Information Note 25/2025 **September 2025**

Climate Change and Extreme Landslide Events

Key Message: **In recent years, extreme weather exacerbated by climate change has brought about many disasters worldwide, causing significant casualties and economic losses. Given its hilly terrain and densely populated development, there is a risk that landslides with multiple fatalities and serious consequences may occur should Hong Kong be hit by an extreme rainfall event. Concerted efforts of the Government and the public are crucial in enhancing the community's resilience against landslide disasters and reducing the potential loss of life and damage to property.**

Introduction

After years of effort, the Hong Kong Slope Safety System is world-acclaimed and has successfully brought about a significant reduction in landslide risk in Hong Kong. However, landslide risk would progressively increase with time due to slope degradation, population growth and effects of climate change. Hong Kong is still vulnerable to severe landslides under its hilly terrain setting particularly during extreme rainfall. Therefore, the Government is sustaining its efforts on getting prepared for extreme rainfall events through taking suitable measures.

Extreme Weather Events near Hong Kong

In recent years, extreme weather events have caused significant casualties and economic losses worldwide. In Hong Kong, the last rainstorm that triggered landslides and resulted in fatalities occurred over fifteen years ago in June 2008. The record-breaking rainstorm triggering a landslide caused two fatalities. The rainstorm also resulted in more than 2 400 natural terrain landslides on Lantau Island and havoc in western Lantau. The debris flow occurred at the natural terrain above Yu Tung Road on the same day involved a source area of approximately 1 600 m^2 (2 350 m^3). The North Lantau Highway was blocked by the debris and the traffic to the airport was paralysed for 16 hours.

Subsequently, in September and October 2023, there were two heavy rainstorms that prompted Landslip Warnings and reached a landslide risk level of "Extremely high" according to the Landslide Potential Index (LPI)[1] classification. The Hong Kong Observatory (HKO) recorded a one-hour rainfall of 158.1 millimeters on September 7, the highest on record since 1884. In addition, the maximum 24-hour rainfall at the HKO Headquarters exceeded 600 mm, which is about a quarter of the normal annual total rainfall of Hong Kong. The rock avalanche occurred at the natural terrain above the Yiu Hing Road in Shau Kei Wan on the same day involved a source area of approximately 2 000 m^3 (source volume of 4 000 m^3). The volume of landslide debris is more than the capacity of a standard swimming pool, resulted in closure of Yiu Hing Road for months. The Emergency Control Centre of the GEO continued

[1] More information on Landslide Potential Index (LPI) can be found in GEO Information Note No. 15/2025.

to operate day and night for more than ten days. It received a total of 181 confirmed reports of landslides. The rainstorm resulted in 238 reported landslides eventually. The Hong Kong Observatory (HKO) has predicted that climate change would render extreme rainfall events more frequent, as well as more intense. The hourly rainfall record in Hong Kong has been broken for several times in the last few decades, whereas it used to take several decades to break the record in the past.

Impact of Climate Change on Landslide Risk

To face the unprecedented challenge brought about by climate change and extreme rainfall, the GEO has been proactively undertaking studies to shed light on the impact of extreme rainfall on landslide risk. For this purpose, the GEO has evaluated the likely impact of credible extreme rainfall scenarios if that struck the densely urbanised area of Hong Kong.

Despite that the Hong Kong Slope Safety System has successfully reduced the overall risk of landslides in Hong Kong to an "as low as reasonably practicable" level, the results of the study indicate that if heavy rainstorm strike the densely urbanised area of Hong Kong, several hundred severe landslides particularly debris flows on natural hillside would occur. The landslides could block roads, damage buildings and affect other important facilities, and the occurrence of large-scale and severe landslides resulting in multiple casualties and significant economic losses could not be ruled out. Even worse, if an extreme rainfall event like those that affected other parts of the world in recent years hits Hong Kong (e.g. Typhoon Morakot that hit Taiwan in 2009), several thousand severe landslides would occur.

Although the landslide threat brought about by extreme rainfall cannot be entirely avoided, it is imperative that Hong Kong maintains highly vigilant, learns from the past and gets prepared to deal with the challenge in order to minimise the potential loss of life and damage of property to the lowest possible.

Preparedness for Increasing Landslide Risk Due to Climate Change

The Government has formulated strategies to prepare Hong Kong for the ever-increasing threat of extreme landslide events brought about by climate change. In this regard, the GEO has adopted a multi-pronged approach in managing the landslide risk associated with extreme rainfall events due to climate change. The approaches include:

(i) Enhancement of Robustness of Slopes

(ii) Upgrading Emergency Response Capability

(iii) Improving the Community's Resilience

Enhancement of Robustness of Slopes against Extreme Rainfall

The GEO launched the Landslip Prevention and Mitigation Programme (LPMitP) in 2010 to manage the landslide risk of both natural hillside and man-made slopes in a more holistic manner. Natural terrain landslide hazards are usually dealt with by risk mitigation measures such as construction of concrete rigid barriers or steel flexible barriers at the hill toes to prevent debris from impacting on house or roads and resulting in casualties. The GEO also

endeavours to enhance the prevailing slope engineering design standard and practice to strengthen the slope robustness against extreme rainfall events, in order to reduce the probability of occurrence of severe landslides. Examples are use of soil nails to enhance the ductility of slope, improvement of slope drainage to cater for the increased precipitation due to extreme rainfall events, and use of innovative technology to regulate the regional groundwater.

Upgrading Emergency Response Capability to Cope with Extreme Landslide Events

Given that the forecast of climate change effects bears many uncertainties, it is neither practical nor cost-effective to rely solely on engineering solutions to manage the risk of extreme rainfall events. Thus, enhancement of the Government's emergency response capability is essential. The Government has put in place a Contingency Plan for Natural Disasters to ensure that all departments concerned will respond quickly and effectively in a coordinated manner to deal with emergency situations. If needed, the Emergency Command System will be triggered to pool together all emergency works resources within the Government to allow a well-coordinated effective and prompt response to deal with extreme landslide scenarios. The GEO also assists in developing and managing the "Common Operation Picture" to facilitate real-time sharing of emergency information (such as on landslide, flooding, etc.) among various departments. Training events and operational drills are conducted to ensure adequacy and effectiveness of the Plan.

The GEO maintains a 24-hour year-round landslide emergency service to advise Government departments on actions to be taken in case of danger arising from landslides. The landslide emergency service has played a significant role in keeping public away from landslide danger and thereby reducing landslide risk. When the Landslip Warning is in force, the GEO operates an Emergency Control Centre and keeps vigilant of the weather condition. When it is predicted that many landslides will occur based on recorded and forecast rainfall, the GEO will put in place the contingency provision which include deployment of additional dedicated teams to conduct follow up inspection of major landslide events. The GEO has introduced virtual reality training to further enable their geotechnical engineers to deal with severe landslide incidents.

The GEO has also explored using new technology to strengthen its emergency response capability. For example, a landslide detection system, namely "Smart Barrier", has been developed using novel Internet of Things technology to monitor the condition of landslide debris-resisting barriers. The Smart Barriers could continuously monitor the condition of the barriers and provide alerts to the GEO via mobile application in the event of any accumulation of landslide debris, which may forewarn the occurrence of major debris flow and hence allow a timely emergency evacuation of nearby people to minimise any possible casualties. The GEO has also developed and applied advanced tools such as unmanned aerial vehicles equipped with laser scanning and remote sensing technologies such as photogrammetry to collect spatial data to assist engineers with emergency inspections and repairs. In addition, the GEO is exploring the use of satellite monitoring for slopes and integrating artificial intelligence and other cutting-edge technologies to enhance landslide risk assessment capabilities.

Improving the Community's Resilience against Extreme Weather

Despite the enhancements made to landslide emergency preparedness, there is still a limit to the Government's emergency capacity. It is therefore paramount for the general public to work with the Government in emergency situations by taking necessary personal precautionary measures. When natural disaster occurs and before the arrival of responders, the public may follow simple and pragmatic self-help tips to protect themselves and minimise damages and avoid casualty.

The key messages to the public are simple and effective. The public should always remain vigilant about the warnings and advice issued by the Government during severe rainstorms. When the Landslip Warning / Special Landslip Advisory[2] is in force, or during heavy rainfall, the public should stay away from slopes and watch out and report to the police for signs of landslide danger. Pedestrians should avoid walking along or standing close to steep slopes. Motorists should avoid driving in hilly areas or along roads with landslip warning signs, or parking their vehicles in front of slopes. For buildings close to slopes, residents should stay in rooms on higher floors and/or furthest away from slopes. It is essential for citizens to follow the instructions of the rescue personnel strictly and act promptly. If asked to evacuate, the public should leave immediately and should not re-enter those areas that have been cordoned off.

Although severe landslides arising from extreme rainfall events cannot be precluded, the concerted efforts of the Government and the public could enhance our resilience against landslide disasters and reduce loss of life and damage to property to the lowest possible level.

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[2] More information on the Landslip Warning System can be found in GEO Information Note No. 18/2025.