natural disasters for ASEAN and the Pacific regions at large in recent years. Disaster risks are assessed by scenario, exposure, vulnerability, damage, and loss. An assessment framework is also sought to give an overview of risks, hazard and vulnerability.
Singapore	The website of the Singapore Government, PUB has extensive data information on the flood situation and strategies to prepare for flooding.

References for Data and Further Reading

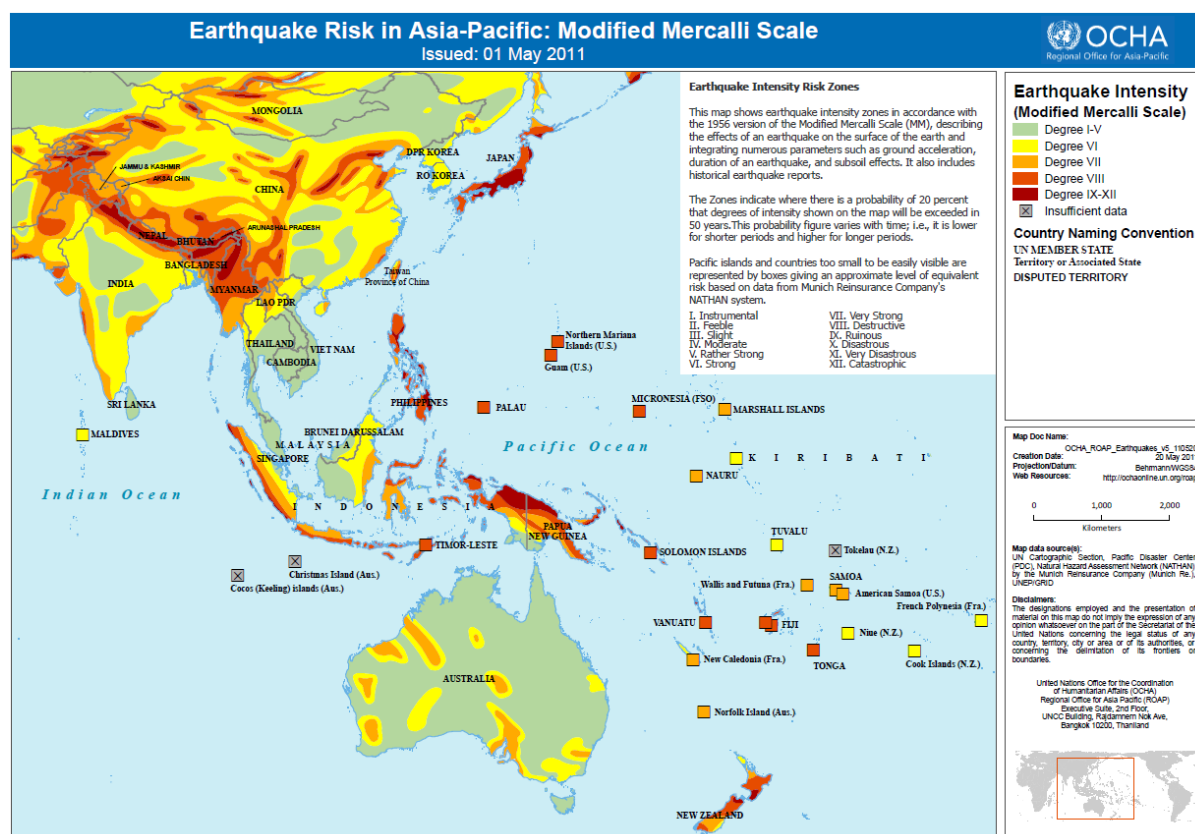
- 1) Ministry of Foreign Affairs of Japan (2013): "Information on Singapore in Japanese", 05 2013
- 2) Shigenobu Tanaka et al (2010). Progress Report on Flood Hazard Mapping in Asian Countries. PWRI.
- 3) Velasquez, Jerry et al (ed.) (2012). Reducing vulnerability and exposure to disasters: Asia-Pacific disaster report 2012, ESCAP/UNISDR AP
- 4) World Bank (2011). Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation, Washington: Global Facility for Disaster Reduction and Recovery
- 5) World Bank, UNISDR (2010). Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment.

2.3 Earthquake

Risks

Earthquake disasters are not common in Singapore. There is no record of significant disaster caused by earthquakes in its history.

Figure 2.3 shows earthquake risk in the Asia-Pacific region. The zones indicate where there is a probability of 20% that degrees of intensity shown on the map will be exceeded in 50 years. This probability figure varies with time; i.e., it is lower for shorter periods and higher for longer periods. Singapore is categorized as VI on the Modified Mercalli Scale.



Source: OCHA

Figure 2.3 Earthquake Risk in Asia-Pacific

Responses by Singapore

The National Environment Agency (NEA) provides weather surveillance and multi-hazard warning services on a 24/7 basis to the public, industry, and relevant agencies in Singapore.

NEA established the Meteorological Service Singapore (MSS). MSS provides the country's weather forecasts, heavy rain warnings, smoke haze advisories, and information of earthquake/shaking/tsunami.

Sources of Hazard and Risk Information

Table 2.4 Sources of Hazard and Risk Information: Earthquake

National Environment Agency
http://app2.nea.gov.sg/
Meteorological Service Singapore (MSS)

Reports on Hazard and/or Risk Assessment

Useful information and studies on earthquake hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies with analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, the methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessments are required.

Locations of existing investigations and studies on earthquake are shown in Figure 2.4. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.5.



Figure 2.4 Locations of Existing Investigations and Studies: Earthquake, Tsunami, Volcano

Table 2.5 Summary of Existing Investigations and Studies: Earthquake

Country/Region	Summary of Existing Studies and Reports
ASEAN	There are natural hazard assessment reports for ASEAN region created by international organizations like World Bank etc. They summarize frequency, vulnerability, loss, and others subject for each disaster. Some reports describe the methodology and assessment points/items.
Singapore	There is no record of earthquake disaster in Singapore and no investigations or studies limited to this country and its region was found.

References for Data and Further Reading

- 1) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
- 2) Japan International Cooperation Agency (JICA) (2012): “Data Collection Survey on ASEAN Regional Collaboration in Disaster Management”
- 3) UNISDR (2009). Global assessment report on disaster risk reduction, Risk and poverty in a changing climate
- 4) United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Regional Office for Asia Pacific (ROAP) (2011): “Earthquake Risk in Asia-Pacific: Modified Mercalli Scale”, Downloaded from http://reliefweb.int/sites/reliefweb.int/files/resources/map_613.pdf

2.4 Tsunami

Risks

It is well known that tsunamis are generated by sea floor earthquakes. However an undersea volcanic eruption, an undersea landslide, or any other disturbances above or below water can also generate a tsunami. There is very low probability that large earthquakes along the coast of Singapore will generate tsunamis and cause major disasters. In fact, there is no record of significant disaster caused by tsunamis.

However, tsunami disasters may occur due to large earthquakes occurring outside the country.

Responses by Singapore

The National Environment Agency (NEA) provides weather surveillance and multi-hazard warning services on a 24/7 basis to the public, industry, and relevant agencies in Singapore.

NEA established the Meteorological Service Singapore (MSS). MSS provides the country's weather forecasts, heavy rain warnings, smoke haze advisories, and information of earthquake/shaking/tsunami.

Sources of Hazard and Risk Information

Table 2.6 Sources of Hazard and Risk Information: Tsunami

National Environment Agency
http://app2.nea.gov.sg/
Meteorological Service Singapore (MSS)

Reports on Hazard and/or Risk Assessment

Useful information and studies on tsunami hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies with analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessment are required.

Locations of existing investigations and studies on tsunami are shown in Figure 2.4. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.7.

Table 2.7 Summary of Existing Investigations and Studies: Tsunami

Country/Region	Summary of Existing Studies and Reports
ASEAN	Tsunami induced by the Sumatra earthquake on December 26, 2004 caused major damage to ASEAN countries. The disaster is summarized by organizations like ADB.
Singapore	There is no record of tsunami disaster in Singapore and no investigations or studies limited to this country and its regions were found.

References for Data and Further Reading

- 1) ADB (2005). From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami
- 2) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
- 3) Japan International Cooperation Agency (JICA) (2012): "Data Collection Survey on ASEAN Regional Collaboration in Disaster Management"

2.5 Volcanoes

Risks

There is no volcano in Singapore and also no record of significant disaster caused by volcanic eruption in its history.

Major hazards caused by volcanic eruption are lava flow, pyroclastic flow, “Lahar” (volcanic mud flow), and volcanic ash fall. Lava flow is a flow of melted rock along the slope. Pyroclastic flow is the flow of a mixture of hot dry masses of fragmented volcanic materials and volcanic gas along the slope. “Lahar” is originally an Indonesian term and is also called volcanic mud flow. It is the flow of a mixture of volcanic materials and water along the slope. These flows cause enormous damage to the side and foot of the volcano, but generally do not have an extended reach.

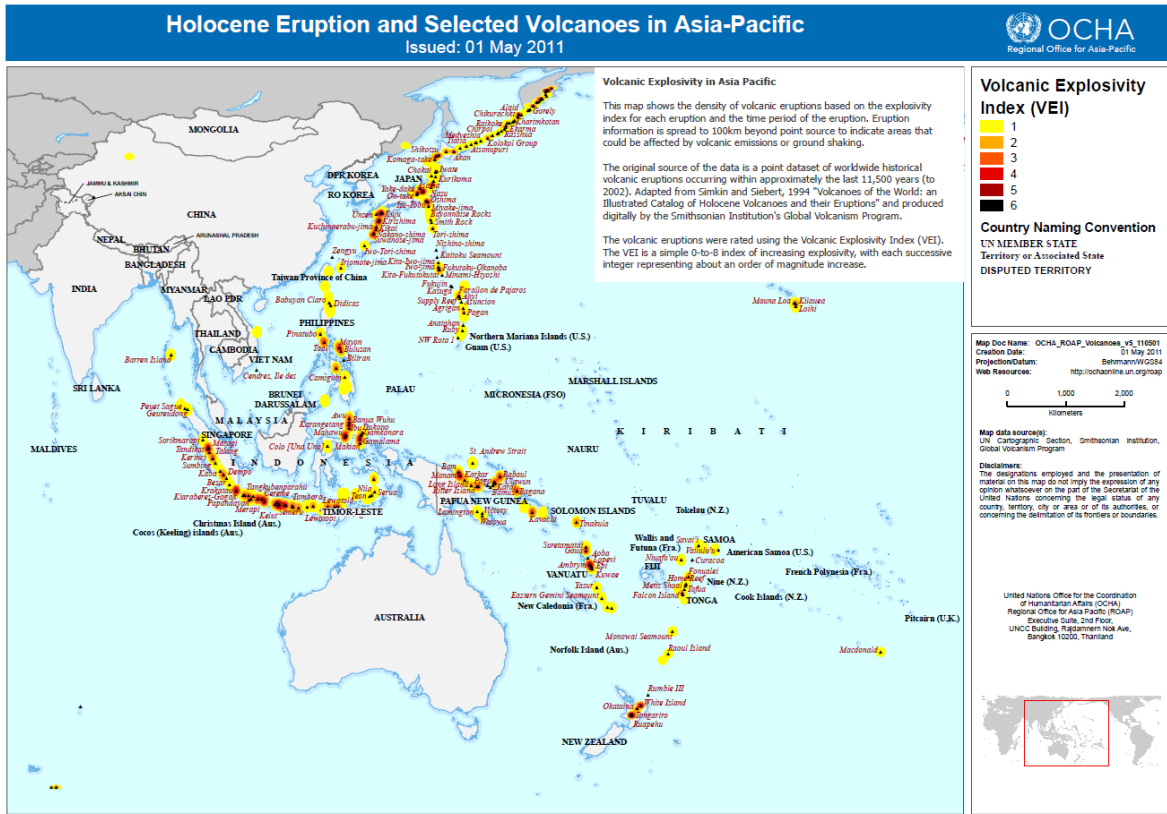
However, volcanic ash fall often spreads widely via the trade winds or the westerlies, causing damage over an extensive area. Therefore, there is a possibility that a volcanic eruption in neighboring countries might wreak a volcanic ash fall on Singapore.

Figure 2.5 shows the volcanoes in the Asia-Pacific region which erupted during the Holocene. The Holocene is a geological epoch from 10,000 years ago to the present. The map indicates that many volcanic eruptions have occurred in Indonesia, Philippines, and other neighboring countries.

Responses by Singapore

The National Environment Agency (NEA) provides weather surveillance and multi-hazard warning services on a 24/7 basis to the public, industry, and relevant agencies in Singapore.

NEA established the Meteorological Service Singapore (MSS). MSS provides the country's weather forecasts, heavy rain warnings, smoke haze advisories, and information of earthquake/shaking/tsunami.



Source: OCHA

Figure 2.5 Holocene Eruption and Selected Volcanoes in Asia-Pacific

Sources of Hazard and Risk Information

Table 2.8 Sources of Hazard and Risk Information: Volcano

National Environment Agency
http://app2.nea.gov.sg/
Meteorological Service Singapore (MSS)

Reports on Hazard and/or Risk Assessment

Useful information and studies on volcanic hazard, risk, and vulnerability were collected from resources available in the public domain including websites. The information and studies include methodologies for analysis and assessment.

There is no standardized or authorized methodology for risk and vulnerability assessment. Therefore, methodology should be selected or updated in accordance with the purpose when risk and vulnerability assessment are required.

Locations of existing investigations and studies on volcano are shown in Figure 2.4. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.9.

Table 2.9 Summary of Existing Investigations and Studies: Volcano

Country/Region	Summary of Existing Studies and Reports
ASEAN	UNOCHA summarized the scale of the explosion of volcanoes around the Asia-Pacific region using the Volcanic Explosivity Index (VEI).
Singapore	There is no record of volcanic disaster in Singapore and no investigations or studies limited to this country and its regions were found.

References for Data and Further Reading

- 1) EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.
- 2) Japan International Cooperation Agency (JICA) (2012): “Data Collection Survey on ASEAN Regional Collaboration in Disaster Management”
- 3) Lee Siebert, Tom Simkin, and Paul Kimberly (2011): “Volcanoes of the World - Third Edition”, Smithsonian Institution/University of California Press
- 4) OCHA -ROAP (2011). Holocene Eruption and Selected Volcanoes in Asia-Pacific
- 5) United Nations Office for the Coordination of Humanitarian Affairs (OCHA), Regional Office for Asia Pacific (ROAP) (2011): “Holocene Eruption and Selected Volcanoes in Asia-Pacific”, Downloaded from [“http://reliefweb.int/sites/reliefweb.int/files/resources/map_619.pdf”](http://reliefweb.int/sites/reliefweb.int/files/resources/map_619.pdf)

2.6 Cyclone and Meteorological Hazards

Risks

Singapore is located on the equator, latitude 1° 17' to the north and longitude 103° 51' to the east. This country has a tropical climate, so the island is warm and humid throughout the year. It is included within the monsoon zone, but the distinction between the rainy season and the dry season is not very clear. The wind usually blows from the north or northeast between December and early March and from the south or southwest between June and September. Annual rainfall is about 2,400 mm. The monthly rainfall does not coincide exactly with the monsoon wind. Rather, increasingly wet weather is observed from October, peaking in December.

As the country is located on the equator, it is not affected by typhoons and tropical cyclones.

Meteorological disasters in Singapore are mainly caused by heavy rains in the short-term. As the city center is located in relatively low-lying land, it is especially prone to flooding. In recent years, the risk of flooding has decreased in Singapore. However, extremely heavy rainfall can sometimes exceed the capacity that the drains were designed for, especially in low-lying areas. That is when flash floods – small and localized floods that come and go relatively quickly – may occur.

Background

Singapore is within the monsoon area. The wind usually blows from the north or northeast between December and early March and from the south or southwest between June and September. The transitions between the monsoon seasons occur gradually, generally over a period of two months.

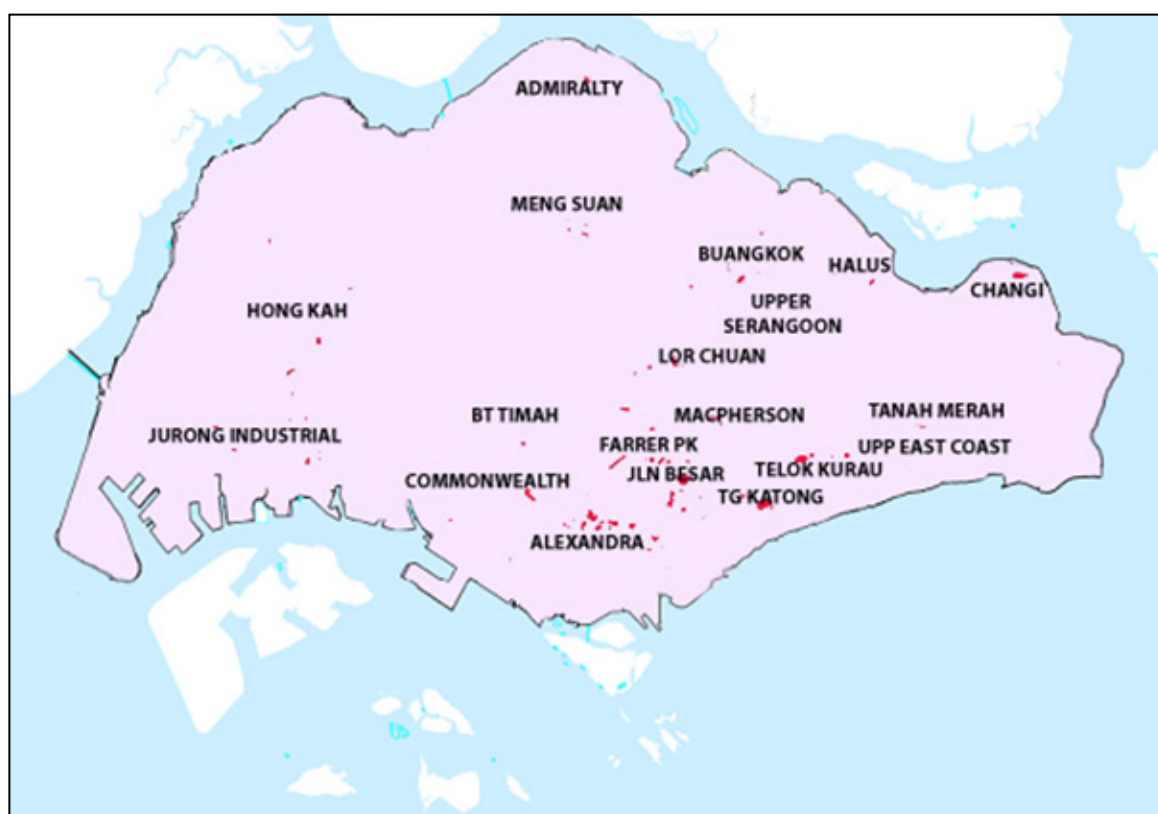
The weather is classified into four periods as below.

- Northeast monsoon season (December to early March)
- Inter-monsoon period 1 (Late March to May)
- Southwest monsoon season (June to September)
- Inter-monsoon period 2 (October to November)

December is usually the wettest month of the year in Singapore. A few heavy rain spells normally contribute to most of the rainfall during the month because the rain belt is more likely to be positioned close to Singapore during this period. From February to early March, the country often sees a sharp drop in rainfall and the number of rainy days in Singapore, because the rain belt tends to move south to affect Java in Indonesia.

During the southwest monsoon period, a squall line can bring about two hours of thunderstorm, called the Sumatra squall, in the Malay Peninsula.

A flash flood is caused by localized rainfall occurring in a short time. For this reason, floods are most likely to occur in low-lying areas close to the coast. The current flood-prone areas are indicated in Figure 2.6.



Source: <http://www.pub.gov.sg/managingflashfloods/Pages/default.aspx>

Figure 2.6 Flood-prone areas (red colored regions)

The Public Utilities Board (PUB) issued the following.

High tides of at least 3.4 meters are expected from 12-15 January 2013. Afternoon showers with thunder are expected for the next few days. During this period, heavy rain coinciding with high tides may lead to localized flash floods, especially in the

low-lying coastal areas such as Fort Road and Meyer Road. Canals that are easily influenced by tides, such as the Bedok Canal and the Siglap Canal, will see high water levels even in the absence of rain.

Climate change vulnerability and impact in Singapore are as follows.

- According to the IPCC (2007), the projected temperature rise by the end of the century in Singapore is 2.5° C, with a range of 1.7 ~ 4.4 (ADB 2009). Changes in annual precipitation for Singapore may range from -2% to + 15%, with a median of about + 7% per cent.
- In this country, extreme rainfall and winds associated with tropical cyclones are likely to increase.
- Sea level rise in Singapore is likely to be close to levels of global concern. Increased coastal erosion has already affected some areas.

Responses by Singapore

Through concerted efforts, careful land development planning, and a comprehensive and continuous drainage improvement program, flood prone areas have been greatly reduced from about 3,200 hectares in the 1970s to about 40 hectares today. This is despite increased urbanization, which would usually result in increased flooding.

The Singapore Meteorological Service is in charge of the NEA (National Environment Agency). Currently, the NEA issues the following products and provides various services:

- weather forecasts,
- information on air pollution,
- lightning affected regions,
- rainfall affected regions,
- wind and tide information,
- flood information, and
- earthquake information.

For now, the terms of forecast include 3-hour, 12-hour, 3-day, and weekly forecasts.

Sources of Hazard and Risk Information

Table 2.10 Sources of Hazard and Risk Information: Cyclone and Other Meteorological Hazards

National Environment Agency (NEA) (Ministry of the Environment)
http://app2.nea.gov.sg/ TEL: +65 1800-225 5632 Email: contact_nea@nea.gov.sg

Table 2.11 Other Sources of Information: Cyclone and Other Meteorological Hazards

Institution	Literature name
Economy and Environment Program for Southeast Asia (2010)	Climate Change Vulnerability Mapping for Southeast Asia http://css.escwa.org.lb/sdpcd/1338/d2-5a.pdf
UNISDR (2010)	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment http://www.unisdr.org/files/18872_asean.pdf

Reports on Hazard and/or Risk Assessment

"Cyclone" is a term to describe many types of low pressure systems, of which tropical cyclones/typhoons are the main types creating disasters in the ASEAN region. Leading countries implement monitoring and detecting tropical cyclones on a regional basis under the framework of WMO. Table 2.12 indicates the responsible territory allocated to ASEAN members and its leading country.

Table 2.12 Members of WMO Tropical Cyclone Committee

	Warning Zones	Members (ASEAN)	Leading Country
Western North Pacific Ocean and South China Sea	0° - 60°(N) 0° - 100°(E)	Cambodia, Lao PDR, Malaysia, Philippines, Singapore, Thailand, Vietnam	Japan
Bay of Bengal and the Arabian Sea	5°S - 45°(N) 30°E - 90°(E)	Myanmar, Thailand	India
South Pacific and South-East Indian Ocean	0°-50°(S) 90° - 170°(E)	Indonesia	Fiji

The dates and information utilized in this report have been acquired from various reports on the studies and research conducted on tropical cyclones and meteorological hazards published on the internet. Collected documents include evaluation results of hazards/risks, as well as their evaluation methods. With regard to tropical cyclones/typhoons, a meteorological organization of each country compiles a summary on the damage situation, including the number of casualties or loss of human lives, and the estimated amount of damage, etc.

Locations of existing investigations and studies on cyclone and other meteorological hazard are shown in Figure 2.2. Outline of those investigations and studies are attached in Appendix 2 and their summary is given in Table 2.13.

Table 2.13 Summary of Existing Investigations and Studies: Cyclone and Other Meteorological Hazards

Country/Region	Summary of Existing Studies and Reports
ASEAN	Study reports on natural disasters in the whole ASEAN region are available.
Singapore	There is no indication of tropical cyclones or meteorological hazards.

References for Data and Further Reading

- 1) National Environment Agency (Singapore). Annual Weather Review 2011 (http://app2.nea.gov.sg/annual_review_new.aspx)
- 2) National Environment Agency (Website): <http://app2.nea.gov.sg/weather-climate/meteorological-services-singapore/meteorological-services>
- 3) PUB, Singapore's National Water Agency <http://www.pub.gov.sg/managingflashfloods/Pages/default.aspx>
- 4) WMO National Meteorological or Hydrometeorological Services of Members (http://www.wmo.int/pages/members/members_en.html)
- 5) WMO (2010). First Meeting of the Task Team on "Meteorological, Hydrological and Climate Services for Improved Humanitarian Planning and Response", WMO Headquarters, Geneva, Switzerland (31 August - 2 September, 2010)

2.7 Landslides

Risks

The risk of landslide disaster in the country is low. A landslide in 2007 occurred along a development for residences and caused no fatalities.

Reports on Hazard and/or Risk Assessment

Locations of existing investigations and studies on landslide are shown in Figure 2.2. Outline of those investigations and studies are shown in Appendix 2 and their summary is given in Table 2.14.

Table 2.14 Summary of Existing Studies and Reports by Country: Landslide

Country/Region	Summary of Existing Studies and Reports
ASEAN	There have been a few reports that study landslides for ASEAN and the Pacific region at large in recent years. Disaster risks are assessed by scenario, exposure, vulnerability, damage, and loss. An assessment framework is also sought to give an overview of risks, hazard, and vulnerability.
Singapore	There is no record of or assessment on landslides in Singapore.

References for Data and Further Reading

- 1) Economy and Environment Program for Southeast Asia (EEPSEA) (2009): "Climate Change Vulnerability Mapping for Southeast Asia", p. 19
- 2) World Bank, UNISDR (2010). Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment

3. Industrial Parks

3.1 Distribution of Industrial Parks in Singapore

75 industrial parks were identified by the study, and their distribution on the Island is shown in Figure 3.1.

A list of the industrial parks in Singapore is given in Appendix 3, and a brief description of the selected industrial parks is given in reference².

Public information on Singapore's industrial estates is readily available, but often lacking detail, especially for older and government-owned estates. Information on ownership structures, park history, number and type of buildings, tenant businesses, and future development plans can be hard to find. Relevant government agencies are willing to provide such information and support foreign investors when contacted. In contrast, detailed information is readily available for privately-owned and publicly-listed industrial estates. Detailed information on these parks is available on their websites and from their marketing teams, who are well-prepared to support incoming investors.

² AHA Centre and JICA (2014), Risk Assessment Reports for ASEAN and its Countries, Natural Disaster Risk Assessment and Area Business Continuity Plan Formulation for Industrial Areas in the ASEAN Region.



Figure 3.1 Distribution of Industrial Parks in Singapore

3.2 Historical Evolution of Industrial Parks

Industrial estate development in Singapore began in the 1960s. Initially, industrial estate planning was conducted through designated government agencies. The Economic Development Board brought in FDI and the state-owned JTC Corporation, Singapore's largest industrial landowner and developer, handled implementation. Today, JTC continues to own a significant share of industrial estates; the rest is shared between another government body, the Housing and Development Board, and the private sector.

In the early stages of industrial park development, the government was focused on estates dedicated to labor-intensive, export-oriented production, which corresponded with the economic realities of 1960s Singapore. Larger estates, like Jurong, occupied suburban and rural parts of the island, while light industrial parks operated within the limits of different urban centers. Due to environmental concerns and policy efforts to develop key industries, namely the petroleum petrochemical industries, in the 1970s, Singapore saw the formation of industry-specific and small industry clusters.

Over the next 20 years, Singapore transitioned towards more higher-end, capital intensive industries. JTC's Jurong Island (petrochemical), One North (biomedical), and Singapore Science Park (R&D) were all examples of new specialized science and business parks. The JTC Corporation also initiated land reclamation projects with emphasis on environmental preservation and plot optimization. New stack-up factories replaced low plot ratio buildings, and infrastructure developments sought to attract high value-added companies, in order to achieve steeper land productivity growth.

By the end of the 1990s, the industrial and service sectors were becoming equally important to Singapore's economy. Technology-intensive industries migrated to new business and science clusters situated in high-density urban areas, which offered abundant amenities, business services, and easy access to infrastructure. The concept of the knowledge-based industrial estate offered a modern "work-live-play-learn" environment, where high-tech enterprises could concentrate on knowledge creation and its practical implementation. Today, JTC conducts next-generation land intensification, commercialization and optimization. Besides building multi-story factories and designing offshore floating storage facilities, JTC is

also introducing East Asia's first underground liquid hydrocarbon storage facility, where applications of technological innovation meets strategic economic planning.

Manufacturing remains Singapore's economic powerhouse, with the chemicals, electronics, and the fast-growing precision engineering clusters at the top. Physical sciences, engineering, and ICT clusters are also growing. A second phase of divestment in 2011 of ready-built properties to private developers underlined the government's commitment to a diverse and competitive industrial estate market. In addition, land for industrial and commercial use is projected to increase from 13%-17% in the next 20 years.

3.3 Recent Trends and Japanese Investment

As one of the world's biggest oil-refining bases, Singapore attracted Japanese investment in petrochemical complexes as early as 1961 (Cosmo Sekiyu Co. Ltd.). In the 1970s, Japanese FDI in Singapore centered on labor-intensive, assembly production. By the mid-1980s, Japanese textile companies and other labor-intensive manufacturers withdrew from Singapore due to wage increases. The push for the development of capital intensive, high technology industries at this time attracted Japanese investors to the computer sector. After the 1985 Plaza Accord, Japanese FDI in Singapore's manufacturing sector increased by 34% over a five-year period. However, much of this was offset by Japanese tax reforms in the early 1990s, which saw companies like Sony, Toshiba, and Fujikura exit Singapore to avoid taxation on foreign subsidiaries at home.

Singapore's upgraded infrastructure, human capital base, and manufacturing facilities later attracted Japanese automakers like Isuzu (1996), Toyota (2001), and Nissan (2005). However, as a percentage of total FDI into Singapore, Japanese investment in manufacturing continued to decline, especially after the 1997 Asian Financial Crisis. As of 2011, manufacturing was the third largest share of Japanese FDI into Singapore, after retail trade and financial services. Incorporation of Japanese manufacturing companies also declined from 800 in 1997 to 197 in 2012. Dropping from USD 4.5billion in 2011, Japanese FDI into Singapore amounted to USD 1.5 billion in 2012, USD 967 million of which was invested in manufacturing and services.

4. Transport Infrastructure and Lifeline Utilities

4.1 Overview of Transport Infrastructure

Road

In Singapore, construction management of all public roads from the expressway to district roads is under control of the Land Transport Authority (LTA) affiliated with the Ministry of Transportation. The total length of the public road network is 3,356 km. 161 km of the expressway and other major road networks cover all of the country.

The expressway in Singapore is not highway but expressway. There are 9 expressways, which are called AYE, BKE, CTE, ECP, KPE, KJE, PIE, SLE, and TPE. (Incidentally, AYE represents Ayer Rajah Expressway)

Major road networks of Singapore are shown in Figure 4.1.

Railway

The mass transport system is indispensable since five (5) million people live in the island which is the size of Awaji Island. An underground railway called MRT, together with buses and taxi services is used as mass transport systems.

MRT networks are shown in Figure 4.1.



Figure 4.1 Major Road and Railway Networks of Singapore

Port

The Port of Singapore is a base port of the city state which has population of approximately five (5) million people. It is an international hub port since it is located at the entrance of the Strait of Malacca, which connects the Pacific Ocean to Indian Ocean.

Container throughput as of 2009 is 2,587 TEUs, which is largest amount in the world. Facilities are operated and managed by the Port of Singapore Authority (PSA). 80% of throughput consists of transit shipment.

Table 4.1 Container Throughput by Year

Item	2006	2007	2008	2009
Number of Entering vessels	128,922	128,568	131,695	130,575
Entering vessels (thousand Gross Tons)	1,314,990	1,459,221	1,621,065	1,784,669
Throughput (thousand TEUs)	448,504	483,616	515,415	472,300
Container Throughput (thousand TEUs)	24,792	27,935	28,918	25,867

Source: The Council of Local Authorities for International Relations (CLAIR), Japan, Port and Airport in the Policy of Singapore

Table 4.2 Container Terminals in Port of Singapore

Terminal Name	Berth Length (m)	Number of Berths	Maximum Depth (m)
Tanjong Pagar	2,300	8	-14.8
Keppel	3,200	14	-15.5
Brani	2,600	9	-15.0
Pasir Panjang	7,900	23	-16.0
Total	16,000	54	

Source: PSA

Location of the Port is shown in Figure 4.2.



Figure 4.2 Major Port and Airports of Singapore

Airport

Changi Airport is the only international airport in Singapore, which opened in 1981 as a 24-hour airport. Currently, more than 80 airlines provide services at the Changi Airport, which is the world's leading hub airport and is getting larger year by year. In 2010, the number of passengers exceeded 40 million for the first time.

The Changi Airport Group (GAG) is responsible for the management of airports and business expansion to overseas markets.

Location of the airport is shown in Figure 4.2.

4.2 Overview of Lifeline Utilities

Electricity

Electricity and gas services were managed by the Public Utilities Board (PUB), which was established in 1965. However, the Energy Market Authority (EMA) took over its responsibility in 2001.

After the market liberalization around 2000, the Singapore Electricity Pool was adopted. This introduced the principle of competition among the three power companies (Tuas Power, Senoko Power, and Power Seraya), the Ministry of the Environment (ENV), and Independent Power Producers (IPP).

Locations of major power stations and Dams are shown in Figure 4.3.

Table 4.3 Electricity Generating Capacity

Electric Company	Generation Capacity (thousand kW)
Tuas Power	2670
Senoko Power	2635
Power Seraya	2700
SembCorp Cogen	785
Keppel Merlimau Cogen	500
Others	29.1

Source: Japan Petroleum Energy Center, JPEC Report 2011



Figure 4.3 Major Power Stations Dams of Singapore

Water Supply

The Public Utilities Board (PUB), which is under the jurisdiction of the Ministry of the Environment and Water Resource (MEWR), is responsible for water resource development and management.

Water supply and demand forecast in Singapore are shown as follows.

Table 4.4 Water Demand and Supply Forecast by PUB Long Term Water Plans

		2010	2060
Total Demand (per day)		1,730,000m ³	3,460,000m ³
	Household	45%	30%
	Others	55%	70%
Water Reuse		40%	80%
	NE water	30%	50%
	Desalination	10%	30%

Source: The Council of Local Authorities for International Relations (CLAIR), Japan, Water Supply and Sanitation in the Policy of Singapore

Currently, the total length of water supply pipes is 7,000 km, and the water supply service rate is 100%. Water resources in Singapore come from “four national taps”, which are 1) water from local catchments, 2) imported water from Johor, 3) reused water called NEWater, and 4) desalinated water.

The target amount of water use is 155 liters per capita per day in 2020, and it is planned to be reduced to 147 liters in 2020.

Sewerage

The sewer system of Singapore adopts separate systems for waste water and rainwater. Waste water is conveyed through a network of gravity sewers, and rainwater is collected separately by drainage systems and discharged to rivers or reservoirs. Currently, the sewerage service area is 100%.

Waste water is collected through 3100 km of sewer pipes with 131 pump stations, which have been equipped with 210 km of waste water conveyance pipes.

Singapore has six (6) Water Reclamation Plants (WRPs) as follows: Kranji WRP, Jurong WRP, Ului Padan WRP, Seletar WRP, Kim Chuan WRP, and Bedok WRP.

The government has been developing the New Deep Tunnel Sewerage System (DTSS) in order to conduct efficient sewer treatment. The system consists of two (2) large, deep tunnels crisscrossing the island, two centralized water restoration plants, deep sea outfall pipes, and sewer link networks.

Communications

Internet and Broadband

As of March 2012, DSL holds about 45% of the broadband market share, and cable broadband holds 55%, making them nearly equal. The optical-fiber-based NGNBN covers about 83%, and the number of subscribers amounts to 100,000. The number of broadband subscribers is 1.323 million as of 2011, and the diffusion rate is 25.5%.

Mobile Phone

As of March 2012, SingTel holds about 50% of the market, and Starhub and M! each hold 25% of the rest. The number of subscribers to 3G service is 5.92 million (79% of the total mobile phone subscribers). The number of subscribers to mobile phone is 7.755 million as of 2011, and the diffusion rate is 149.5%, which means 1.5 mobile phones per one person.

Fixed-line Phone

The number of subscribers of fixed-line phones has shown a decreasing trend every year. The number of subscribers to fixed-line phones is 2.017 million as of 2011, and the diffusion rate is 38.9%.

Broadcasting

The Terrestrial Broadcasting Service is monopolized by the Media Corp Group, which provides seven (7) channels (English, 2 Chinese, Malay, Tamil and 2 English news). Direct-wave reception of satellite broadcasting is prohibited. Cable television service is monopolized by Starhub, and the number of subscribers is 541,000 as of September 2012.

Waste

Singapore aims to attain living conditions appropriate for the so-called “Garden City” and prioritizes environmental measures. The Ministry of the Environmental Water Resource (MEWR) is responsible for waste management.

The MEWR has worked out the Singapore Green Plan 2012 and aims to achieve a sustainable society. As for waste, it has set a target to increase the recycle ratio of waste from 44% to 60%, and increase the life of landfill disposal sites by decreasing the amount of waste to eliminate landfill disposal sites in the future.

Due to economic development, the amount of waste is increasing yearly. The basis for waste disposal is incineration. 90% of the waste that can be incinerated is burned at the four (4) incineration facilities, and the remaining 10% of the waste is disposed of in landfills. The disposal sites have been moved from the main island to the sea. Semakau Landfill Site, which is located 8 km south off the main island, is in operation and will become an island of 350ha in 2045.

Table 4.5 Amount of Waste Disposal per day by Year (Tons)

Year	2005	2006	2007	2008	2009
Industrial	3,099	3,021	2,928	3,122	3,032
Household	3,883	4,002	4,104	4,057	4,172
Total	6,982	7,023	7,032	7,179	7,203

Source: The Council of Local Authorities for International Relations (CLAIR), Japan, Environment in the Policy of Singapore

4.3 Natural Disasters and Infrastructure

In Singapore, although there are storm rainfalls caused by the north-east monsoon during the rainy season (November to March), natural disasters rarely hit Singapore. If anything, prevention measures for human-induced disasters resulting from urbanization should be taken.

5. Legislative Systems

5.1 Legislative Systems for Disaster Management

Disaster Management Laws

Table 5.1 Laws and Regulations of Disaster Management in Singapore

	Laws / Regulations	Supervisory Authority	Matter
<i>Law</i>	Civil Defense Act, 1936	Ministry of Home Affairs	General Disaster
<i>Law</i>	Civil Defense Shelter Act, 1997	Ministry of Home Affairs	General Disaster
<i>Law</i>	Fire Safety Act, 1986	Ministry of Home Affairs	Fire

No comprehensive disaster management law exists, only individual laws by disaster. These are the Fire Safety Act (1986) and Environmental Pollution Control Act (2002). In relation to emergency response, there is the Civil Defense Act (1986) and Civil Defense Shelter Act (1997).

Disaster Management Strategies and Plans

Table 5.2 Strategies and Plan for Disaster Management in Singapore

	Laws / Regulations	Supervisory Authority	Matter
<i>Plan</i>	Operations Civil Emergency (Ops CE) Plan	Ministry of Home Affairs, SCDF	Emergency
<i>Plan</i>	National Tsunami Response Plan	Ministry of Home Affairs, SCDF	Tsunami

Singapore has an Operation Civil Emergency (Ops CE) Plan, which is a national contingency plan.

The National Tsunami Response Plan has also been developed, and establishment of an early warning system is discussed in this plan.

5.2 Regulations and Standards for Business Continuity Management

Table 5.3 Regulations, Standards or Guidelines for BCM/BCP in Singapore

	Laws / Regulations	Supervisory Authority	Matter
<i>Standard</i>	Singapore Standard 540:2008 (SPRING: Singapore productivity and innovation)	Business Continuity Management Technical Committee	BCP
<i>Standard</i>	Singapore Standard 507:2004 (SPRING: Singapore productivity and innovation)	SPRING Singapore, Ministry of Trade and Industry	BCP
<i>Guideline</i>	MAS Business Continuity Management Guidelines, June 2003	Monetary authority of Singapore	BCP
<i>Guideline</i>	MAS Consultation Paper On Business Continuity Planning (BCP) Guidelines, 2003	Monetary authority of Singapore	BCP
<i>Guideline</i>	Guidelines for Company Emergency Response Plan	Ministry of Home Affairs, SCDF	Business Contingency
<i>Guideline</i>	Business Continuity Management Requirements for SGX members	Singapore Exchange	BCP

SPRING (Standards, Productivity, and Innovation Board) Singapore is the governmental board under the Ministry of Trade and Industry, and it is in charge of standardization and the development of product quality in Singapore. The Singapore Standards 540 introduces the BCM framework and indicates the direction of BCM establishment in industries. The Singapore Standards 507 also indicates providers of business continuity and disaster recovery services.

The MAS Business Continuity Management Guidelines issues principles on senior management responsibilities for BCM. The MAS Consultation Paper on BCP Guidelines was developed in order to encourage the adoption of BCP practices by financial institutions in Singapore.

5.3 Legislative Systems for the Environment and Pollution Control

Environmental Laws and Regulations

Laws and regulations for the environment are stated in Pollution Control Laws and Regulations introduced in the next section. In Singapore, law and regulations for the environment are based on the same laws regarding pollution control.

Pollution Control Laws and Regulations

Table 5.4 Laws and Regulations for Environmental Pollution Control in Singapore

	Laws / Regulations	Supervisory Authority	Matter
<i>Law</i>	Environmental Pollution Control Act, 2002	National Environment Agency	Environment
<i>Regulation</i>	Environmental Pollution Control (Trade Effluent) Regulations	National Environment Agency	Industrial Effluent
<i>Regulation</i>	Environmental Pollution Control (Air Impurities) Regulations	National Environment Agency	Air Pollution
<i>Regulation</i>	Environmental Pollution Control (Hazardous Substances) Regulations	National Environment Agency	Industrial Waste
<i>Law</i>	Environmental Public Health Act	under survey	Environment
<i>Regulation</i>	Environmental Public Health (Toxic Industrial Waste) Regulations	under survey	Industrial Waste
<i>Law</i>	Sewerage and Drainage Act	Public Utilities Board	Industrial Effluent
<i>Regulation</i>	Sewerage and Drainage (Trade Effluent) Regulations	Public Utilities Board	Industrial Effluent

The laws and regulations concerning the environment and environmental pollution prevention in Singapore are mainly prescribed by the statute of Environmental Pollution Control Act of 2002 and the Environmental Public Health Act. By each statute, regulations are defined regarding individual environmental pollution factors including, industrial wastewater regulations, air pollution regulation, regulations about toxic substance management, and regulations about industrial waste management.

Moreover, there is also regulation provided by the Sewerage and Drainage Act.

5.4 Legislative Systems for Development including Land Use, Rivers, and Building Code in Singapore

Table 5.5 Laws and Regulations for Land, Rivers, and Building Code in Singapore

	Laws / Regulations	Supervisory Authority	Matter
<i>Law</i>	Planning Act, Chap.232, 1998	Ministry of National Development	Development
<i>Law</i>	Land Acquisition Act, Chap.152, 2007	under survey	Land Acquisition
<i>Law</i>	Building Control Act, Chap.29, 2007	Building & Construction Authority, Ministry of National Development	Building Standards
<i>Regulation</i>	Building Control Regulations, 2007	Building & Construction Authority, Ministry of National Development	Building Standards

The regulations relevant to the land use concerning development are defined in the Planning Act, Chap. 232, of 1998. Moreover, the legal system about land expropriation is specified in the Land Acquisition Act, Chap.152-2007.

Building Control Act of 2007 defines regulations about construction standards in Singapore and the standards for ensuring building safety are shown. In the law, regulations about environmental maintenance (Environmental Sustainability) in building construction are also specified.

6. Implementation of BCP

Standards and guidelines for the development of BCP among the financial institutes such as banking companies are established by the governmental monetary authorities. Moreover, by the Singapore Standards, the standards for BCP development in general companies are also established.

Information about the actual condition of development of BCP and effort to disperse the BCP among companies in Singapore are not sufficiently disclosed in the internet. The on-site surveys and interviews of institutions concerned are required.

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Appendix 1:

Method for Evaluating Predominant Hazards

The "Damage Amount / GDP" and "Number of Deaths" are used as the indices to show the impacts of the disasters considered and 6 natural hazards will be studied and compared. At the beginning of the study, only the "Damage Amount / GDP" was used as an index because the results can be used for Area BCP planning. However, the scarcity of information related to damage amounts became clear as the study progressed. As the information on the "Number of Deaths" is substantial compared to the damage amount, the "Number of Deaths" has been added as an index of impact.

The process of the study is as follows;

- 1) Based on the Damage Amount / GDP or Number of Death, each disaster is classified according to the ranking system outlined in Table A1.
- 2) The number of disaster events for each country is added by type of hazard and disaster rank, and then classified into Table A2 below,
- 3) The above information is then plotted on the impacts - frequency matrix by country,
- 4) As for earthquakes, tsunamis and volcanic hazards, if an event occurred before 1983 that was of the same (or higher) disaster rank as the maximum disaster rank recorded between 1983 to 2012, a point is plotted on the matrix which corresponds to the relevant disaster and frequency rank (=1).

Table A1 Disaster Rank and Damage

Disaster Rank	Damage Amount / GDP ³	Number of Death
5	1.0% -	10,001 -
4	0.1% - 1.0%	1,001 - 10,000
3	0.01% - 0.1%	101 - 1,000
2	0.001% - 0.01%	11 - 100
1	- 0.001%	- 10

³ Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP, International Monetary Fund, World Economic Outlook Database, October 2012

Table A2 Frequency Rank and Number of Events

Frequency Rank	Number of Events from 1983 to 2012	Average Frequency (Events / Year)
5	7 or more	1/5 -
4	4 to 6	1/10 - 1/5
3	2 to 3	1/15 - 1/10
2	1	1/30
1	Large Events occurred before 1983	-

Appendix 2:

Data Sheets

Outline of Existing Investigations and Studies

No.:	FL-001	Published Year:	2010
Study/ Report Name:	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment		
Access to Information:	www.unisdr.org/files/18872_asean.pdf		
Research Organization:	UNISDR/World Bank		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Flood		
Main Data Sources:	CRED EM-DAT, ADRC, NGDC, GSHAP, MRC, WAMIS, DWR, Munich Re, World Bank, UNISDR, GAR, In Terragate, IFNet, CCFSC, DESINVENTAR		

Summary of the Study:

1) Overview

Disaster risks are assessed for years (1970-2009) by 1) Scenario, Exposure, Vulnerability, Damage and Loss analysis using existing database. The dominant disaster risks are cyclonic storms (typhoons), earthquakes, tsunamis, floods, epidemics, landslides, droughts volcanic eruptions and forest-fires. In total 1,211 reported disasters caused over 414,900 deaths.

2) Vulnerability

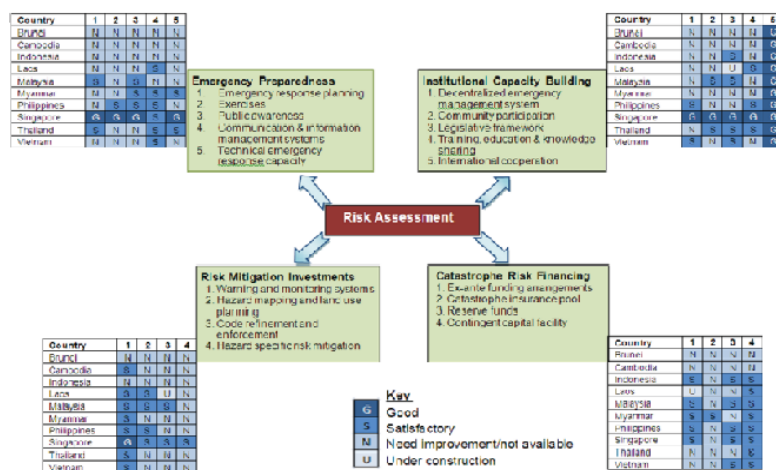
Method: the number of disaster events, deaths, affected population and economic losses are plotted against hazard types for 5 year intervals.

To estimate social vulnerability=> the average number of people killed.

ASEAN 17.7 death/year/million, Cambodia 3.56, Indonesia 20.38, Lao PDR 4.22, Malaysia 1.26, Myanmar 72.35, Philippines 11.93, Thailand 4.63, Vietnam 4.60. Brunei and Singapore have no data.

3) Risk assessment framework

A status of risk assessment framework is assessed by country to view the current capacity of risk assessment. The evaluation table is show below.



No.:	FL-003	Published Year:	2010
Study/ Report Name:	Progress Report on Flood Hazard Mapping in Asian Countries ICHARM Publication No.16, ISSN 0386-5878/ Technical Note of PWRI No. 4164		
Access to Information:	http://www.icharm.pwri.go.jp/publication/pdf/2010/4164_progress_report_on_fhm.pdf		
Research Organization:	UNESCO (ICHARM)/PERI		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Hazard Map		
Main Data Sources:			

Summary of the Study:

1) Overview

This is a seminar report on Flood Hazard Mapping production process for Asian Countries. Target countries were (China, Cambodia, Indonesia, Laos, Vietnam, Thailand, the Philippines and Malaysia).

2) Accuracy of Hazard Map

Two types of mapping methods are: i) interview based mapping (community-based), ii) quantitative hydrological data simulation models.

For the local usage, a simpler version is also effective. Examples of practical hazard maps are demonstrated as follows.

Map without inundation area

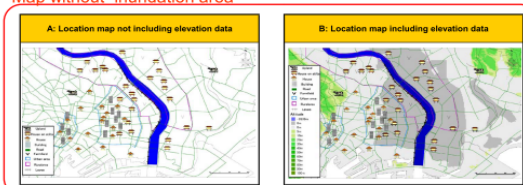


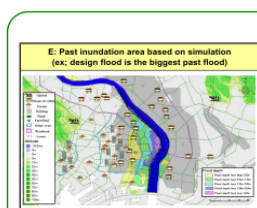
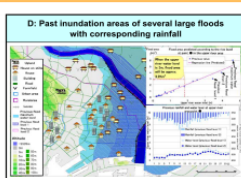
Table 3-2 List of Maps according to the level

Map showing past inundation areas

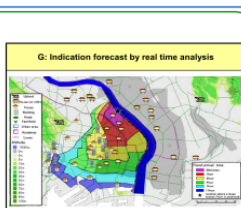
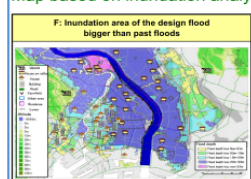


Map without inundation analysis but including past inundation area

Map predictable inundation area



Map based on inundation analysis



No.:	FL-004	Published Year:	2005
Study/ Report Name:	A Primer: Integrated Flood Risk Management in Asia 2		
Access to Information:	www.adpc.net/maininforesource/udrm/floodprimer.pdf		
Research Organization:	Asian Disaster Preparedness Center (ADPC)/UNICEF		
Study Area (Country):	Asia including ASEAN countries		
Studied Hazard:	Flood		
Studied Damage/ Risk:	Assessment method		
Main Data Sources:			
<p>Summary of the Study:</p> <p>This is a comprehensive and practical how-to-handbook for policy makers and implementation stakeholders of flood risk management in Asia, with updated resources to (1) authorize programs; (2) formulate decisions; (3) plan, develop and implement decisions; (4) support implementation of decisions. There are extensive glossaries of words and concepts in relation to flood risk management.</p> <p>Topics include:</p> <p>Chapter 2: Types and levels of flood: riverine flood, slow-onset, rapid-onset, normal flood (1 year flood), catastrophic flood (100 year flood). Causes of flood: meteorological, hydrological and anthropogenic.</p> <p>Chapter 3: Policies, legal and institutional arrangement plans:</p> <p>Chapter 4: Flood risk assessment, data required for an assessment of potential damages and losses, Flood frequency calculations</p> <p>Chapter 5: Importance of watershed and floodplain management for flood risk management</p> <p>Chapter 6: Structural interventions: flood storage reservoir, dykes, levee and embankment, EIA, cost benefit analysis</p> <p>Chapter 7: Flood-proofing measures, relocation, elevation, dry-flood proofing, wet-flood proofing, flood-proofing measures categories: permanent, contingent and emergency measures</p> <p>Chapter 8: Flood preparedness planning: preparedness framework, activities, flood forecasting, public awareness</p> <p>Chapter 9: Effective emergency response in environment health management, evacuation camps, delivery of goods</p> <p>Case studies of ASEAN countries include:</p> <p>Disaster Management and Relief in Malaysia,</p> <p>Hazard Assessment in the Philippines,</p> <p>Flood mitigation mix measures/community level management in Thailand,</p> <p>Mekong River Commission Mediation of Transboundary Flood Issues</p>			

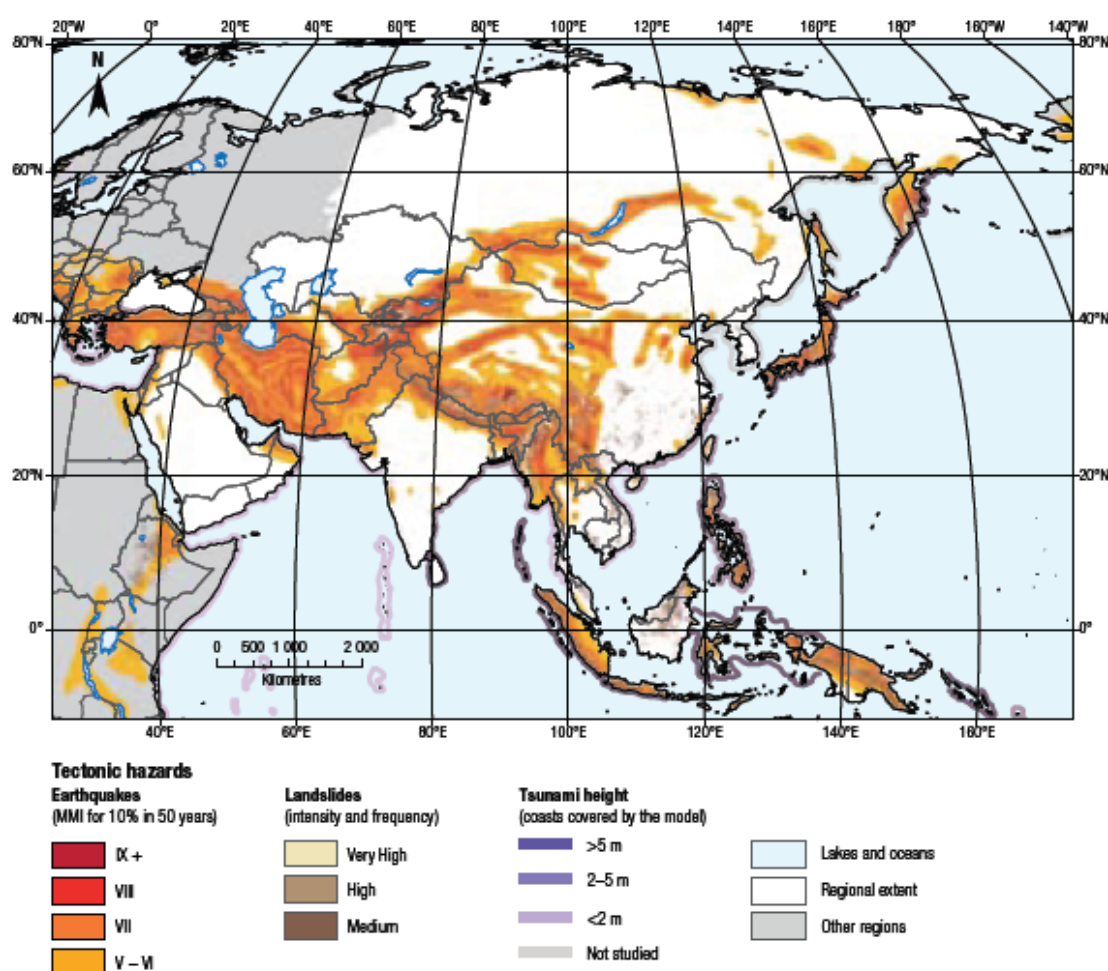
No.:	FL-006	Published Year:	2012
Study/ Report Name:	Reducing Vulnerability and Exposure to Disasters The Asia-Pacific Disaster Report 2012		
Access to Information:	http://www.unisdr.org/we/inform/publications/29288		
Research Organization:	ESCAP/UNISDR		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Hydro-meteorological Hazard		
Studied Damage/ Risk:	Economic losses, fatalities, houses, risk-sensitive plans of investment		
Main Data Sources:			
Summary of the Study:			
1) Overview			
<p>The Asia-Pacific region represents 75% of all global disaster fatalities. The economic and population growth contribute to a greater exposure to natural disasters. The population was doubled from 2.2 to 4.2 billion between 1970 and 2010. But the number of people who are exposed to flooding has increased from 29.5 to 63.8 million. The urban settlements are more vulnerable as the urban population increased from 17 to 44% of the total population between 1950 and 2010.</p>			
2) Vulnerability			
<p>Generally, smaller and less diversified economies are more vulnerable to disaster risks. Flood mortality risks are higher in rural areas with a densely concentrated and rapidly growing population with weak governance.</p>			
3) Risk			
<p>Risks are associated with economic and mortality risks. The exposure to flooding events constantly increases as of 1980 but mortality risks are decreasing as countries strengthened their risk governance capacities. However economic risks are increasing, due to slow adaptation of the existing fixed assets, such as old buildings and infrastructure, and institutional instruments such as land use planning and building regulation to cope with flooding particularly in rapidly urbanizing areas.</p>			
4) Spatial and land use plan			
<p>The national spatial and land use plans and policies are a key to reduce flood risks. Brunei, Indonesia, Lao PDR, Malaysia, Philippines, Singapore and Vietnam have land-use policies, plans or measures for DRR.</p>			

No.:	FL-008	Published Year:	2011
Study/ Report Name:	Advancing Disaster Risk Financing and Insurance in ASEAN Countries: Framework and Options for Implementation, Volume2: Appendix 1		
Access to Information:	https://www.gfdr.org/sites/gfdr.org/files/documents/DRFI_AS_EAN_Appendices_June12.pdf		
Research Organization:	GFDRR/World Bank		
Study Area (Country):	ASEAN (10 countries)		
Studied Hazard:	Flood (multiple disasters)		
Studied Damage/ Risk:	Damage, affected population, vulnerability index		
Main Data Sources:	World Bank, EM-DAT, Relief Web, GFDRR, CIA fact book		
Summary of the Study:			
1) Overview			
Disaster risks were compiled for ASEAN countries with data between 1982 and 2011. The following items are analyzed: disaster profile (% of different disasters), damage (\$), affected population, vulnerability index (estimated number of people killed/year).			
2) Disaster profile: Typhoon is the dominant incidence causing flood and landslide in most countries except Singapore and Brunei			
Cambodia: 45% flood (Mekong river), 9% storm, 16% drought, 29% epidemic			
Indonesia: west and dry zones most severely hit (Jakarta, Medan, Bandug)			
Lao PDR: 50% flood, 22% epidemics, 13% storm, 13% drought			
Malaysia: dominantly flood			
Myanmar: multiple hazards, earthquake serious risk			
Philippines: dominantly typhoons causing other hazards in conjunction			
Thailand: multiple hazard (flood, drought, storms and landslide)			
Vietnam: 49% storm, 37% floods, 5% epidemic, 3% landslide, 2% drought			
3) Vulnerable areas			
Mekong River Delta in Vietnam, all regions of the Philippines, most regions in Cambodia, North ad East Lao PDR, Bangkok in Thailand, the west and south of Sumatra and western and eastern Java in Indonesia.			
4) Vulnerability			
Urban (especially coastal) areas are more vulnerable against disasters due to a rapid population growth, urbanization, deforestation, and unplanned land use.			

No.:	EQ-001	Published Year:	2009
Study/ Report Name:	Global assessment report on disaster risk reduction (2009) Risk and poverty in a changing climate		
Access to Information:	http://www.unisdr.org/we/inform/publications/9413		
Research Organization:	United Nations International Strategy for Disaster Reduction Secretariat (UNISDR)		
Study Area (Country):	Worldwide		
Studied Hazard:	Tropical cyclones, Floods, Landslides, Earthquakes (10% in 50 years MMI), Drought, Tsunamis, Forest and other biomass fires		
Studied Damage/ Risk:	Multi-hazard risk		
Main Data Sources:			

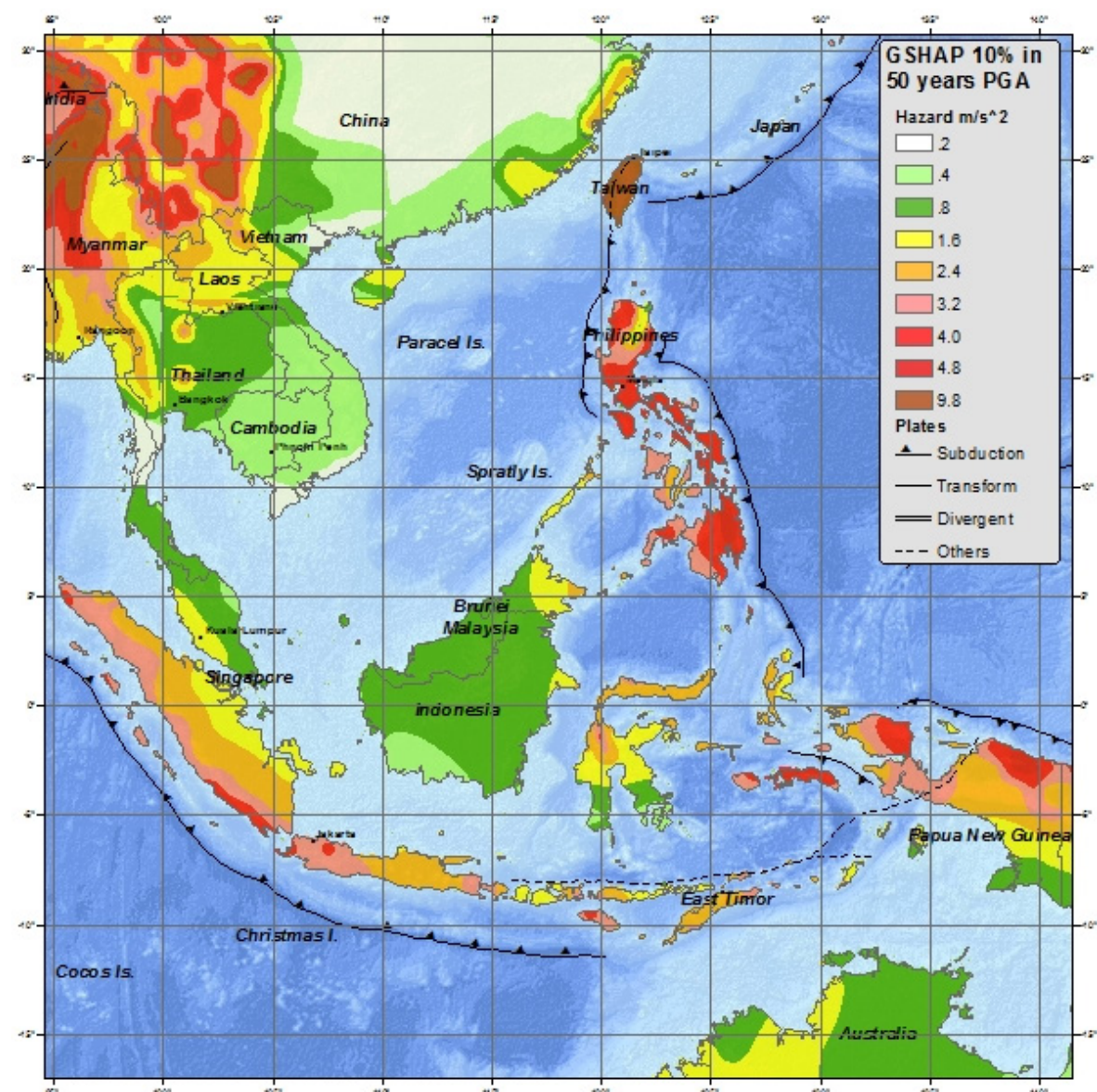
Summary of the Study:

An observation of disaster risk patterns and trends at the global level allows a visualization of the major concentrations of risk described in the report and an identification of the geographic distribution of disaster risk across countries, trends over time and the major drivers of these patterns and trends.



No.:	EQ-002	Published Year:	unknown
Study/ Report Name:	Seismic Hazard Map		
Access to Information:	http://earthquake.usgs.gov/earthquakes/world/indonesia/gshap.php		
Research Organization:	GSHAP, USGS		
Study Area (Country):	ASEAN		
Studied Hazard:	Earthquake / 10% in 50 years		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:



No.:	TN-002	Published Year:	2005
Study/ Report Name:	From Disaster to Reconstruction: A Report on ADB's Response to the Asian Tsunami		
Access to Information:	http://www.adb.org/publications/disaster-reconstruction-report-a-dbs-response-asian-tsunami		
Research Organization:	Asian Development Bank		
Study Area (Country):	ASEAN		
Studied Hazard:	Tsunami		
Studied Damage/ Risk:			
Main Data Sources:			

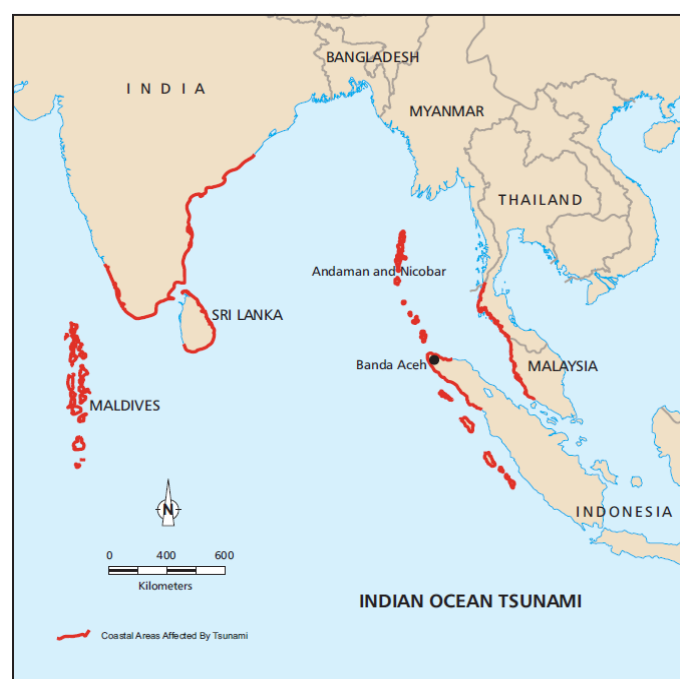
Summary of the Study:

This report summarizes ADB's response to the earthquake and tsunami during the first year. It highlights major activities, details project components and identifies challenges ahead and lessons learned in responding to this unprecedented regional natural disaster.

Table 1: Tsunami Losses

Country	Number of			Estimated Overall Damage (\$ billion)
	Dead	Missing	Displaced/ Injured	
India	12,405	5,640	6,913	2,560
Indonesia	131,029	37,000	556,638	4,500
Maldives	82	26	29,577	0.472
Sri Lanka	35,322		516,150	1,000
Thailand	5,395	2,817	54,500	0.711

Sources: Government of India: United Nations Development Programme; Government of the Maldives: Government of Sri Lanka; UN Resident Coordinator, Thailand.

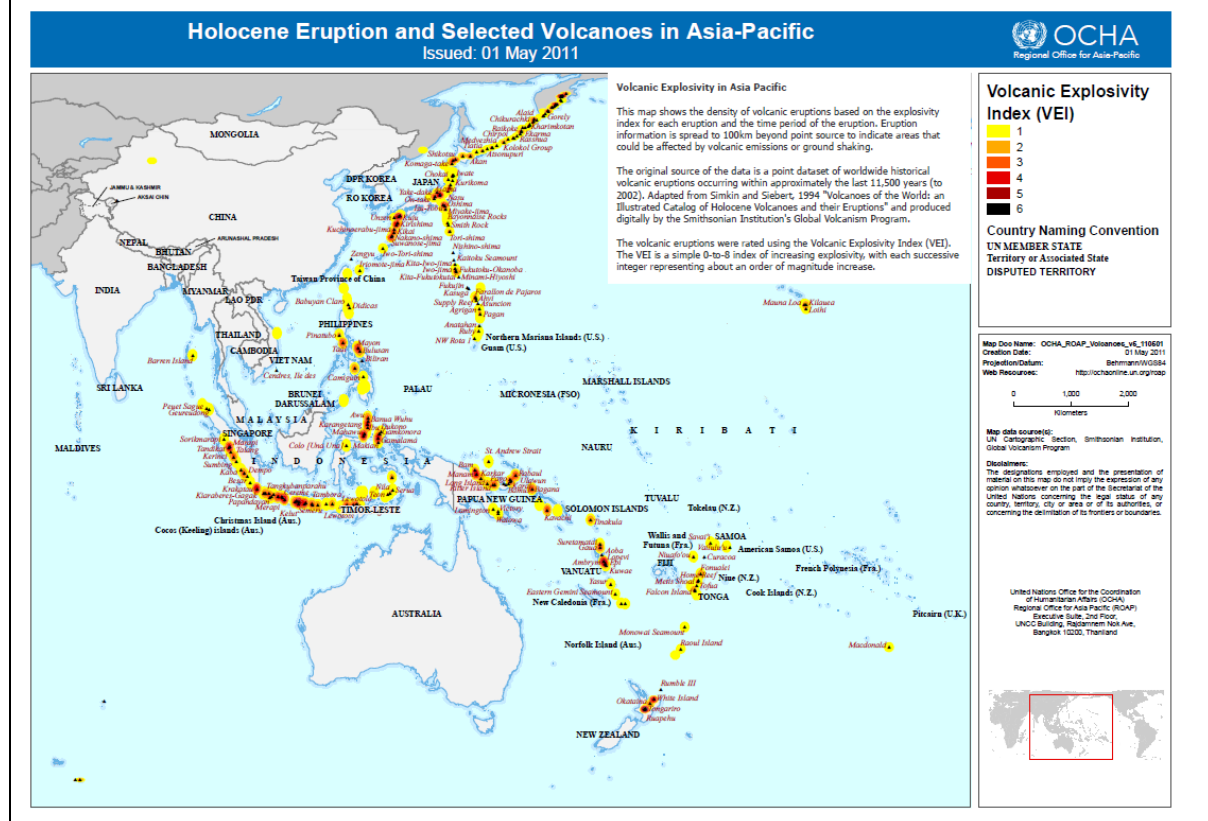


No.:	VE-001	Published Year:	2011
Study/ Report Name:	Holocene Eruption and Selected Volcanoes in Asia-Pacific		
Access to Information:	http://reliefweb.int/sites/reliefweb.int/files/resources/map_619.pdf		
Research Organization:	United Nations Office for the Coordination of Humanitarian Affairs, Regional Office for Asia Pacific (OCHA -ROAP)		
Study Area (Country):	Asia-Pacific		
Studied Hazard:	Volcanic Explosivity Index (VEI)		
Studied Damage/ Risk:			
Main Data Sources:	UN Cartographic Section, Smithsonian Institution, Global Volcanism Program		

Summary of the Study:

This map shows the density of volcanic eruptions based on the explosivity index for each eruption and the time period of the eruption. Eruption information is spread to 100km beyond point source to indicate areas that could be affected by volcanic emissions or ground shaking.

The volcanic eruptions were rated using the Volcanic Explosivity Index (VEI). The VEI is a simple 0 to 8 index of increasing explosivity, with each successive integer representing about an order of magnitude increase.



No.:	LS-006	Published Year:	2010
Study/ Report Name:	Synthesis Report on Ten ASEAN Countries Disaster Risks Assessment		
Access to Information:	http://www.unisdr.org/files/18872_asean.pdf		
Research Organization:	UNISDR/World Bank		
Study Area (Country):	An assessment of disaster risks in ten ASEAN countries		
Studied Hazard:	earthquakes, tropical cyclonic storms (typhoons), floods, landslides, tsunamis, droughts, and forest fires.		
Studied Damage/ Risk:	Hazard profile and Risk profile		
Main Data Sources:	CRED EM-DAT, ADRC, NGDC, GSHAP, MRC, WAMIS, DWR, Munich Re, World Bank, UNISDR, GAR, InTerragate, IFNet, and CCFSC, DESINVEN-TAR 1970-2009		

Summary of the Study:

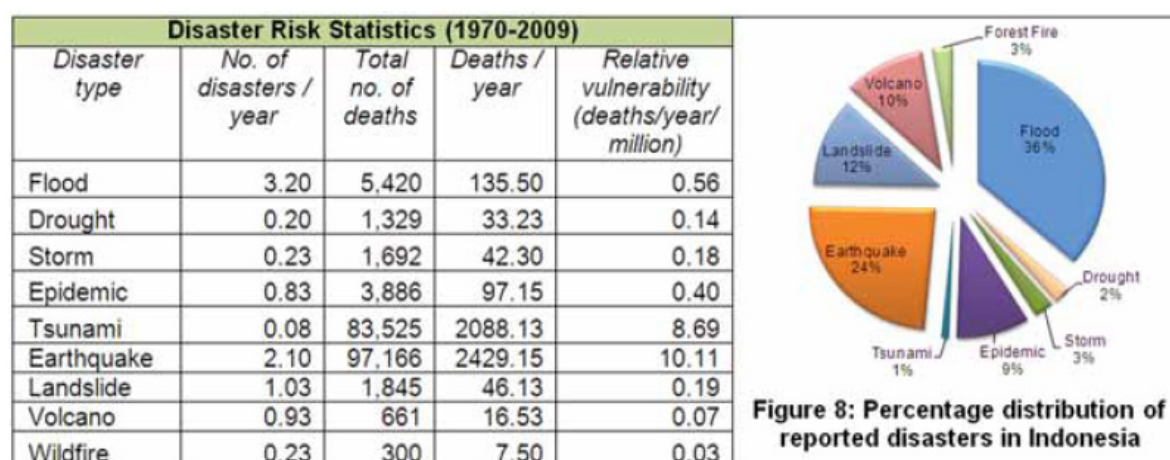
1) overview

This synthesis report on the Ten ASEAN Countries is based on a desk review of existing studies by academia, governments and international governmental and non-governmental organizations. Risk assessments are carried out directly based on recorded historical losses. The economic loss probability estimates presented in this report are not intended for designing catastrophe insurance schemes, which require a much more detailed approach that models hazard, exposure and vulnerability of buildings and infrastructure.

2) landslide and mudslide analysis

Landslide and mudslide analysis data sources are shown in above table (Main Data Sources). The landslide hazard risks maps were derived from the GAR Preview platform (GAR, 2009; <http://previewgrid.unep.ch>), has 10km grid resolution. This report explains overview, Regional setting, Hazard profile and Risk profile of each 10 countries separately.

Assessment sample of Natural disaster (Indonesia)



No.:	LS-007	Published Year:	2005
Study/ Report Name:	Natural Disaster Hotspots:A Global Risk Analysis		
Access to Information:	http://sedac.ciesin.columbia.edu/data/set/ndh-landslide-hazard-distribution/maps		
Research Organization:	World Bank,		
Study Area (Country):	Whole World		
Studied Hazard:	Flood, Landslide, Drought, drought,earthquakes, storms, volcanoes		
Studied Damage/ Risk:			
Main Data Sources:			

Summary of the Study:

1)overview

This study presents a global view of major natural disaster risk hotspots—areas at relatively high risk of loss from one or more natural hazards. It summarizes the results of an interdisciplinary analysis of the location and characteristics of hotspots for six natural hazards. Data on these hazards are combined with state-of-the-art data on the sub-national distribution of population and economic output and past disaster losses to identify areas at relatively high risk from one or more hazards. This study belongs to the project of Global Risk Identification Program (GRIP) by the world bank, which objects a framework which is improved evidence base for disaster risk management to enable the application and prioritization of effective disaster risk reduction strategies at the national, regional and global scales.

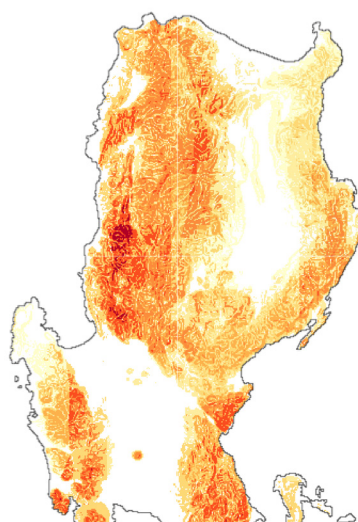
2)

And a web site of CIESIN publishes detailed risk map of 6 hazards distribution studied in this project as shown in below. The maps are able to estimate risk levels at sub-national scales.

Sample of Landslide Hazard

ippines

Global Landslide Hazard Distribut



Appendix 3:

List of Industrial Parks in Singapore

ID	Short List	Long List	COUNTRY	PROVINCE	PARK NAME	ADDRESS
SG0001			Singapore		Kranji Industrial Estate	Gali Batu Flyover
SG0002			Singapore		Sungei Kadut Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0003			Singapore		Woodlands Central Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0004			Singapore		Woodlands East Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0005			Singapore		Woodlands West Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0006		XXSG20	Singapore		Woodlands Industrial Park	122 Woodlands Industrial Park E3 Singapore 757848
SG0007			Singapore		Yew Tee Industrial Estate	365 Woodlands Rd Singapore 677932
SG0008		XXSG03	Singapore		Ang Mo Kio Industrial Park	30 Ang Mo Kio Industrial Park 2 Singapore 569509
SG0009		XXSG04	Singapore		Ayer Rajah Industrial Estate	N Buona Vista Rd Singapore
SG0010			Singapore		Bishan Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0011		XXSG06	Singapore		Henderson Industrial Park	Henderson Industrial Park 209 Henderson Rd, Singapore 159552
SG0012		XXSG09	Singapore		Kallang Basin Industrial Estate	77 Gey lang Bahru
SG0013			Singapore		Kallang Park Industrial Estate	20 Kallang Ave Singapore 339411
SG0014			Singapore		Kampong Ampat Industrial Estate	159 Kampong Ampat Singapore 368328
SG0015		XXSG11	Singapore		Kolam Ayer Industrial Estate	Pan Island Expy Singapore
SG0016			Singapore		Redhill Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0017			Singapore		St. Michael's Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0018		XXSG14	Singapore		Singapore Science Park I, II	2 Science Park Dr Singapore 118222
SG0019			Singapore		Sims Avenue Industrial Estate	Paya Lebar Rd Singapore 408999
SG0020			Singapore		Tanglin Halt Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0021			Singapore		Tanjong Rhu Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0022		XXSG17	Singapore		Telok Blangah Industrial Estate	1200 Depot Road
SG0023			Singapore		Tiong Bahru Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0024		XXSG18	Singapore		Toa Payoh Industrial Estate	Block 230 230 Lorong 8 Toa Payoh, Singapore 310230
SG0025	XXSG05	XXSG05	Singapore		Bedok Industrial Park	3013 Bedok Industrial Park E Singapore
SG0026			Singapore		Changi North Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0027			Singapore		Changi South Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0028		XXSG08	Singapore		Kaki Bukit Industrial Estate	6 Kaki Bukit Avenue 1 Singapore 417940
SG0029		XXSG10	Singapore		Kampong Ubi Industrial Estate	New Paya Lebar Proton Ubi Ave2
SG0030		XXSG12	Singapore		Loyang Industrial Estate	222 Loyang Ave Singapore 509068
SG0031		XXSG15	Singapore		Tai Seng Industrial Estate	Tai Seng Ave.

Country Report

ID	Short List	Long List	COUNTRY	PROVINCE	PARK NAME	ADDRESS
SG0032			Singapore		Yio Chu Kang Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0033			Singapore		Tampines Industrial Park	20 Tampines Industrial Crescent Singapore 528812
SG0034			Singapore		Clementi West Industrial Estate	Hillview Industrial Estate 27 Hillview Terrace, Singapore 669266
SG0035		XXSG07	Singapore		Jurong Industrial Estate	Pioneer Road, Gul Road/Circle, Benoi Sector and Shdipyard Roa
SG0036			Singapore		Southern Islands Jurong Island	114 Windsor Park Rd Singapore 574178
SG0037			Singapore		Eunos Techpark & Eunos Technolink	114 Windsor Park Rd Singapore 574178
SG0038			Singapore		Tuas View Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0039		XXSG19	Singapore		Tuas Biomedical Park I, II	31 TUAS south Ave.6
SG0040			Singapore		North Coast Wafer Fab Park	114 Windsor Park Rd Singapore 574178
SG0041			Singapore		Woodlands Wafer Fab Park	114 Windsor Park Rd Singapore 574178
SG0042			Singapore		Seletor Aerospace Park	Seletar Aerospace Rd Singapore
SG0043			Singapore		Pasir Ris Wafer Fab Park	114 Windsor Park Rd Singapore 574178
SG0044		XXSG02	Singapore		Airport Logistics Park of Singapore (ALPS)	Changi Airport
SG0045		XXSG16	Singapore		Tampines Wafer Fab Park	6 Tampines Industrial Avenue 5
SG0046		XXSG01	Singapore		Advanced Display Park	10 Tampines Industrial Avenue 3
SG0047			Singapore		Changi International LogisPark (North)	114 Windsor Park Rd Singapore 574178
SG0048			Singapore		Changi International LogisPark (South)	114 Windsor Park Rd Singapore 574178
SG0049			Singapore		Biopolis	Biopolis Rd Singapore
SG0050			Singapore		Fusionopolis	11 Portsdown Rd Singapore 139301
SG0051			Singapore		Mediapolis	114 Windsor Park Rd Singapore 574178
SG0052			Singapore		Clementi West LogisPark	114 Windsor Park Rd Singapore 574178
SG0053			Singapore		Toh Tuck LogisPark	114 Windsor Park Rd Singapore 574178
SG0054			Singapore		Toh Guan LogisPark	114 Windsor Park Rd Singapore 574178
SG0055			Singapore		Banyan LogisPark	114 Windsor Park Rd Singapore 574178
SG0056			Singapore		Meranti LogisPark	114 Windsor Park Rd Singapore 574178
SG0057			Singapore		Tampines LogisPark	54 Harvey Ave Singapore 489526
SG0058			Singapore		Tukang Innovation Park	3 International Business Park Singapore
SG0059			Singapore		International Business Park	3 International Business Park Singapore
SG0060			Singapore		Changi Business Park	7 Changi Business Park Vista Singapore
SG0061			Singapore		CleanTech Park	85 Lorong Tawas Singapore 639823
SG0062			Singapore		Paya Lebar iPark	114 Windsor Park Rd Singapore 574178
SG0063			Singapore		Senoko Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0064			Singapore		Defu Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0065			Singapore		Alexandra Village Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0066			Singapore		Aljunied Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0067			Singapore		Bukit Batok Industrial Estate	Hillview Industrial Estate 27 Hillview Terrace, Singapore 669266
SG0068			Singapore		Depot Lane Industrial Estate	4006 Depot Ln Singapore

Appendix 3: List of Industrial Parks in Singapore

ID	Short List	Long List	COUNTRY	PROVINCE	PARK NAME	ADDRESS
SG0069			Singapore		Eunos Industrial Estate	114 Windsor Park Rd Singapore 574178
SG0070			Singapore		Geylang Bahru Industrial Estate	80 Geylang Bahru Singapore
SG0071			Singapore		Geylang East Industrial Estate	117 Aljunied Avenue 2 Singapore 380117
SG0072			Singapore		Marsiling Industrial Estate	Marsiling Industrial Estate Road 10 Singapore
SG0073			Singapore		Sin Ming Industrial Estate	15 Sin Ming Industrial Estate Sector A Singapore
SG0074			Singapore		Yishun Industrial Park	10 Yishun Industrial Park A Singapore
SG0075		XXSG13	Singapore		One-North	JTC Corporation, The JTC Summit, 8 Jurong Town Hall Road, Singapore 609434

Appendix 4:

General Investment Risk of Singapore

(1) Political Risk

The People's Action Party (PAP) government, which has been in power since independence in 1965, has established efficient public services and has a strong, ingrained anti-corruption policy, making corruption a low risk to businesses. Although it still holds a firm grip on power, the PAP's popularity at the polls has steadily declined over the past two elections. In the May 2011 elections - the first time opposition parties mounted a comprehensive electoral challenge - the PAP secured 60% of the popular vote, its lowest level since independence. Despite this, the PAP retained 81 seats, meaning the government is still able to plan and implement long-term economic policies with ease.

The government is under pressure to satisfactorily address grievances over high immigration, which is overburdening public housing and transport. This contributed to the reduced support for the PAP in the May 2011 polls and led to the government-backed candidate, Tony Tan, winning the presidential elections by a very narrow margin in August 2011. If the government is perceived not to have addressed these grievances by the next general election in 2016, its support would probably be further eroded, though it would still retain power. Since 2011, the government has introduced immigration quotas and removed tax incentives for immigrants.

(2) Economic Risk

A highly industrialized and successful free-market economy, Singapore is renowned for its strong economic fundamentals and prudent macroeconomic policies. The country has achieved significant economic progress over the last 40 years. Under the aegis of the PAP, the city-state has been transformed from its underdeveloped state in the 1960s to an advanced global trading and financial center, consistently ranked as one of the world's most open economies.

The country's healthy public finances, strong net-creditor position, solid economic fundamentals, and stable political environment all contribute to its economic stability. The government has actively welcomed foreign investment for decades, and virtually

tariff-free trade has allowed Singapore's economy to flourish despite the city-state's lack of natural resources. Well-organized governance has given rise to sound infrastructure, including sophisticated telecommunications networks, extensive public transportation, well-managed healthcare and education, and modern air and seaport facilities.

In the near term, major risks to the export-reliant economy center on poor global demand, with GDP growth set to only marginally recover in 2013. Meanwhile, over the medium and longer terms, the economy will grow at more sustainable rates, in line with economic fundamentals, as Singapore's per capita income begins to converge with those of other advanced economies and as competition from low-cost producers such as China and India intensifies. The government has consistently demonstrated its commitment to enhancing economic competitiveness and maintaining solid macroeconomic policies to foster economic growth and stability.

(3) Legal Risk

Singapore's legal system is consistent, transparent, efficient, and internationally respected, providing a positive environment for foreign and domestic business operations. The legal framework is based mainly on English common law, but certain aspects of law have been modified and incorporated into statutory law. Respect for the law is widespread, and contractual rights and intellectual property rights are protected and can be enforced without difficulty. There is no restriction on the type of business that may be established in Singapore, but all businesses must be registered with the Accounting and Corporate Regulatory Authority (ACRA). Singapore has no requirements for local equity participation in foreign businesses, which can be 100%-owned by a foreign national or company. The judiciary is competent, experienced, and independent. There are no notable legal risks to investment in Singapore.

(4) Tax Risk

Tax system in Singapore is transparent and tax rates are generally low. The tax regime is designed to enhance the country's competitiveness, and is considered to be attractive to business. It has undergone a number of systematic changes, resulting in the reduction of direct corporate and individual tax rates to 17% and 20%

respectively by 2010. Capital gains or outbound dividends are not taxed and there are various tax incentives, exemptions, and reductions available for specific pioneer industries and expanding businesses. Singapore also has a wide tax treaty network of some 70 comprehensive treaties, meaning possible further reductions to tax rates. Over the past few years, the government has also made substantial progress in improving transparency and complying with the global standard for tax co-operation and exchange of information.

(5) War Risk

Relations with Indonesia, Thailand and Malaysia occasionally come under strain as a result of political disputes, although these disagreements are very unlikely to lead to armed hostilities. These countries are substantial trading partners and are among the principal members of the Association of Southeast Asian Nations committed to keeping the region peaceful. Further, Singapore's strategic relationship with the US, under which the US regional naval fleet has a base in Singapore, reduces the risk of interstate war with its neighbors.

Singapore also has intermittent disputes with the Malaysian government, from which it gained independence in 1965. Previous disputes have revolved around the status of island territories along their maritime boundary and the joint management of the two causeways linking the two countries. Two border disputes over Pedra Branca and a maritime territory were resolved by international arbitration in 2008 and 2003 respectively. The government's move to build desalination plants in order to meet national water requirements has mitigated the risk of disputes with Malaysia arising from the fact that Singapore sources its water from Malaysia. Disputes that do arise are usually resolved at the prime ministerial level, making a military confrontation unlikely.

(6) Terrorism Risk

Singapore is an attractive target for international and regional Muslim militant groups given its role as a supporter of US counterterrorism activities and as a base for the US navy. Moreover, being a largely non-Muslim country in a region with countries with substantial Muslim populations - such as Indonesia and Malaysia - further marks Singapore as a target for militants. Despite this, the risk of a militant attack has been moderate since the end of 2001, when a Jemaah Islamiyah (JI) militant cell was

found to be operating in the country with plans to target US naval personnel, the US Embassy and other key buildings. Following the discovery of this cell, suspected JI cell members were arrested. Since then, the capability of JI has deteriorated due to joint counterterrorism operations in Indonesia between Singaporean and Indonesian authorities and from the killing and arrest of senior JI leaders. Furthermore, the new generation of jihadist militants in Indonesia is increasingly focused on domestic issues, making it unlikely that they would target Singapore. In the unlikely event of an attack, militants would most probably target Sembawang naval base, Changi naval base (where US aircraft carriers dock) or the MRT subway system along with ports, Changi Airport, embassies, oil refineries and hotels. There is no indication of any home-grown militant threat.

(7) Civil Unrest Risk

Throughout the country's brief history, labor unrest has been rare and poses little risk to business continuity. The government has a close relationship with the National Trade Unions Congress, ensuring smooth labor-management relations. Further, the government can also rely on the pro-government media to support its policies concerning wage reform and the need for workers to retrain and upgrade their skills. Recently however, unequal treatment of foreign workers has become a more prominent issue. In December 2012, four foreign bus drivers from China were charged with inciting Singapore's first labor strike in 26 years after 171 went on a two-day strike over being paid almost 25% less than their Malaysian colleagues. While further protests related to this issue are likely, we expect them to remain infrequent and brief.

The risk of political protests is low. The PAP has been in power since 1965 with little political opposition. Over the years, the PAP government has delivered a substantial increase in living standards to the population. In February 2012, the country's GDP per capita was around USD 56,000, bettered only by Qatar and Luxembourg. The economy is open and export-oriented so it is sensitive to global economic conditions. In 2008, the economy contracted due to the global economic slowdown and went into recession, causing a rise in unemployment. However, the government successfully undertook stimulus measures making new jobs available. Future global economic problems will likewise affect domestic economic conditions and unemployment levels, but the government is likely to respond with remedial measures

that make it very unlikely that unemployment would rise to levels that would prompt social unrest.