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主動調查行動報告
Direct Investigation Operation Report

政府的防治山泥傾瀉工作及對政府斜坡的管理
Government's Work on Landslide Prevention and Mitigation and Management of Government Slopes

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Introduction

The Hong Kong Special Administrative Region is characterised by its hilly terrain and scarcity of land, where over 60% of land area is covered by natural hillsides. Coupled with the high population density, buildings and public transport facilities are often constructed along hillsides, resulting in a vast number of man-made slopes in various sizes. Upon continuous heavy rain or extreme rainstorms, there may be landslide risks in both natural hillsides and man-made slopes, posing potential threats to people's daily activities, lives and property.

2. In 1977, the Government launched the Landslip Preventive Measures Programme, primarily targeting man-made slopes, to address landslide risks in Hong Kong. In 2010, the Landslip Prevention and Mitigation Programme ("the Programme") was launched under the lead of the Civil Engineering and Development Department ("CEDD") to dovetail with the Landslip Preventive Measures Programme upon its completion.

3. Under the Programme, CEDD, as the Government's technical adviser for regulation of slope safety, adopts a risk-based approach to identify suitable government and private man-made slopes for upgrading works and safety screening studies respectively. Should safety screening studies reveal significant distress or potential hazards on the private man-made slopes, CEDD will refer such cases to the Buildings Department for further action under the Buildings Ordinance. CEDD has also extended the scope of the Programme from man-made slopes to include natural hillside catchments.

4. Over the decades since the launch of these two programmes, CEDD has carried out various types of landslide prevention and mitigation works as well as safety screening studies on thousands of slopes. Currently, the overall landslide risk in Hong Kong is substantially lower than that prior to the launch of the Landslip Preventive Measures Programme in 1977. Although landslides still occur every year in Hong Kong, the annual average of around 214 incidents recorded over the past decade (2015 to 2024) is nearly one-third below the annual average of around 300 incidents recorded in the past. The continuous effort and achievement of CEDD in monitoring and regulating slope safety over the years is commendable.

5. In addition to the hard work of CEDD, the effective maintenance of slope safety and stability also relies on slope owners or responsible parties properly undertaking maintenance and repairs for man-made slopes under their management. In this direct

investigation operation, the Office not only examined CEDD's overall prevention and mitigation work, but also scrutinised the routine maintenance of government man-made slopes. For such purpose, four departments with maintenance responsibility for a large majority of government man-made slopes and the highest number of slopes involved in landslides are included in our investigation, namely the Lands Department ("LandsD"), the Highways Department ("HyD"), the Water Supplies Department ("WSD") and the Architectural Services Department ("ArchSD").

6. Overall, the Office considers that with CEDD's continuous efforts in implementing the Programme and regulating slope safety over the past few decades, the landslide risks of Hong Kong's slopes at present are substantially lower than in over ten years ago. In this regard, the Office highly commends CEDD's work. The Office is also pleased to note that during this investigation, CEDD has formulated a number of forward-looking measures to address extreme weather events and proactively support the current-term Government's ongoing efforts to strengthen the overall capacity in coping with extreme weather in four key areas, namely preparedness, early warning, emergency response and recovery. Nevertheless, as global climate change intensifies, slope safety in Hong Kong still faces new challenges and risks. CEDD should continually keep up with an innovative spirit and strive for excellence to safeguard the monitoring and regulation of slope safety in Hong Kong. As regards the various departments with maintenance responsibility for government man-made slopes, the Office considers them to have carried out slope maintenance and repairs in accordance with their respective purview and the technical guide issued by CEDD. Following landslide incidents, these departments have also closely followed up (including seeking advice from CEDD), and arranged emergency inspections and necessary repairs. Our comments regarding the work of the five departments under investigation are elaborated in several areas, including the Programme, safety management of natural hillside catchments and government man-made slopes, application of technologies and inter-departmental collaboration.

Our Findings and Comments

The Landslip Prevention and Mitigation Programme

7. In 2010, CEDD launched the Programme with the annual targets to identify 150 government man-made slopes for upgrading works and 100 private man-made slopes for safety screening studies according to a risk-based approach. It also identifies 30 natural hillside catchments annually for risk mitigation works based on the "react to known hazard" principle. As of December 2024, CEDD was able to meet the pre-set annual targets of completed works and safety screening studies.

8. CEDD explained that the above annual targets were set for the purpose of controlling landslide risks, while giving due consideration to multiple factors including the inconvenience to the public caused by the works, as well as the situation and manpower within the geotechnical engineering sector.

9. CEDD added that it would periodically review its risk-based criteria for identification and inclusion of slopes in the Programme. After completing a systematic investigation and study of a series of landslides triggered by extreme rainstorms in September 2023, it has proposed several adjustments to the Programme: (1) selecting three sites under similar geological conditions to Yiu Hing Road, Shau Kei Wan, where a landslide occurred in September 2023, for inclusion in the Programme; (2) prioritising the man-made slopes adjacent to the sole vehicular access with greater impact on people's livelihood under the risk-based approach; and (3) progressively increasing the annual targets for upgrading and risk mitigation works and safety screening studies.

10. The Office notes that the Programme has been operating effectively as the Government's integral and long-term measure in response to landslide risks arising from climate change, particularly extreme weather events. It is positive and commendable for CEDD to conduct timely review and adjust the Programme's operational directions to ensure its validity and keep pace with changing circumstances. Given that the Programme has been launched for quite a long time and extreme weather events have become increasingly frequent and unpredictable in recent years, we recommend that CEDD, while reviewing and adjusting the Programme's directions in response to individual major incidents, also conduct periodic comprehensive reviews of the Programme (Note: CEDD had reported the results of periodic reviews of the Programme to the Legislative Council in 2015 and 2021). We believe that a comprehensive review can facilitate the formulation of forward-looking operational directions, which will not only greatly benefit CEDD's landslide prevention and mitigation work but also further enhance the entire Programme's sustainability. We recommend that CEDD continue to conduct periodic comprehensive reviews of the Programme depending on actual circumstances, such as the latest climate conditions and the trend of landslides in Hong Kong.

11. We understand that it takes time for CEDD to implement the proposed adjustments to the Programme in **paragraph 9** due to the significant extent of alteration and involvement of long-term planning including resource allocation and risk assessment of slopes. Consequently, CEDD should consider mapping out a schedule for phased implementation of all the adjustments according to priority and feasibility, and closely monitor whether the adjustments are implemented as scheduled. Meanwhile, we also recommend that CEDD review from time to time whether the adjustments can achieve the intended objectives and outcomes in line with the changing environment.

12. One of the adjustments proposed by CEDD to the Programme is the inclusion of three sites under similar geological conditions to Yiu Hing Road, Shau Kei Wan, where a landslide occurred in September 2023. While acknowledging this adjustment proposed by CEDD, we note that the Yiu Hing Road incident was the largest rockfall on record in Hong Kong. Moreover, the natural hillside concerned was situated along a major traffic corridor used by residents, and thus had a relatively severe impact on the community and livelihood. Considering the severity of possible incidents and the potential impact on the community and livelihood, we recommend that CEDD actively

explore the feasibility of expediting risk mitigation works for the three sites already included in the Programme with similar geological conditions to Yiu Hing Road.

13. Secondly, we are pleased to note that CEDD will also progressively increase the annual target of upgrading works from 150 to 200 government man-made slopes. Currently, upgrading works under the Programme are led by CEDD, with works design undertaken by consultants and construction carried out by contractors. Prior to the commencement of works, CEDD will apply to LandsD for temporary land allocation to take over the relevant slopes. Upon review of a landslide occurred in September 2023 on a government man-made slope in Sha Tin, we note that CEDD had already included the slope in the Programme for study and design of upgrading works prior to the incident. However, CEDD expected to commence works only in the first quarter of 2026. In other words, there was a gap of at least two years between the inclusion of the slope in the Programme and the commencement of upgrading works. The Office is not inclined to comment on the study and works design after the inclusion of slopes in the Programme which involves professional judgement in the geotechnical field.

14. However, our review of landslides revealed that repeated incidents took place in some government man-made slopes within three years. Hence, even if the government department with maintenance responsibility has carried out emergency works after the first incident, this does not necessarily entail full mitigation of the potential landslide risks. In this light, we recommend that CEDD examine the feasibility of further streamlining or even reducing the administrative procedures after the inclusion of government man-made slopes in the Programme, thereby further expediting its implementation.

15. Taking a step further, to align with its gradual increase of the annual target of upgrading works for government man-made slopes, we recommend that CEDD explore any room for collaboration with maintenance departments to carry out upgrading works under the Programme. For example, CEDD can undertake the works design, while the relevant maintenance department can carry out the works. This is because each government man-made slope has a designated department responsible for its routine maintenance, and all such departments should be familiar with the structure and condition of the slopes under their purview. This arrangement should help streamline procedures by, for example, obviating the need for CEDD to apply for temporary land allocation and enhance the cost-effectiveness of resource utilisation.

16. In addition to the proposed adjustments to the Programme, we note that CEDD is also actively developing the Smart Slope Catalogue[1] to enhance the effectiveness of slope safety management. We understand that it may be difficult to pursue the Smart Slope Catalogue in one go as its development and rollout involve substantial research, data collation and administrative work. As such, we recommend that CEDD consider a phased rollout, followed by examinations and necessary revisions based on experience

[1] Actively developed by CEDD and targeted for rollout within 2026, the Smart Slope Catalogue will expand the existing slope database to include records of landslide prevention and mitigation works, historical rainfall data, landslide records and relevant complaint records.

obtained from each phase. CEDD may also systematically sum up and consolidate experience in each phase to ensure complete rollout of the Catalogue within 2026. In the long run, CEDD should enhance the management of landslide prevention and mitigation works and slope maintenance audits as well as the planning of post-landslide responses through the gradual increase of slope monitoring and management data (such as the maintenance records from the Centralised Slope Maintenance Database[2] to be launched later), coupled with artificial intelligence and big data analytics. Meanwhile, CEDD should continue to apply new technologies with the data applications of the Smart Slope Catalogue to optimise slope maintenance and the landslip warning system.

17. The Programme was launched to reduce the overall landslide risk in Hong Kong. However, as and when there is continuous heavy rain or extreme rainstorms, the threat of landslides to the local community inevitably increases. Therefore, while implementing the Programme, CEDD should enhance public awareness of slope safety and understanding of Hong Kong's landslide risks through publicity and education to maximise the effectiveness of its work. In this regard, we note that CEDD has disseminated information on slope safety and maintenance through television, radio, social media and seminars. It has also established the Community Advisory Unit to assist private owners in fulfilling their slope maintenance responsibility. Given the inconvenience inevitably brought by landslide prevention and mitigation works, CEDD should enlist the understanding and support of affected residents by highlighting the importance of such works for public safety through publicity and education.

Safety Management of Government Man-made Slopes

18. Based on ownership and maintenance responsibility, man-made slopes can be categorised into government or private slopes. Regardless of ownership, the departments with maintenance responsibility for government slopes and owners of private slopes are obliged to carry out regular inspection and maintenance in accordance with CEDD's Guide to Slope Maintenance. Data from CEDD shows that between 2015 and 2024, there were 882 landslides involving government slopes and 117 involving private slopes in Hong Kong, which represents a noticeable difference.

19. Undeniably, there are far more government man-made slopes than private slopes[3], so the higher number of incidents involving government man-made slopes is understandable. However, discounting the actual difference in the number of incidents involving the two kinds of slopes, we notice that the failure rate of government man-

[2] The Centralised Slope Maintenance Database to be launched by CEDD soon is an electronic platform enabling maintenance departments to upload slope maintenance records for centralised storage. Database analytics will be performed to select government man-made slopes for site inspections.

[3] As at December 2024, there were 38,656 government man-made slopes across the territory, more than double the number (15,878) of private man-made slopes.

made slopes[4] was still higher than that of private man-made slopes[5] by one to three times between 2020 and 2024. We also note that the consequence-to-life category[6] of most government man-made slopes with landslides over the past five years was the lower category 2 or 3. Furthermore, the failure rates of both government and private man-made slopes remained at a very low level of less than 1% each year. Nevertheless, we consider that the relatively higher failure rate of government man-made slopes still warrants the Government's continuous attention.

20. Admittedly, our review of landslide cases involving government man-made slopes did not reveal any inadequacies on the part of the departments in slope maintenance and repairs. During site inspections, we also found no irregularities in the inspections carried out by the departments' consultants and contractors. However, in response to our request for information, LandsD was unable to locate the routine maintenance inspection records from the two years preceding the landslide occurred in 2016 on Wing Lung Road, Hang Hau, Sai Kung. To ensure proper retention of information, LandsD started planning in 2014 to fully digitise the slope maintenance records of the department for centralised storage in an online register. In September 2016, it launched the Slope Maintenance Information System, which has been in use since then. Separately, LandsD indicated that it will align with and use the Centralised Slope Maintenance Database to be launched by CEDD later, such as regularly uploading slope maintenance records or interfacing with its existing information systems to share maintenance records. We consider that proper compilation and retention of slope maintenance records are essential for departments to monitor slope safety and carry out landslide prevention and mitigation work. Therefore, we recommend that all maintenance departments (including LandsD, HyD, WSD and ArchSD) make effective use of CEDD's Centralised Slope Maintenance Database to be launched later by regularly uploading slope maintenance records for CEDD's data analytics and ensuring the proper retention of information. The departments concerned should also regularly remind consultants, contractors and departmental staff of the importance of recording and maintaining slope maintenance data in accordance with established guidelines.

21. On another front, we recommend that CEDD continue to take note of the difference in the failure rates between government and private man-made slopes, examine the underlying cause and formulate proper counter-measures where necessary. If any areas for improvement are revealed in slope maintenance undertaken by maintenance departments, CEDD should continue to issue technical guidelines for their compliance. Taking a step further, CEDD should continue to monitor the number of landslides involving government man-made slopes and conduct timely reviews when any unusual upward trend is detected to ensure the precision and effectiveness of the Government's landslide prevention and mitigation work.

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[4] (Number of government man-made slopes with landslides / Total number of government man-made slopes) × 100%

[5] (Number of private man-made slopes with landslides / Total number of private man-made slopes) × 100%

[6] The consequence-to-life category reflects the potential severity of casualties in the event of slope failure. It is classified into three levels from highest to lowest: category 1, category 2 and category 3.

22. In addition, we have the following two key observations upon review of a number of landslides involving government man-made slopes.

23. Firstly, we note that among the government man-made slopes with repeated landslides of a more serious nature since 2014, a vast majority of them had not been included in the Programme. Some of them recorded repeated landslides within three years since the first incident, and one of them even recorded four landslides at different parts of the slope within five years since 2016. Although the consequence-to-life category of all these slopes was not the highest category 1, and some of the incidents were not large-scale, the recurrence of incidents inevitably raises concerns about the potential risks and structural safety of these slopes.

24. We recommend that CEDD review any room to optimise the current selection criteria for inclusion of government man-made slopes in the Programme to undertake upgrading works, such as according more flexibility in prioritising slopes with repeated landslides under the Programme based on actual circumstances. If CEDD concludes after review that no changes or additions to the selection criteria are necessary, it may continue to assess whether the emergency maintenance works on these government slopes with repeated landslides should be further enhanced to prevent recurrence more effectively.

25. Secondly, we have selected several serious landslides that occurred on government slopes in consequence-to-life category 1 or 2 for scrutiny. We note that CEDD included many of these slopes in the Programme immediately after the incidents. We reckon that it is justifiable to prioritise these slopes for landslide prevention and mitigation work as they have higher consequence-to-life categories, representing greater risks to lives and property when landslides occur.

26. However, to strengthen the effectiveness of landslide prevention and mitigation work, we recommend that CEDD continue with its systematic review on the key factors for including these government slopes in the Programme. It should draw on these factors as a reference to promptly identify other government man-made slopes with similar characteristics for inclusion in the Programme before incidents occur, thereby further enhancing the Programme's prevention and mitigation capacity.

Safety Management of Natural Hillside Catchments

27. Over 60% of Hong Kong's land area is covered by natural hillside catchments. Natural hillside catchments refer to slopes without artificial alteration in structure. These hillsides in general do not require regular inspection or maintenance, and hence the Government has not assigned any maintenance departments for them. Prevention and mitigation work for natural hillside catchments relies primarily on CEDD's "react to known hazard" principle, whereby those with higher potential risks are identified for inclusion in the Programme to carry out risk mitigation works (mainly flexible barriers and rigid barriers).

28. Between 2015 and 2024, there were 507 landslide incidents involving natural hillside catchments, accounting for 23.7% of all incidents during the same period, at a rate just lower than that involving government man-made slopes. These figures reflect the potential risks posed by natural hillsides and should not be taken lightly. Therefore, we recommend that CEDD continue to closely monitor the number of landslides involving natural hillside catchments and examine the reasons promptly should there be any unusual rising trend observed, thereby addressing the problem early.

29. After reviewing nine serious landslides that occurred since 2008 (including the incident on Yiu Hing Road, Shau Kei Wan in September 2023), we found that most of them involved natural hillside catchments. A majority of them had not been included in the Programme before the incidents, or even if they had been so included in the Programme, they were accorded a relatively low priority such that the actual study and design of works had yet to commence by a consultancy contract before the incidents. Given that the Government mainly relies on the Programme to control landslide risks associated with natural hillside catchments, we recommend that CEDD continue to regularly review any room to optimise the criteria for identifying natural hillside catchments for inclusion in the Programme, so that those with potential risks can be identified by it earlier. In conducting this review, CEDD should continue to consult the Slope Safety Technical Review Board and explore collaboration with academic institutions to conduct relevant researches.

30. Additionally, we note that in response to findings from a recently completed systematic landslide investigation and study, CEDD has identified territory-wide three sites under similar geological conditions and hydrological environment to Yiu Hing Road, Shau Kei Wan. Natural hillside catchments at these sites, which pose potential risks to existing buildings and traffic corridors, are included in the Programme. In this regard, we recommend that if specific geological conditions and hydrological environment contribute to occurrence of landslides on natural hillsides again, CEDD should likewise seriously review whether there are other similar natural hillside catchments that require prioritisation, and promptly identify and include them in the Programme for detailed assessment and design of appropriate risk mitigation works.

Application of Technologies

31. Given the vast number of slopes, CEDD should, in addition to long-term planning and a sustainable programme to address the increasing landslide risks brought about by climate change, adopt innovative technologies proactively and extensively to strengthen slope risk control and enhance the effectiveness of its landslide prevention and mitigation work.

32. We are pleased to note that over the years, CEDD has applied innovative technologies for monitoring and regulating slope safety in various aspects, and has collaborated with several tertiary institutions to initiate related research projects. CEDD is also actively developing the Smart Slope Catalogue, and plans to expand the existing Catalogue of Slopes to include natural hillside catchments. In addition, CEDD

is exploring the use of automated drones for works management, slope monitoring and contingency response through the two pilot projects on Low-altitude Economy Regulatory Sandbox under the Transport and Logistics Bureau.

33. We consider that CEDD deserves recognition in keeping abreast of the times in the application of innovative technologies, thereby achieving continuous progress in the territory's landslide prevention and mitigation work. We recommend that CEDD continue to closely monitor technological developments related to slope safety, and explore the feasibility of collaborating with local universities and relevant academic or research institutions to initiate research projects concerning the monitoring of slope safety, thereby further integrating technologies into slope safety work. Regarding its plan to expand the coverage of the Catalogue of Slopes to include natural hillside catchments, we recommend that CEDD study how the expanded catalogue can support the further development of the Programme and slope safety monitoring.

Inter-departmental Collaboration

34. Our review of the four selected maintenance departments revealed that they have complied with the Guide to Slope Maintenance to schedule inspections based on the consequence-to-life category of each slope; they have also consulted CEDD on post-landslide response actions. In addition to the routine management of government slopes, CEDD has set up an inter-departmental platform and organises meetings regularly to facilitate collaboration in monitoring and ensuring slope safety.

35. Since the inspection and maintenance of government man-made slopes and post-landslide response actions involve geotechnical expertise, CEDD has seconded professional staff to each of the four maintenance departments to provide technical support. CEDD also deploys staff to conduct site inspections and provide suggestions for contingency response after landslides. The four departments themselves have assigned professional staff to oversee maintenance of their slopes. We note that the ratio of professional staff (i.e., the average number of slopes managed per professional officer) varies considerably from department to department. We recommend that each maintenance department review its current professional staff complement and determine whether there is any need for adjustment or redeployment. Where necessary, the departments may seek professional advice from CEDD to ensure adequate staffing for operational needs.

36. CEDD also conducts slope maintenance audits to assess whether departments have properly maintained and repaired their slopes. We are pleased to note that in the audit cycle ended in late 2023, CEDD did not discover any non-conforming practices among the maintenance departments. Nonetheless, we note that the existing audits mainly focus on slope maintenance and inspection. Given that a significant number of landslides involving government man-made slopes still occur each year, we recommend that CEDD explore expanding the scope of audit to include post-incident investigation and response, in order to review the performance of departments from multiple perspectives and identify possible areas for improvement. This would help the

authorities to learn from experience and nip the landslide risks in the bud as far as possible. At the same time, CEDD can refine its audit work through the insights gained from examining the follow-up actions taken by different departments after landslide incidents.

37. We consider that the existing collaboration mechanism among relevant departments is effective for properly discharging their maintenance responsibility for government man-made slopes. However, given the ever-changing climate conditions, all departments should continue deepening their collaboration to create synergy in enhancing slope safety and reducing landslide risks. On this basis, all relevant departments may make use of the Centralised Slope Maintenance Database being developed by CEDD and the Smart Slope Catalogue for data analytics, in order to monitor the latest situations of slope maintenance, share common maintenance issues, and assess the impact of heavy rainfall on slopes. This should facilitate their planning of routine maintenance inspections and special inspections after adverse weather events, leading to higher efficiency.

38. Furthermore, CEDD should continue to encourage its professional staff seconded to various departments to maintain close communication and exchange insights gained from managing government man-made slopes. Their observations and experiences can help review whether slope management practices and procedures are consistent across departments. These officers can also serve as a bridge between CEDD and the frontline staff responsible for slope management within their seconded departments to foster the exchange of views and sharing of experience.

Recommendations

39. In the light of the above, the Ombudsman makes recommendations in five key areas: the Programme, safety management of government man-made slopes, safety management of natural hillside catchments, application of technologies and inter-departmental collaboration. Details are as follows:

Regarding the Landslip Prevention and Mitigation Programme

(1) While the Programme has been operating effectively, given the increasing occurrence of extreme weather events in Hong Kong, CEDD, while reviewing and adjusting the Programme's directions in response to individual major landslides, should continue to conduct periodic comprehensive reviews of the Programme to further enhance its overall sustainability;

(2) CEDD should map out a schedule for phased implementation of the proposed adjustments to the Programme based on the outcomes of its systematic landslide investigation and study;

(3) Following recommendation (2), CEDD should implement the adjustments by phases according to priority and feasibility, and closely monitor whether all the adjustments are implemented as scheduled;

(4) Following recommendation (2), CEDD should review from time to time whether the adjustments proposed for the Programme can achieve the intended objectives and outcomes in line with the changing environment;

(5) CEDD should actively explore the feasibility of expediting risk mitigation works for the three sites already included in the Programme with similar geological conditions as Yiu Hing Road, Shau Kei Wan;

(6) CEDD may examine the feasibility of further streamlining or even reducing the administrative procedures after the inclusion of government man-made slopes in the Programme, thereby further expediting its implementation;

(7) CEDD may explore any room for collaboration with maintenance departments to carry out upgrading works under the Programme, thereby enhancing the cost-effectiveness of resource utilisation;

(8) CEDD may consider a phased rollout of the Smart Slope Catalogue, followed by examinations and necessary revisions based on experience obtained from each phase for complete rollout;

(9) Following recommendation (8), CEDD may systematically sum up and consolidate experience in each phase to ensure complete rollout of the Smart Slope Catalogue within 2026;

(10) In the long run, CEDD should continue to enhance the management of landslide prevention and mitigation works and slope maintenance audits as well as the planning of post-landslide responses through the gradual increase of slope monitoring and management data, coupled with artificial intelligence and big data analytics;

(11) Following recommendation (10), CEDD should continue to apply new technologies with the data applications of the Smart Slope Catalogue to optimise slope maintenance and the landslip warning system;

(12) CEDD should continue to strengthen publicity and education to enhance public awareness of slope safety and understanding of Hong Kong's landslide risks, and to enlist the understanding and support of affected residents by highlighting the importance of landslide prevention and mitigation works for public safety, thereby maximising its effectiveness;

Safety Management of Government Man-made Slopes

(13) Relevant maintenance departments (including LandsD, HyD, WSD and ArchSD) should regularly upload slope maintenance records to the Centralised Slope Maintenance Database to be launched by CEDD later for CEDD's data analytics and ensuring the proper retention of information;

(14) Relevant maintenance departments (including LandsD, HyD, WSD and ArchSD) should regularly remind consultants, contractors and departmental staff of the importance of recording and maintaining slope maintenance data in accordance with established guidelines;

(15) CEDD should continue to take note of any considerable difference in the failure rates between government and private man-made slopes, examine the underlying cause and formulate proper counter-measures where necessary;

(16) Following recommendation (15), if its examination reveals any areas for improvement in the maintenance of government man-made slopes on the part of the maintenance departments, CEDD should continue to issue technical guidelines for their compliance;

(17) CEDD should continue to monitor the number of landslides involving government man-made slopes, conduct timely reviews when any unusual upward trend is detected to ensure the precision and effectiveness of the Government's landslide prevention and mitigation work;

(18) CEDD should continue with its regular review for any room to optimise the current selection criteria for inclusion of government man-made slopes in the Programme for upgrading works (for example, according more flexibility in prioritising slopes with repeated landslides under the Programme based on actual circumstances);

(19) Following recommendation (18), if CEDD concludes after review that no changes or additions to the selection criteria are necessary, it may continue to assess whether the emergency maintenance works on these government slopes with repeated landslides should be further enhanced to prevent recurrence more effectively;

(20) In respect of the several cases examined by the Office of government man-made slopes in consequence-to-life category 1 or 2 which were included in the Programme after serious landslides, CEDD should continue with its systematic review on the key factors for their inclusion in the Programme, and draw on these factors as a reference to promptly identify other government slopes with similar characteristics for inclusion in the

Programme, thereby further enhancing the Programme's prevention and mitigation capacity;

Safety Management of Natural Hillside Catchments

(21) CEDD should continue to closely monitor the number of landslides involving natural hillsides catchments and examine the reasons promptly should there be any unusual rising trend observed;

(22) CEDD should continue to review regularly any room to optimise the criteria for identifying natural hillside catchments for inclusion in the Programme, so that those with potential risks can be identified earlier;

(23) Following recommendation (22), in conducting reviews, CEDD should continue to consult the Slope Safety Technical Review Board and explore collaboration with academic institutions for research;

(24) If specific geological conditions and hydrological environment contribute to occurrence of landslides on natural hillsides again, CEDD should likewise seriously review whether there are other similar natural hillside catchments that require prioritisation;

(25) Following recommendation (24), if natural hillside catchments requiring prioritisation are revealed, CEDD should promptly identify and include them in the Programme for detailed assessment and design of appropriate risk mitigation works;

Application of Technologies

(26) CEDD should continue to closely monitor technological developments related to slope safety, and explore the feasibility of collaborating with local universities and relevant academic or research institutions to initiate research projects concerning the monitoring of slope safety, thereby further integrating technologies into slope safety;

(27) Regarding its plan to expand the coverage of the Catalogue of Slopes to include natural hillside catchments, CEDD should study how the expanded catalogue can support the further development of the Programme and slope safety monitoring;

Inter-departmental Collaboration

(28) Each maintenance department (including LandsD, HyD, WSD and ArchSD) should review its current professional staff complement and determine whether there is any need for adjustment or redeployment. Where necessary, the departments may seek professional advice from

CEDD to ensure adequate staffing for operational needs;

(29) CEDD should explore expanding the scope of slope maintenance audits to include post-incident investigation and response actions involving government man-made slopes, with a view to reviewing the performance of maintenance departments from multiple perspectives and identifying possible areas for improvement, thereby learning from experience and nipping the landslide risks in the bud;

(30) Given the ever-changing climate conditions, all relevant departments (including CEDD, LandsD, HyD, WSD and ArchSD) should continue to deepen their collaboration to create synergy in enhancing slope safety and reducing landslide risks;

(31) All relevant departments (including LandsD, HyD, WSD and ArchSD) may make use of the Centralised Slope Maintenance Database being developed by CEDD and the Smart Slope Catalogue for data analytics, so as to monitor the latest situations of slope maintenance, share common maintenance issues, and assess the impact of heavy rainfall on slopes. This should facilitate their planning of routine maintenance inspections and special inspections after adverse weather events, leading to higher efficiency; and

(32) CEDD should continue to encourage its professional staff seconded to various departments to maintain close communication and exchange insights gained from managing government man-made slopes. Their observations and experiences can help review whether slope management practices and procedures are consistent across departments. These officers can also serve as a bridge between CEDD and the frontline staff responsible for slope management within their seconded departments to foster the exchange of views and sharing of experience.

Office of The Ombudsman
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INTRODUCTION

BACKGROUND

1.1 The total land area of the Hong Kong Special Administrative Region exceeds 1,100 square kilometres, over 60% of which is covered by natural terrain. In addition, there were about 61,000 man-made slopes as of June 2024. The risk of landslides increases rapidly during the rainy season, especially when severe rainstorms occur, posing a significant threat to life and property. Over the past 30 years, there has been an annual average of about 300 landslides recorded in Hong Kong. While there has been a downward trend in the overall number of landslides, the risk of serious landslides under extreme weather remains a major concern. In 2023 alone, the number of landslides exceeded 600, with widespread landslides triggered by the record-breaking torrential rain in September including serious incidents in Shau Kei Wan and on Shek O Road. These incidents caused considerable disruption and inconvenience to the public and raised alarms in the community.

1.2 Currently, the monitoring and regulation of slope safety falls within the ambit of various government departments. The Lands Department ("LandsD") is responsible for determining the maintenance responsibility of man-made slopes, categorised into government and private man-made slopes, while some are slopes involving mixed responsibility. Every year, the Civil Engineering and Development Department ("CEDD") selects natural hillside catchments and government man-made slopes with higher potential risks and impacts for upgrading or risk mitigation works according to a risk-based approach. It also conducts safety screening studies for private man-made slopes and recommends to the Buildings Department ("BD") the issuance of Dangerous Hillside Orders to the owners of slopes with potential dangers requiring them to carry out remedial or preventive works. Our preliminary inquiry revealed that between 2014 and 2022, CEDD completed risk mitigation works for over 300 natural hillside catchments, upgraded over 1,400 government man-made slopes, and conducted safety screening studies for over 900 private man-made slopes. Different government departments (mainly LandsD, the Highways Department ("HyD"), the Water Supplies Department ("WSD") and the Architectural Services Department ("ArchSD")) are responsible for the routine inspection and maintenance of man-made slopes under their purview.

1.3 Government information showed both government and private man-made slopes were involved in past landslides, while more severe incidents mainly concerned natural hillside catchments. Our preliminary inquiry also revealed that a considerable number of Dangerous Hillside Orders issued by BD to private owners have remained long outstanding, with disputes over the maintenance responsibility being one of the common causes. In addition, the Office has received almost 20 complaints related to slope safety over the past five years, reflecting considerable public concerns about slope safety.

1.4 With the Government's continuous efforts over the past few decades, slope safety in Hong Kong has been substantially strengthened compared with the 1970s. However, as extreme weather has become more frequent, coupled with gradual degradation of man-made slopes, landslide risks still exist. The Ombudsman launched this direct investigation operation to examine whether there is room for further enhancement of the Government's monitoring and regulation of slope safety, including the overall strategy on landslide prevention and mitigation, the routine repair and maintenance of government man-made slopes, the issuance and subsequent enforcement of Dangerous Hillside Orders, the determination of maintenance responsibility and dispute handling, post-landslide follow-up actions, as well as inter-departmental collaboration on case referral, exchange of information and professional knowledge, with a view to making targeted recommendations for improvement where necessary.

PROCESS OF INVESTIGATION

1.5 On 12 November 2024, the Office launched this direct investigation operation pursuant to section 7(1)(a)(ii) of The Ombudsman Ordinance against CEDD, BD, LandsD, HyD, WSD and ArchSD. On 14 November, the Office issued a press release to invite public views on this topic. We received a total of four written submissions, mainly concerning the upgrading works and maintenance of government man-made slopes, monitoring of private man-made slopes, and the dissemination of information about slope maintenance responsibility.

1.6 The scope of landslide prevention and mitigation work and slope management is extensive, encompassing the work of authorities over the past several decades, the management and regulation of both government and private man-made slopes, post-landslide response actions, inter-departmental collaboration, etc. The replies from various departments also involved voluminous information.

1.7 Given the extent and complexity of this topic, the Office decided to initiate two direct investigation operations under a series approach to focus on the different aspects mentioned in the **previous paragraph** more effectively. While the first direct investigation operation examines in detail the Government's landslide prevention and mitigation work and its management of government man-made slopes, the second operation to be announced later will focus on the authorities' determination of slope maintenance responsibility and risk management of private man-made slopes.

Regarding the public views mentioned in the **previous paragraph**, we have obtained information from the relevant departments. We will elaborate and respond in the following chapters or the report of the second operation.

1.8 Between May and July 2025, our officers also shadowed the staff of CEDD and relevant maintenance departments in conducting inspections, with a view to understanding CEDD's planning and implementation of the Landslip Prevention and Mitigation Programme ("the Programme"), its slope maintenance audits on departments with maintenance responsibility for government man-made slopes (see **paras. 4.22 to 4.23**), and the Routine Maintenance Inspections and Engineer Inspections for Maintenance carried out by the consultants and contractors engaged by maintenance departments (see **paras. 4.13 to 4.16**).

1.9 On 22 September 2025, we issued a draft investigation report to CEDD, LandsD, HyD, WSD and ArchSD for comment, and received replies from the five departments between 14 and 24 October 2025. Upon considering and incorporating their comments as appropriate, we completed this final report on 6 January 2026.

2

GOVERNMENT'S WORK ON LANDSLIDE PREVENTION AND MITIGATION

OVERVIEW

2.1 Around 60% of Hong Kong's land area is covered by natural hillside catchments, mostly located within country parks. As natural hillsides are interconnected without distinct physical boundaries, it is difficult to carry out formal survey and registration.

2.2 Meanwhile, Hong Kong's dense population and scarcity of flat land have led to the construction of buildings and roads along hillsides. The numerous steep man-made slopes pose landslide risks during heavy rainfall. Currently, CEDD is responsible for registering and maintaining records of all man-made slopes in the Catalogue of Slopes[1]. As of December 2024, 61,241 man-made slopes were registered in the Catalogue.

NATURAL HILLSIDE CATCHMENTS AND MAN-MADE SLOPES

Natural Hillsides Catchments

2.3 Natural hillsides are slopes without significant artificial alteration from their original state and generally do not require regular maintenance. However, CEDD continuously assesses the potential risks associated with different natural hillsides. Specifically, it analyses high-flight aerial photographs taken by fixed-wing drones to identify the characteristics (such as the type, width, length, elevation difference, gradient and vegetation cover) of natural hillsides where landslides have occurred and compiles

[1] Members of the public can access the Slope Information System on CEDD's website to view details of man-made slopes registered in the Catalogue of Slopes, including slope number, location, height, gradient, maintenance parties, photographs and drainage facilities. CEDD continuously collects latest information on newly constructed and existing slopes submitted by private slope owners and government departments for monthly updating of the Slope Information System.

the Enhanced Natural Terrain Landslide Inventory. Based on the data in the Inventory, CEDD evaluates the potential impact of future landslides on nearby buildings and traffic corridors, and includes natural hillside catchments with more significant potential impact in the Programme (see **para. 2.14**) for design and implementation of risk mitigation works.

Man-made Slopes

2.4 Man-made slopes refer to slopes or retaining walls constructed during land formation or other works by cutting back hillsides or filling platforms with earth and rock. Regardless of whether man-made slopes are designed and built by the Government or private sector, they are subject to approval by CEDD in accordance with current technical standards. Upon receiving the designs of new slopes submitted by private developments through BD[2] or from other government departments, CEDD would assign a geotechnical engineer to conduct an audit, to be reviewed by a senior geotechnical engineer. CEDD then provides the audit results and makes recommendations to BD or relevant departments within one month. During slope construction, CEDD conducts surprise inspections to ensure that the works conform to the approved designs. Additionally, for facilities constructed in the course of risk mitigation works for natural hillside catchments (see **para. 2.17**), CEDD classifies them as man-made slopes and registers them in the Catalogue of Slopes. LandsD then determines under the current mechanism which government departments or private owners are responsible for maintenance.

2.5 As of December 2024, there were 61,241 registered man-made slopes across Hong Kong, of which 38,656 were government slopes, 15,878 were private slopes, 6,319 were slopes in mixed responsibility[3], and 388 were slopes with maintenance responsibility yet to be determined.

2.6 The Geotechnical Engineering Office ("GEO") under CEDD has established the Slope Information System[4] by integrating various spatial and textual datasets from the Geographic Information System. The Slope Information System enables the public and engineering professionals to access online the data of man-made slopes registered in the Catalogue of Slopes, including slope number, location, height, length, gradient, consequence-to-life category (see **paras. 4.6 and 4.7**), maintenance parties, photographs, drainage facilities, etc. The GEO continuously collects latest information on newly

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[2] Pursuant to the statutory powers vested by the Buildings Ordinance, BD is responsible for approving the engineering designs of private development projects. CEDD is responsible for assisting BD with auditing the designs of newly constructed or the upgrading works for existing man-made slopes within private development plans. Separately, CEDD regulates by means of administrative directives the designs of geotechnical works of man-made slopes constructed by government departments. The design and technical standards applied by CEDD for approving private and government man-made slopes are the same.

[3] A mixed responsibility slope is a slope divided into private and government sections according to the land lot and land grant conditions, with each party responsible for maintaining their respective section.

[4] The Slope Information System webpage is accessible through CEDD's Hong Kong Slope Safety website: https://hkss.cedd.gov.hk/hkss/en/facts-and-figures/slope-information-system/sis/index.html

constructed and existing man-made slopes submitted by private owners and government departments for monthly updating of the Slope Information System.

DEVELOPMENT OF LANDSLIDE PREVENTION AND MITIGATION WORK

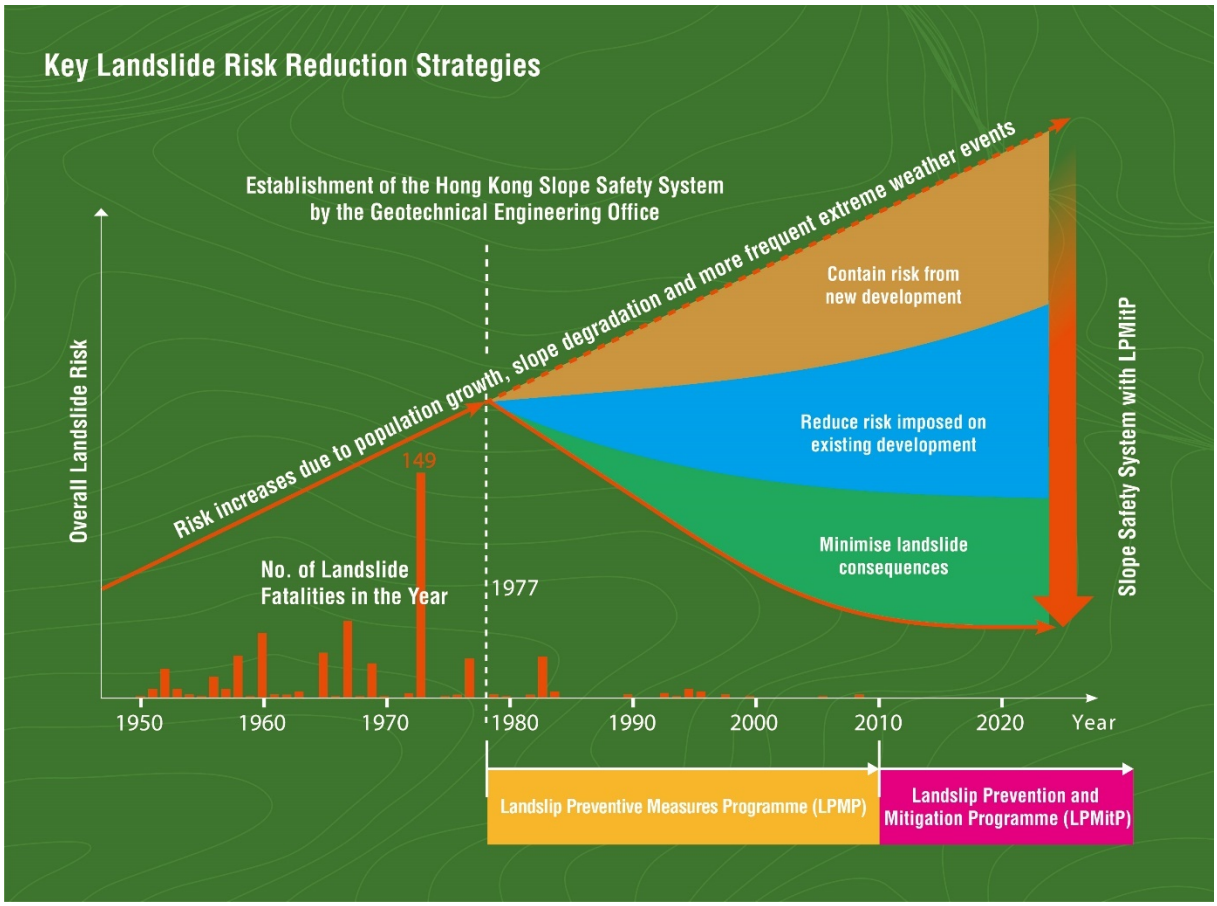
2.7 Over the years, the GEO under CEDD (formerly the geotechnical control body established by the Government in 1977 to manage slope safety) has formulated a comprehensive strategy, known as the Slope Safety System, to strengthen slope resilience against severe weather and reducing landslide risk to a level as low as reasonably practicable through a three-pronged approach (see **fig. 1**). The key components of the System are:

(1) Contain risk from new development: Auditing the geotechnical designs and construction of man-made slopes to ensure compliance with current standards;

(2) Reduce risk imposed on existing development: Applying a risk-based approach to carry out risk mitigation works for natural hillside catchments and upgrading works for government man-made slopes. Safety screening studies are conducted for private man-made slopes, and cases showing significant signs of distress or potential danger are referred to BD for enforcement under the Buildings Ordinance. CEDD also requires maintenance departments and private owners to carry out slope maintenance in accordance with the standards set out in the Guide to Slope Maintenance; and

(3) Minimise landslide consequences: Jointly operating the landslip warning system with the Hong Kong Observatory ("HKO") to alert the public to potential landslides and recommend precautionary measures during periods of heavy rainfall. A 24-hour emergency service is also provided year-round, with geotechnical engineers deployed to inspect landslide sites and offer expert advice on road closures, resident evacuation and emergency repair works.

Figure 1: CEDD's strategies for landslide prevention and mitigation (Courtesy of CEDD's Hong Kong Slope Safety website)



GOVERNMENT'S WORK ON LANDSLIDE PREVENTION AND MITIGATION

Landslip Preventive Measures Programme (1977–2010)

2.8 After setting up the GEO in 1977, the Government launched the Landslip Preventive Measures Programme in parallel. Under this Programme, man-made slopes registered in the Catalogue of Slopes were rated and ranked according to a risk-based approach for upgrading works (for government man-made slopes) and safety screening studies (for private man-made slopes) in a systematic order. Specifically, a higher priority was given to slopes constructed before the launch of the Landslip Preventive Measures Programme and posing a greater potential impact on the safety and daily lives of the community, including those affecting residents, hospitals and schools.

2.9 Under the Landslip Preventive Measures Programme, CEDD has handled all the man-made slopes that posed a greater potential impact as mentioned above, including completion of upgrading works for around 4,600 government slopes, and safety screening studies for around 5,200 private slopes to assess the probability of slope

failure and potential consequences. Of which, 2,100 private man-made slopes with higher potential risk were referred to BD for the issuance of Dangerous Hillside Orders under the Buildings Ordinance, requiring the relevant private owners to carry out investigation and remedial works (see **para. 2.20**). In the interim, CEDD also identified 500 private man-made slopes where landslides had occurred or signs of instability were found, and referred them to BD for enforcement.

2.10 Since the launch of the Landslip Preventive Measures Programme, the number of fatal landslides has significantly decreased. The most recent incident involving multiple deaths occurred nearly 30 years ago in 1994 at Kwun Lung Lau, Sai Wan, where a landslide claimed five lives. Since the severe rainstorm[5] in June 2008, there have been no recorded landslides in Hong Kong resulting in casualties. Comparing to around 500 landslide reports recorded annually during the 1980s and 1990s, currently an annual average of less than 300 landslide reports are received, where the scale of incidents and their impact on society were also relatively minor.

2.11 When the Landslip Preventive Measures Programme was formally completed in 2010, the overall landslide risk associated with man-made slopes in Hong Kong was substantially lower than that in 1977, with the relative risk level controlled at a level as low as reasonably practicable[6].

2.12 CEDD explained that the Government established in 1995 the Slope Safety Technical Review Board with members appointed by the Director of CEDD. Comprising internationally renowned experts in the field of geotechnical engineering, the Board is tasked with reviewing the Government's slope safety management practices and providing technical advice on the operation of the Slope Safety System. CEDD would actively follow up on the Board's recommendations. During their annual visits to Hong Kong, the Board members would join the staff of CEDD to conduct site inspections and engage in in-depth discussions and exchanges with the latter. CEDD would, on the other hand, report to the Board on its follow-up actions and outcomes, as well as the progress of technical developments and future directions. The Board has noted in its reports that CEDD's Slope Safety System is on a par with the best standards in risk management recognised internationally and continues to lead international practice on slope safety and is a model that other countries aspire to follow. The current-term Board (2022–2025) consists of three geotechnical experts from Norway, the United Kingdom and Canada. Previous Boards included experts from the Chinese Mainland, Japan, Australia, Canada, etc.

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[5] Over the past five decades, Hong Kong has recorded three severe torrential rain events on 18 June 1972, 7 June 2008 and 8 September 2023. The daily rainfall exceeded 200 millimetres in each event, and surpassed 600 millimetres on 8 September 2023. The landslides triggered by the 1972 and 2008 events resulted in 140 and two fatalities respectively. On the day of the 2023 event, 181 landslides were reported. Although no loss of life was recorded, some more severe incidents caused road blockages and property damage.

[6] Controlling landslide risks at the level "as low as reasonably practicable" means that after cost-effectiveness analysis and subject to economic viability, the authorities shall minimise landslide hazards to the lowest level possible, maintaining slopes at a highly safe and genuinely feasible standard.

Landslip Prevention and Mitigation Programme (2010 to Present)

2.13 Given slope degradation over time and the increasingly common urban development or redevelopment near steep hillsides, the Government recognises the need to continuously allocate resources in slope safety. To this end, CEDD launched the Programme in 2010 mainly for identifying and handling man-made slopes with moderate potential risk, including: (1) old slopes (i.e. those constructed before the establishment of the Geotechnical Control Office in 1977) located near and potentially affecting major transport and infrastructure, frequently used roads, pedestrian walkways or public waiting areas; (2) slopes affecting squatter dwellings; and (3) slopes built in the late 1970s to 1980s that relied primarily on slope flattening to improve stability, without the use of reinforcement steel bars or structural support.

2.14 In addition, CEDD has expanded the Programme to cover natural hillside catchments. Specifically, CEDD uses high-flight aerial photographs to continuously monitor various natural hillside catchments for signs of past landslide activity, and to assess nearby buildings and transport infrastructure that may be affected in the event of failure, thereby prioritising natural hillside catchments for follow-up under the "react to known hazard" principle. Other consideration factors include the size, gradient, geological conditions and hydrological environment of the natural hillside catchments.

2.15 CEDD explained that due to the vast number of natural hillside catchments and man-made slopes to be handled under the Programme, it is not cost-effective or practical to complete the work in a short period. Moreover, as many of the slopes are located near buildings and major roads, consideration must also be given to public inconvenience caused by road closures when works are in progress. After balancing the control of landslide risk, resources allocation and cost-effectiveness, the Government has set three annual targets, including completion of risk mitigation works for 30 natural hillside catchments, upgrading works for 150 government man-made slopes, and safety screening studies for 100 private man-made slopes.

2.16 After selecting the 150 government man-made slopes for upgrading works and the 30 natural hillside catchments for risk mitigation works each year, CEDD contacts the relevant government departments (including those responsible for slope maintenance) to check whether any projects are planned for the selected slopes in the next five years and to obtain the latest information of those slopes. CEDD then commissions consultants to design the upgrading and risk mitigation works to be carried out by contractors. During the design stage, CEDD maintains close communication with the relevant departments regarding works details and maintenance requirements, finalising the design upon reaching consensus. Before commencement of works, CEDD applies to LandsD for temporary allocation of government land.

2.17 CEDD classifies the facilities (mainly flexible barriers and rigid barriers) constructed on natural hillside catchments during risk mitigation works as man-made slopes, the maintenance responsibility of which is determined by LandsD (see **para. 1.2**). While flexible barriers (see **fig. 2**) can absorb and diffuse the kinetic energy of rockfall,

as well as effectively intercept debris, rigid barriers (see **fig. 3**) can block large-scale landslide debris and reduce the impact on public safety. Regardless of risk mitigation works for natural hillside catchments or upgrading works for government man-made slope, CEDD would prepare a Slope Maintenance Manual specifying the items for future inspection, maintenance and repairs for handover to the maintenance department upon completion of works.

Figure 2: Flexible barrier above Repulse Bay Road
(Photo taken by our officer during site inspection in May 2025)

Figure 3: Rigid barrier on Repulse Bay Road
(Photo taken by our officer during site inspection in May 2025)

2.18 Two examples of upgrading works and risk mitigation works are shown below (see **figs. 4–7**).

Figures 4 and 5: Upgrading works undertaken by CEDD for government man-made slope (Courtesy of CEDD)

Location: Bowen Road, Wan Chai (Feature Ref. No. 11SW-D/F641)

Figure 4: Before upgrading works

Figure 5: After upgrading works

Figures 6 and 7: Risk mitigation works undertaken by CEDD for natural hillside catchment (Courtesy of CEDD)

Location: Yu Tung Road, Lantau Island (Feature Ref. No. 9SE-B/ND1)

Figure 6: Before risk mitigation works

Figure 7: After risk mitigation works

2.19 CEDD pointed out that many risk mitigation measures have been proven effective during severe rainstorms, reflecting the effectiveness of past prevention and mitigation works for natural hillside catchments. As an example, the rigid and flexible barriers constructed on the natural hillside catchment at Pok Fu Lam and Pa Mei, Tung Chung effectively intercepted debris during two rainstorms in August and October 2021,

thereby preventing damage to buildings located below the slopes. Additionally, during the record-breaking rainstorm in September 2023, the rigid barriers on Lei Pui Street, Kwai Chung and at Pinehill Village, Tai Po successfully intercepted debris generated by collapsing hillsides and protected the facilities downslope.

2.20 Regarding private man-made slopes, CEDD each year selects 100 slopes with higher degree of moderate potential risks according to a risk-based approach for safety screening studies. If significant signs of distress or potential danger are revealed, CEDD will recommend the issuance of Dangerous Hillside Order by BD under the Buildings Ordinance, requiring the owners to carry out specified investigation and remedial works. We will elaborate and examine the Government's determination of maintenance responsibility and risk management of private man-made slopes later in our second direct investigation operation report (see **para. 1.7**).

2.21 Upon reviewing the annualised data of the Programme over the past decade (2015 to 2024) (see **tables 1 and 2**), we note that CEDD consistently met its annual targets (see **para. 2.15**) of completing risk mitigation works for natural hillside catchments, upgrading works for government man-made slopes, and safety screening studies for private man-made slopes. Since 2011, CEDD has cumulatively completed risk mitigation works for 489 natural hillside catchments, upgrading works for 2,227 government man-made slopes, and safety screening studies for 1,434 private man-made slopes.

Table 1: Annualised data of natural hillside catchments with risk mitigation works completed under the Programme

Year	No. of natural hillside catchments with risk mitigation works completed (Annual target: 30)	
	Completed during the year	Cumulative no. since 2011
2015	33	146
2016	49	195
2017	49	244
2018	33	277
2019	33	310
2020	35	345
2021	36	381
2022	36	417
2023	35	452
2024	37	489

Table 2: Annualised data of government man-made slopes with upgrading works completed under the Programme

Year	No. of government man-made slopes with upgrading works completed (Annual target: 150)	
	Completed during the year	Cumulative no. since 2011
2015	155	788
2016	165	953
2017	155	1,108
2018	152	1,260
2019	165	1,425
2020	166	1,591
2021	176	1,767
2022	158	1,925
2023	152	2,077
2024	150	2,227

2.22 CEDD stated that the Programme launched in 2010 not only serves to control the landslide risks posed by the remaining man-made slopes, but also extends the work on landslide prevention and mitigation to natural hillside catchments. The overall landslide risk in Hong Kong at present is significantly lower than that in 1977. Each year, the Programme identifies natural hillside catchments and around 1% of the remaining man-made slopes that pose the highest potential impact for follow-up. This enables a swift and effective reduction of the overall landslide risk. CEDD considered the annual targets (see **para. 2.15**) appropriate after balancing the control of landslide risks and the public inconvenience caused by works, as well as taking into account the situation and manpower within the geotechnical engineering sector. After reviewing the Programme's annual targets and progress in 2015 and 2021, CEDD concluded that both were on a par with expectations.

2.23 CEDD further explained that it often reviews and adjusts its risk-based selection criteria as necessary. To strengthen slope management in response to increasingly frequent extreme weather events brought about by climate change, CEDD plans to raise the annual targets of the Programme by identifying more natural hillside catchments and government man-made slopes for upgrading and risk mitigation works, and carrying out safety screening studies for more private man-made slopes. Further details are given in **paragraph 5.59(4)**.

APPLICATION OF INNOVATIVE TECHNOLOGIES

2.24 Apart from implementing the Programme, CEDD has been actively applying innovative technologies to reduce landslide risks and enhance the effectiveness and quality of its services, with the aim of protecting public safety from multiple aspects. Its efforts include promoting collaboration among government departments, industry stakeholders and academia, and serving as a bridge between academic research and technological application. CEDD has established several cross-sector platforms to identify needs and shared objectives, formulate technology development measures and foster collaboration. It has also set up an Expert Panel to assess proposals involving new materials, novel designs or unconventional construction methods in geotechnical engineering projects. The Panel applies innovative thinking to approve key aspects of new technologies and provides direction and guidance for the audit process. Examples of CEDD's application of innovative technologies in prevention and mitigation work are detailed below.

2.25 For monitoring landslides on natural hillside catchments, CEDD conducted territory-wide airborne Light Detection and Ranging ("LiDAR") surveys in 2010 and 2020 to obtain digital terrain models capable of revealing geomorphological features of natural hillside catchments, such as landslide scars, providing crucial data for risk assessment (see **fig. 8**). In addition, CEDD has collaborated with academic institutions to advance this area of work, including joint research with tertiary institutions on the use of artificial satellites and the latest integrated remote sensing technology to monitor landslides on natural hillside catchments. Research teams are developing Earth observation satellites for extensive monitoring of landslides on natural hillside catchments with satellite remote sensing technology. Previously, CEDD also partnered with tertiary institutions to conduct research on using artificial intelligence to identify landslides on natural hillside catchments from satellite and aerial images, delineating boundaries and classifying types of landslides for expediting updates on the Enhanced Natural Terrain Landslide Inventory (see **para. 2.3**).

2.26 After a landslide, relevant departments are required to inspect and assess the situation and initiate emergency maintenance works. To support these operations, CEDD has collaborated with companies specialising in artificial intelligence and robotics to develop a quadruped robotic dog, known as "SPOT", for pilot use (see **fig. 9**). The robotic dog can be equipped with various data collection instruments and devices for inspection of landslide sites and data collection in place of engineering personnel. Moreover, CEDD has partnered with tertiary institutions to lead the development of a climbing robot with caterpillar tracks capable of conducting inspections at steeper landslide sites.

Figures 8 and 9: LiDAR survey and robotic dog
(Courtesy of CEDD)

Figure 8

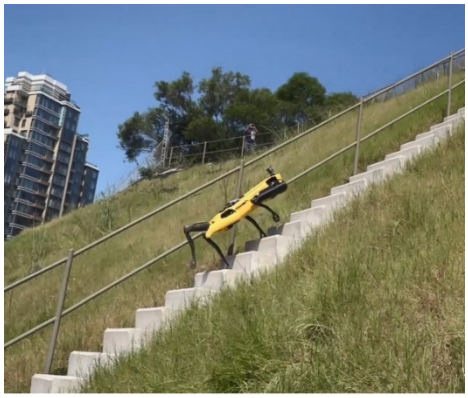

Figure 9

2.27 In terms of slope information dissemination, CEDD has in earlier years adopted Building Information Modelling and Geographic Information System technologies to comprehensively manage its geospatial data and develop the Slope Information System, which contains records of man-made slopes registered in the Catalogue of Slopes accessible to both the industry practitioners and the public. In 2023, CEDD completed an updated version of the Slope Information System, which now includes three-dimensional geotechnical data to facilitate the analysis and research conducted by the industry. After completing a systematic landslide investigation and study recently, CEDD is actively developing the Smart Slope Catalogue to expand the existing slope database for more effective slope safety management. Further details are given in **paragraph 5.61**.

2.28 Beyond the areas mentioned above, CEDD has in recent years leveraged innovative technologies (including automated drones and machine learning applications) to strengthen its capabilities in landslide risk assessment, remote monitoring, and management of landslide incidents and response actions. Further details are given in **paragraphs 3.5, 5.62 and 5.63**.

PUBLICITY AND EDUCATION

2.29 CEDD has striven to promote public awareness of slope safety, landslide risks and disaster preparedness through a variety of channels and methods, including television and radio announcements in the public interest, the production and distribution of leaflets, posters and guides, and the organisation of seminars, conferences and training courses. It also shares information on slope safety and maintenance via social media platforms.

2.30 CEDD has set up the Community Advisory Unit to advise owners of private man-made slopes on slope maintenance, investigation and upgrading works, facilitating them fulfil maintenance responsibility. The Unit regularly organises slope safety

lectures and seminars, meets with members of the public, and offers consultation services on slope maintenance and cases involving Dangerous Hillside Orders. It also provides private slope owners with step-by-step guidance in a simplified format on how to comply with the requirements of such orders promptly and effectively.

3

LANDSLIP WARNING AND REPORTING SYSTEMS

LANDSLIP WARNING

3.1 When there is a high risk of multiple landslides triggered by torrential or persistent heavy rainfall, CEDD and HKO will issue a Landslip Warning to draw public attention to the risk of landslides and remind them to take precautionary measures.

3.2 Whether to issue a Landslip Warning primarily depends on the area and intensity of rainfall and the number of slopes affected. HKO uses radars to monitor the movement and development of rain-bearing clouds across Hong Kong and neighbouring regions. High-resolution meteorological satellite images also provide information on cloud patterns around Hong Kong for rainfall forecast. Currently, CEDD operates a network of around 90 automatic raingauges throughout Hong Kong, each equipped with a rainfall measuring unit and a data logger powered by solar energy. Real-time rainfall data are transmitted to the cloud servers via mobile networks at 1-minute intervals. Additional rainfall data from automatic raingauges operated by HKO and the Drainage Services Department ("DSD") are also used in the landslip warning system. Over the past five years (2020 to 2024), the authorities issued a total of nine Landslip Warnings, or an average of one to three each year (see **table 3**).

Table 3: Statistics on Landslip Warnings issued by CEDD and HKO between 2020 and 2024

Year	No. of Landslip Warnings issued
2020	2
2021	2
2022	1
2023	3
2024	1
Total	**9**

Special Landslip Advisory

3.3 To enhance early warning and information dissemination, CEDD and HKO introduced the Special Landslip Advisory in May 2024. Its purpose is similar to that of the Localised Heavy Rain Advisory currently issued by HKO during heavy rainfall.

3.4 CEDD explained that the development and movement of rain bands affecting Hong Kong are highly variable, with rainfall impacts ranging from widespread to localised. When localised heavy rain persists, the risk of landslides increases significantly in relevant districts. However, the overall landslide risk of Hong Kong as a whole may not yet reach the threshold for issuing Landslip Warning. At such times, CEDD will assess the landslide risk in each district based on the cumulative rainfall recorded over the preceding 24 hours. Where necessary, it will issue a Special Landslip Advisory jointly with HKO for districts with higher landslide risk as an alert the public. Should the affected areas change, CEDD and HKO will update the Special Landslip Advisory accordingly. Furthermore, when heavy rainfall is anticipated to potentially spread to a wider area, the authorities may consider replacing the Special Landslip Advisory with the Landslip Warning based on the circumstances.

Smart Landslip Warning System

3.5 In line with the Chief Executive's 2024 Policy Address Supplement, CEDD has explored application of machine learning technology and big data analytics. In the 2025 rainy season, CEDD is piloting a landslide prediction model employing Hong Kong rainfall data, historical landslide records and information on man-made slopes, supported by machine learning and big data analytics. The model will further enhance the authorities' capability to assess landslide risks, including improvement on the accuracy of estimating the number of landslide reports during heavy rainfall and optimisation of the issuance of Landslip Warnings.

LANDSLIDE POTENTIAL INDEX

3.6 In addition to issuing Landslip Warnings to the public, CEDD has established a model on the correlation between rainfall intensity and the probability of landslides. The model is derived from analysing the historical rainfall and landslide data in conjunction with the spatial distribution of slopes in Hong Kong.

3.7 CEDD explained that Hong Kong's rainfall distribution can be highly uneven, hence the rainfall intensity of a particular raingauge may not reflect the rainfall intensity in other parts of Hong Kong. In different areas, rainstorms with the same intensity may result in significantly different risks of landslides. If there are plenty of slopes within the rainfall area, the potential risk of landslides will increase. To more accurately represent the risk of landslides triggered by rainstorms, CEDD collects and converts rainfall data recorded during rainstorms into rainfall intensity distributions, followed by applying the correlation model mentioned above to estimate the potential number of

landslides triggered by rainstorms and then quantified as the Landslide Potential Index ("LPI").

3.8 After analysing the LPI of rainstorms that triggered Landslip Warnings since 1985, CEDD found that Hong Kong experienced five rainstorms with the LPI higher than 100 (indicating extremely high risk of landslides) in 1994, 2005, 2008 and 2023 (twice). During the rainstorm with LPI at 103 on 23 July 1994, 214 landslides were reported, including a serious incident at Kwun Lung Lau, Sai Wan which caused 5 fatalities and 3 injuries. On 7 June 2008, the rainstorm with LPI at 126 resulted in 347 landslides and 2 fatalities. As for the record-breaking rainstorm on 7 September 2023, Hong Kong recorded unprecedented rainfall levels (with 500 to 800 millimetres of rainfall in urban areas) and the LPI reached a record high of 130. Overall, the authorities received 181 landslide reports, including a major incident at Yiu Hing Road, Shau Kei Wan (see **paras. 5.8 to 5.14**). The number of landslide reports was lower than those received during the rainstorms of 1994 and 2008.

3.9 Currently, CEDD will publish the LPI of each intense rainstorm on its Hong Kong Slope Safety website[7] once the event ends (typically marked by the cancellation of Landslip Warning) to inform the public of its severity. The LPI of previous intense rainstorms that triggered Landslip Warnings is also available on the website for public information.

[7] The Hong Kong Slope Safety website is at https://hkss.cedd.gov.hk

4

MAINTENANCE OF GOVERNMENT MAN-MADE SLOPES BY DEPARTMENTS

OVERVIEW

4.1 As at December 2024, there were 61,241 man-made slopes in Hong Kong. Among them, 38,656 were government man-made slopes and 6,319 were mixed responsibility slopes (see **note 3**) with one of the responsible parties being government department, accounting for 63.1% and 10.3% of the total respectively and more than half in the aggregate. Consequently, government departments' timely and proper inspection and maintenance of slopes under their purview are crucial to the overall slope safety of Hong Kong and the authorities' landslide prevention and mitigation work.

4.2 Categorised by maintenance department, the departments with the largest number of government man-made slopes were, in descending order, LandsD (17,363), HyD (11,231), WSD (6,372) and ArchSD (5,871) (see **table 4**). While the GEO under CEDD is not a maintenance department, it acts as a technical adviser monitoring the overall slope safety. According to CEDD's information, among the landslides occurred between 2014 and September 2023, the government man-made slopes under the purview of the above four maintenance departments also accounted for a larger share (see **table 5**).

Table 4: Seven major maintenance departments with a breakdown by government man-made slopes and mixed responsibility slopes (As at December 2024)

Maintenance department *	No. of government man-made slopes	No. of mixed responsibility slopes	Total #
LandsD	12,878	4,485	17,363
HyD	9,995	1,236	11,231
WSD	6,239	133	6,372
ArchSD	5,425	446	5,871
DSD	873	132	1,005
AFCD	847	1	848
HD	837	81	918

Since government and mixed responsibility slopes maintained by more than one department are counted in the figures for each department, the total number of slopes listed by maintenance department exceeds the actual number of government and mixed responsibility slopes in **paragraph 4.1**.

Table 5: Statistics on government and mixed responsibility slopes involved in landslides between 2014 and September 2023

Maintenance department	No. of government or mixed responsibility slopes involved in landslides
LandsD	299
HyD	301
WSD	194
ArchSD	72
DSD	5
AFCD	41
HD	3

4.3 Based on the above data, we have decided to include the four departments responsible for the largest number of slopes, namely LandsD, HyD, WSD and ArchSD, in this direct investigation operation. Our aim is to understand how these departments conduct routine maintenance of government man-made slopes under their purview, their post-landslide follow-up, and the inter-departmental collaboration with CEDD on slope management matters.

MAINTENANCE OF GOVERNMENT MAN-MADE SLOPES

4.4 As mentioned in **paragraph 1.2**, LandsD is responsible for determining the maintenance responsibility for man-made slopes listed in the Catalogue of Slopes. The results are uploaded to the Slope Maintenance Responsibility Information System website[8] managed by LandsD.

4.5 For the four maintenance departments examined in this direct investigation operation, the slopes under each department's purview are closely linked to its core functions. Specifically, HyD primarily maintains roadside man-made slopes on unallocated government land that affect public roads under its charge; WSD primarily maintains man-made slopes near waterworks (including reservoirs, service reservoirs, catchwaters, etc.); while ArchSD maintains man-made slopes mainly located on or nearby government buildings and facilities. LandsD maintains the remaining man-made slopes in the Catalogue of Slopes where no government department or private landowner is responsible for maintenance.

Consequence-to-life Categories and Various Types of Maintenance Inspections

4.6 Currently, risk assessments must be conducted by engineers for both government and private man-made slopes in accordance with GEO Technical Guidance Note No. 15 to determine their consequence-to-life categories. In the risk assessment, due considerations would be given to such factors as the proximity of the buildings and facilities to the slope (primarily the crest and toe), their likely density of occupation and frequency of usage, scale of failure, travel distance of the landslide debris, and resistance of the buildings and facilities to debris impact.

4.7 The consequence-to-life category is classified into three levels, i.e. categories 1, 2 and 3 from highest to lowest, to reflect the potential severity of casualties in the event of slope failure. According to the examples given in the abovementioned Technical Guidance Note, category 1 slopes are typically located near buildings or facilities closely related to people's livelihood (including residential buildings, hospitals, commercial buildings, schools, indoor car parks, sports grounds and major thoroughfares). Facilities commonly situated near category 2 slopes include railways, flyovers, and roads with moderate to heavy vehicular and pedestrian traffic density. Category 3 slopes are commonly adjacent to remote facilities such as country parks, undeveloped green belts and roads with low traffic density. Departments with maintenance responsibility for government man-made slopes conduct regular Engineer Inspections for Maintenance, Routine Maintenance Inspections and Regular Checks of Buried Water-carrying Services (where applicable) in accordance with the slope's consequence-to-life category and the Guide to Slope Maintenance[9] issued by CEDD.

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[8] The Slope Maintenance Responsibility Information System website is at https://www2.slope.landsd.gov.hk/smris/disclaimer

[9] The Guide to Slope Maintenance issued by CEDD stipulates the standards of good practice for maintenance of slopes, retaining walls, non-original slopes and landslide mitigation facilities.

4.8 Among these, Engineer Inspection for Maintenance must be conducted by a professionally qualified geotechnical engineer to assess the condition of the man-made slope and whether it has been properly maintained, and to determine whether detailed investigation, Stability Assessment or other improvement works (such as preventive maintenance works and upgrading works) are required. The purpose of Routine Maintenance Inspection is, on the other hand, to determine whether maintenance works have to be carried out for the man-made slope. As recommended by the Guide to Slope Maintenance, Engineer Inspection for Maintenance and Routine Maintenance Inspection should be conducted at least once every five years and once a year respectively for man-made slopes in consequence-to-life category 1 or 2, and at least once every ten years and once every two years respectively for man-made slopes in consequence-to-life category 3.

4.9 Regular Checks of Buried Water-carrying Services are applicable to man-made slopes with water-carrying services underneath, aiming at preventing leakage that could affect the structural safety of slopes. Take ArchSD as an example, as of June 2024, there were over 4,300 government man-made slopes with buried water-carrying services under its purview. Depending on the consequence-to-life category of the slopes, ArchSD would arrange for contractors to conduct a regular check in every five or ten years.

Maintenance of Government Man-made Slopes by Four Maintenance Departments

4.10 Based on information provided by the four major maintenance departments (namely LandsD, HyD, WSD and ArchSD), each department currently engages geotechnical engineering consultants and contractors to carry out Engineer Inspections for Maintenance, Routine Maintenance Inspections and Regular Checks of Buried Water-carrying Services in accordance with the prevailing intervals set out by the respective department (see **table 6**). Engineer Inspections for Maintenance must be conducted by professionally qualified geotechnical engineers, with the primary focus on the structural safety and stability of slopes. Routine Maintenance Inspections, on the other hand, can be undertaken by general personnel which mainly involve checking day-to-day maintenance items, such as any blockage of drainage channels by accumulated debris, or whether trimming is required for overgrown vegetation on the slopes. We note that the inspection intervals set by the departments are in line with CEDD's recommendations in the Guide to Slope Maintenance (see **para. 4.8**).

Table 6: Frequency of maintenance inspections for government man-made slopes conducted by LandsD, HyD, WSD and ArchSD

	LandsD		HyD		WSD		ArchSD	
	Consequence-to-life category of government man-made slopes							
	1 & 2	3	1 & 2	3	1 & 2	3	1 & 2	3
Engineer Inspection for Maintenance[#]	Every 5 years	Every 10 years	Every 5 years	Every 10 years	Every 5 years	Every 10 years	Every 5 years	Every 10 years
Routine Maintenance Inspection	Every year	Every 2 years	Every year	Every 2 years	Every year	Every 2 years	Every year	Every year
Regular Checks of Buried Water-carrying Services	NA	NA	[Note 1]	NA	Every 5 years	NA	[Note 2]	

[#] According to the Guide to Slope Maintenance, Engineer Inspection for Maintenance is generally not applicable to facilities constructed for risk mitigation works on natural terrain. Furthermore, where necessary, CEDD will specifically follow up on maintenance or replacement of flexible barriers.

[Note 1]: Water-carrying services that may affect fill slopes are to be inspected every five years; those affecting slopes not constructed by filling are to be inspected every ten years.

[Note 2]: During the Engineer Inspection for Maintenance, the geotechnical engineer will review data related to water-carrying services and re-assess the proper inspection frequency (generally every five or ten years), which will be recorded in the Maintenance Manual.

4.11 We requested the four maintenance departments to provide information on the government man-made slopes involved in various landslides for examination. In general, each department had carried out different maintenance inspections and related works on the slopes as scheduled. However, there were individual cases that the respective departments were unable to provide specific records of maintenance inspections, or data had been lost due to computer system failure.

4.12 At the same time, each department assigns staff to manage the maintenance of government man-made slopes under its purview. Such duties mainly include arranging for consultants and contractors to conduct Engineer Inspections for Maintenance and Routine Maintenance Inspections respectively, monitoring the performance of consultants and contractors through regular meetings, and conducting internal technical audits by spot checks on the reports of Engineer Inspections for Maintenance.

4.13 Between May and July 2025, we carried out site inspections to understand the four departments' maintenance of government man-made slopes (involving Engineer Inspections for Maintenance and Routine Maintenance Inspections conducted respectively by consultants and contractors), as well as CEDD's procedures for conducting slope maintenance audit inspections.

4.14 According to our observations and understanding, Engineer Inspections for Maintenance are conducted by the professional engineers of consultants. Before carrying out an inspection, engineers first review past records of Engineer Inspections for Maintenance to identify any areas requiring attention, and then confirm the slope boundaries on site. These inspections focus primarily on the structure and stability of slopes. For example, if a slope is largely covered by such vegetation as trees, inspecting engineers will assess slope stability by checking for any overgrown vegetation, abnormalities of trees on the slope (such as tilting or signs of loosening at the roots) and erosion of soil surface (see **figs. 10 and 11**). For instance, during an inspection of a government man-made slope in Tuen Mun, inspecting engineers found signs of loosening at the roots of trees on the slope and leaning tree trunks (see **figs. 12 and 13**). These situations were recorded and referred to the slope maintenance department for follow-up.

4.15 Slopes with concrete surfacing generally have weepholes installed on the surface. In some cases, gunny sacks filled with soil and stones are placed at the weepholes to facilitate drainage and prevent the weepholes from being blocked by other objects. Inspecting engineers would check for any abnormalities in the condition of the concrete surface and weepholes (see **figs. 14 and 15**). Regardless of whether the slope is covered by vegetation or concrete surfacing, inspecting engineers would also check drainage channels and catchpits (if any) for any blockage, cracks, damage and leakage (see **figs. 16 and 17**).

Figures 10 to 17: Engineer Inspection for Maintenance conducted by consultant, inspected by slope maintenance department and shadowed by our officers (Photos taken by our officers)

Figure 10

Figure 11

Figure 12

Figure 13

Figure 14

Figure 15

Figure 16

Figure 17

4.16 Routine Maintenance Inspections are carried out by contractors, covering mainly the day-to-day maintenance of slopes, such as any need to remove sand, stones or overgrown vegetation, any blockage of drainage channels and catchpits by debris or fallen leaves and need for repairs, and any blockage of weepholes on slope surfaces (see **figs. 18 and 19**). After completing the inspection, contractors would arrange for maintenance staff to follow up on items requiring action.

Figures 18 to 19: Routine Maintenance Inspection conducted by contractor, inspected by slope maintenance department and shadowed by our officers (Photos taken by our officers)

Figure 18

Figure 19

4.17 The four departments differ in staff complement, but they share a common point where CEDD's professional geotechnical engineers are seconded to each department to provide technical support on geotechnical works for slope maintenance. Staff complement of the four departments is specified as follows:

(1) LandsD's Slope Maintenance Section comprises 16 professional officers, 17 technical officers and 33 engineering officers.

(2) HyD's slope maintenance and related technical support are undertaken by the Slope Sections of two regional offices (the Urban Region and the New Territories Region) and the Geotechnical Advisory Unit at headquarters, which comprise 14 professional officers and 50 technical officers in aggregate[10].

[10] Six professional officers and six technical officers are also responsible for other duties in addition to slope maintenance.

(3) WSD's slope management is mainly handled by four regional offices (Hong Kong & Islands, Kowloon, New Territories East and New Territories West) and the Slope Safety Section thereunder, which comprise nine professional officers and 12 technical officers.

(4) ArchSD's Special Duties 31 section is responsible for managing fixed-term contracts for slope maintenance, and its Slope Safety section is tasked with overseeing consultants. There are nine professional officers (including maintenance surveyors and geotechnical engineers), ten site supervisors and 14 technical officers.

While all four departments deploy professional staff to handle maintenance and repairs of slopes under their purview, the number ranges from nine to 16 officers. The number of government man-made slopes and mixed responsibility slopes maintained by each department also differs, ranging from 5,871 to 17,363 (see **table 4**). Our calculations revealed that the ratios of professional staff to slopes vary considerably, with each professional officer responsible for an average of 652 to 1,085 government man-made slopes and mixed responsibility slopes (see **table 7**).

Table 7: Ratio of professional staff in LandsD, HyD, WSD and ArchSD

Department	No. of government slopes maintained by department	No. of professional staff	Ratio of professional staff (Average no. of slopes managed per staff) #
LandsD	17,363	16	1,085
HyD	11,231	14	802
WSD	6,372	9	708
ArchSD	5,871	9	652

(No. of government man-made slopes maintained by department / No. of professional staff)

Slope Maintenance Audits and Inter-departmental Collaboration Coordinated by CEDD

4.18 In addition to upgrading government man-made slopes under the Programme, CEDD also periodically selects a department for slope maintenance audits to examine whether it has properly maintained and repaired the slopes under its purview. CEDD explained that slope maintenance audits cover seven major maintenance departments (see **table 4**). Each year, CEDD completes audits of two to three departments, thereby completing a cycle of auditing all seven departments every three years.

4.19 During a slope maintenance audit, each maintenance department is required to submit slope maintenance documents to CEDD, including slope maintenance plans, inspection and repair records, consultancy contracts, meeting minutes and independent audit reports of Engineer Inspections for Maintenance. CEDD spot-checks the documents submitted by departments in accordance with prevailing slope maintenance policies and standards, and verifies whether each department has properly carried out independent audits. In addition, CEDD would inspect a random sample of government man-made slopes to examine whether their actual maintenance conditions align with the documents (including independent audit reports of Engineer Inspections for Maintenance) submitted by departments.

4.20 If there is any area failing to meet the prevailing standard or requiring improvements, CEDD will make recommendations to the maintenance department and ask for submission of a follow-up plan. To further enhance the maintenance and management of government man-made slopes, CEDD has strengthened the site inspections of slope maintenance audits since 2025, with the aim of progressively increasing the number of slopes inspected to around 400 each year. CEDD also plans to launch a Centralised Slope Maintenance Database electronic platform, enabling maintenance departments to upload slope maintenance records for centralised storage. Database analytics will be performed to select government man-made slopes for site inspections.

4.21 The previous cycle of slope maintenance audits commenced in November 2021 and completed in October 2023, where CEDD has not identified any substandard areas or areas requiring recommendations in the work of the seven maintenance departments.

4.22 Further to **paragraph 4.13**, our staff shadowed CEDD staff during audit inspections of three government man-made slopes along the traffic lanes from Repulse Bay Road to Stanley Gap Road. CEDD explained that audit inspections to selected slopes mainly check for any major problems in the maintenance of surface structure, in order to reflect whether the audited departments have properly inspected and maintained the slopes. Drawing on the experience of landslides triggered by the heavy rainstorms in September 2023, CEDD has selected slopes in the latest round of audit inspections based on the maintenance plans submitted by the audited departments, focusing on government man-made slopes located near facilities with greater impact on people's livelihood (such as hospitals) or adjacent to the sole vehicular access.

4.23 Following the inspections, CEDD staff did not find any major problems in the maintenance of the above three slopes, but there were certain weepholes blocked and some drainage channels filled with accumulated debris and fallen leaves at two of the slopes in stone pitching surface (see **figs. 20 and 21**) and vegetated surface (see **figs. 22 and 23**). After consolidation, CEDD referred the issues observed during the inspections to the maintenance departments for follow-up. Subsequent follow-up work has since been completed.

Figures 20 to 23: Slope maintenance audit inspections conducted by CEDD and shadowed by our officers
(Photos taken by our officers)

Location: Repulse Bay Road
(Feature Ref. No. 15NE-A/C80)

Figure 20

Figure 21

Location: Stanley Gap Road
(Feature Ref. No. 15NE-A/C134)

Figure 22

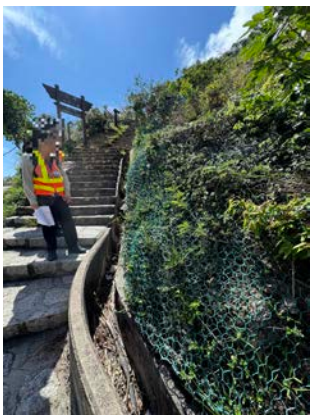

Figure 23

4.24 Moreover, CEDD has since 1996 established an inter-departmental platform for slope management with regular meetings, chaired by the Head of the GEO and comprising representatives from the Development Bureau ("DEVB"), the seven major maintenance departments and BD. Held biannually, the meetings promote collaboration among departments in monitoring and ensuring slope safety. The matters discussed at the meetings mainly cover the different types of works carried out by maintenance departments on slopes under their purview, the latest situation regarding private man-made slopes subject to Dangerous Hillside Orders, technical issues relating to slope safety and management, and coordination of emergency responses to landslides. To further enhance the effectiveness of implementing matters discussed at the meetings, CEDD has since 2024 required participating departments (including the seven major maintenance departments) to nominate directorate officers to attend.

5

ANALYSIS OF PAST LANDSLIDES

OVERVIEW

5.1 According to CEDD's statistics, more than 7,800 landsides were reported in the 26 years between 1989 and 2014, representing an average of 300 per year. During this period, more than 800 landsides were reported in 1993 and 2008 due to extreme rainstorms (see **fig. 24**). The statistics suggest a downward trend with 2,141 landslides reported in the recent decade (2015 to 2024), ranging from 76 to 601 each year or an annual average of 214 which is nearly one-third lower than the annual average of 300 between 1989 and 2014 (see **table 8**).

5.2 However, there were 601 landslides recorded in Hong Kong in 2023, mostly triggered by extreme rainfall. During the torrential rainstorms between September and October 2023, CEDD received 300 reports of confirmed landslides, accounting for 50% of the entire year. After consolidating the landslide statistics for 2023 based on three criteria, namely the scale of incidents, the type of slopes involved and the impact, CEDD found that over one-fifth (127 cases or 21.1%) were major landslides (with a debris volume of 50 cubic metres or more) (see **para. 5.46**). Regarding slope types, over seventy per cent (432 cases or 71.9%) involved man-made slopes, with the remainder occurring on natural hillside catchments. As regards the impact, over half of the incidents affected transport infrastructure such as roads and footpaths, while nearly one-fifth (108 cases or 16.3%) had an impact on buildings.

5.3 On the other hand, CEDD explained that the location, intensity and duration of heavy rainfall would all affect the probability of landslides. During heavy rainfall, large volumes of rainwater flow rapidly over the slope surface, which may erode the surface and trigger landslides. At the same time, rainwater seeping into the soil of the slope raises the groundwater level. The increased water pressure reduces the friction between soil particles, which may also cause landslides. Should rainfall exceed the capacity of streams, catchwater or drainage channels, particularly when catchwater or drainage channels were obstructed by debris and fallen foliage carried by the downpour, rainwater may pool and overflow at specific points, subsequently flowing towards adjacent slopes. When substantial volumes of rainwater wash over and infiltrate the

slope, it may cause surface erosion and rise of groundwater level as mentioned above, thereby triggering a landslide.

Figure 24: Statistics on landslides reported in Hong Kong between 1989 and 2014

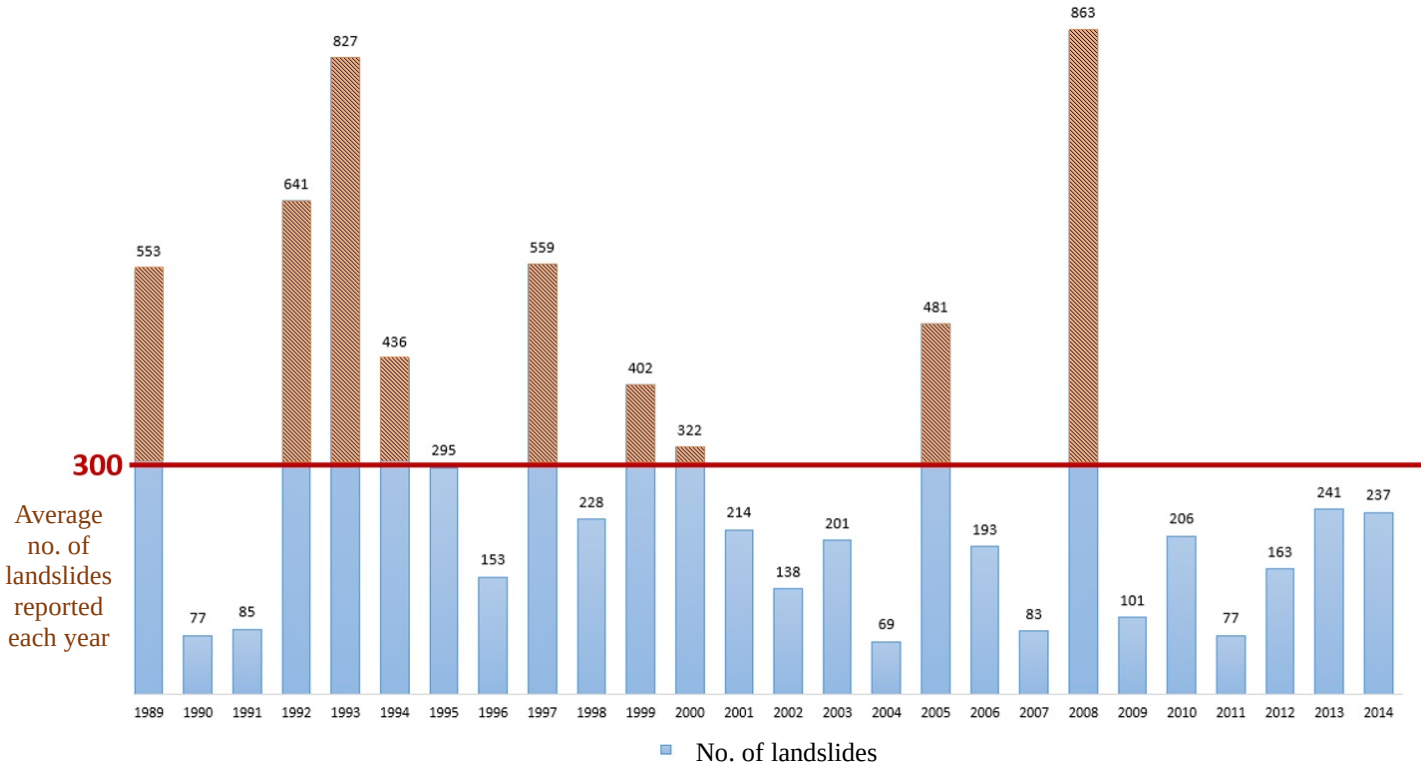

Table 8: Statistics on landslides reported in Hong Kong between 2015 and 2021

Year	No. of landslides	
2015	161	**An average of 214 landslides each year** (2,141/10) = 214.1
2016	226	
2017	152	
2018	253	
2019	131	
2020	214	
2021	146	
2022	76	
2023	601	
2024	181	
Total	**2,141**	

STATISTICS ON LANDSLIDES INVOLVING DIFFERENT TYPES OF SLOPES

5.4 According to CEDD's data, more than 40% of landslides in Hong Kong over the past decade (2015 to 2024) involved government man-made slopes (882 cases), followed by natural hillside catchments (507 cases or nearly 25%). Both figures are significantly higher than the 5.4% (117 cases) associated with private man-made slopes (see **table 9**). Our investigation revealed that between 2020 and 2024, around 10% (68 cases) of the 630 landslides involving man-made slopes in Hong Kong were classified as major incidents (with a debris volume of 50 cubic metres or more). The failure rates of both government and private man-made slopes remained at very low levels (see **tables 10 and 11**). Furthermore, a majority (79.5%) of the landslides occurred on government man-made slopes classified as consequence-to-life category 2 or 3 (see **table 12**) (Note: The consequence-to-life category is classified into three levels, with category 1 being the highest and 3 the lowest, as detailed in **paragraph 4.7**).

5.5 We note that there are far more government man-made slopes than private ones in Hong Kong, so the higher number of incidents involving government man-made slopes is understandable. However, discounting the difference in the number of incidents involving the two kinds of slopes, the failure rate of government man-made slopes is still higher than that of private ones. Take 2024 as an example, the failure rate was 0.2% for government man-made slopes[11] (see **table 10, column (c)**) and 0.06% for private ones[12] (see **table 11, column (c)**), representing a difference of more than twofold. CEDD explained that the landslides in 2024 were mainly caused by several heavy rainstorms during the year, and the types of slopes affected were largely subject to the area affected by the rainstorms. For example, the heavy rainstorms in May 2024 primarily occurred in Sai Kung District, where there were fewer private man-made slopes but numerous government man-made slopes classified as consequence-to-life category 3 located along non-busy roads or in rural areas. In that month, CEDD recorded 24 landslides involving government man-made slopes and 4 involving private ones in Sai Kung District, which accounted for over one-third of all landslides in 2024. These figures demonstrate how the distribution of rainfall influences the types of slopes affected by landslides.

[11] (Number of government man-made slopes with landslides / Total number of government man-made slopes) × 100%

[12] (Number of private man-made slopes with landslides / Total number of private man-made slopes) × 100%

Table 9: Statistics on landslides between 2015 and 2024, with a breakdown by type of slopes

	No. of landslides involved	Percentage # (%)
Natural hillside catchments	507	23.7%
Government man-made slopes	882	41.2%
Private man-made slopes	117	5.5%
Mixed responsibility slopes	122	5.7%
Other unregistered small man-made slopes ^	513	23.9%
Total	**2,141**	**100%**

Percentage = (No. of landslides involved / Total no. of landslides) x 100%

^ "Unregistered small man-made slopes" are man-made slopes not meeting the registration requirements stipulated in DEVB Technical Circular (Works) No. 2/2018. For example, a landslide occurred in 2022 on an unregistered cut slope adjacent to Hatton Road, Mid-levels. The cut slope less than 3 metres in height did not meet the requirements for slope registration.

Table 10: Statistics on failure rate of government man-made slopes between 2020 and 2024

Year	No. of government man-made slopes (a)	No. of landslides involving government man-made slopes # (b)	Failure rate of government man-made slopes # [(b)/(a)] x 100% (c)
2020	37,791	84 (3)	0.2% (0.01%)
2021	38,268	61 (6)	0.2% (0.02%)
2022	38,474	36 (4)	0.1% (0.01%)
2023	38,583	237 (45)	0.6% (0.12%)
2024	38,656	66 (6)	0.2% (0.02%)

Figures in ( ) represent the number or percentage of major landslides.

Table 11: Statistics on failure rate of private man-made slopes between 2020 and 2024

Year	No. of private man-made slopes (a)	No. of landslides involving private man-made slopes # (b)	Failure rate of private man-made slopes # [(b)/(a)] x 100% (c)
2020	15,312	8 (1)	0.05% (0.01%)
2021	15,706	8 (0)	0.05% (0%)
2022	15,825	4 (0)	0.03% (0%)
2023	15,885	43 (2)	0.3% (0.01%)
2024	15,878	10 (1)	0.06% (0.01%)

Figures in ( ) represent the number or percentage of major landslides.

Table 12: Statistics on government man-made slopes with landslides between 2020 and 2024, with a breakdown by consequence-to-life category

Year	Consequence-to-life category (No. and percentage of government man-made slopes with landslides)			
	1	2	3	Total #
2020	22 (23.2%)	14 (14.7%)	59 (62.1%)	95 (100%)
2021	14 (21.2%)	25 (37.9%)	27 (40.9%)	66 (100%)
2022	5 (13.5%)	5 (13.5%)	27 (73%)	37 (100%)
2023	44 (16.9%)	50 (19.1%)	167 (64%)	261 (100%)
2024	24 (32.4%)	15 (20.3%)	35 (47.3%)	74 (100%)
Total	109 (20.5%)	109 (20.5%)	315 (59%)	533 (100%)

Since one incident might involve more than one man-made slope, the number of slopes in **table 12** may exceed the number of incidents in **table 10**.

ANALYSIS OF LANDSIDES INVOLVING NATURAL HILLSIDE CATCHMENTS

5.6 As mentioned in **paragraph 5.4**, the landslides occurred in Hong Kong over recent years mostly involved government man-made slopes and natural hillside catchments. In this connection, we have reviewed nine serious landslides that occurred since 2008[13] (including four incidents occurred in 2021 and 2023) and found that most

[13] In 2008, 863 landslides were reported, a record high in more than 30 years (see **fig. 24**).

involved natural hillside catchments. Prior to the incidents, a majority of them had not been included in the Programme, or even if they had been so included, they were accorded a relatively low priority such that the actual study and design of works had yet to commence by a consultancy contract before the incidents (see **table 13**).

Table 13: Statistics on nine serious landslides since 2008

Date and location of incident (In chronological order)	**Type of slope**	**Maintenance department**	**Details of natural terrain involved**	
			Inclusion in the Programme before incident	**Date of inclusion in consultancy contract under the Programme**
Jun 2008 West Lantau	Natural hillside catchments	-	NA #	Risk mitigation works undertaken immediately after incident
Jun 2008 North Lantau	Natural hillside catchments	-	NA #	Risk mitigation works undertaken immediately after incident
Jun 2008 Cafeteria Old Beach	Mixed responsibility slope	Private and LandsD	-	-
May 2016 Sai Wan Road, Sai Kung	Natural hillside catchments	-	No	Risk mitigation works undertaken as part of emergency works
Aug 2018 Fan Kam Road	Natural hillside catchments	-	Yes *	Dec 2019
Jun 2021 South Lantau Road, Lantau Island	Natural hillside catchments	-	Yes *	Mar 2022
Nov 2021 Peak Road, Mid-levels ^	Government man-made slope	HyD	-	-
Sep 2023 Yiu Hing Road, Shau Kei Wan	Natural hillside catchments	-	Yes	Jul 2023

Date and location of incident (In chronological order)	Type of slope	Maintenance department	Details of natural terrain involved	
			Inclusion in the Programme before incident	Date of inclusion in consultancy contract under the Programme
Sep 2023 Shek O Road	Government man-made slope	HyD	-	-

The Programme was launched in 2010.

* Natural hillside catchments on Fan Kam Road and South Lantau Road, Lantau Island were included in the Programme before the incidents, but not in any consultancy contracts for commencement of actual study and design of works due to low priority.

^ A burst underground water pipe on Peak Road caused a landslide by eroding the slope beneath that road section.

Landslide on South Lantau Road, Lantau Island in June 2021 (involving a natural hillside catchment included in consultancy contract under the Programme after the incident)

5.7 When the red rainstorm warning signal was in force in June 2021, a major landslide occurred on a natural hillside catchment near Cheung Sha Beach along South Lantau Road, Lantau Island. It was classified as a major landslide with over 2,000 cubic metres of debris collapsing and covering around 100 metres long of the traffic lanes near Cheung Sha Beach. The bus shelter adjacent to the nearby taxi stand was also damaged. Following the incident, the affected section of South Lantau Road was closed for one day; CEDD also conducted a joint inspection with HyD (see **figs. 25 and 26**). As this landslide involved a natural hillside catchment on unleased and unallocated government land and affected HyD's facilities (i.e. South Lantau Road), CEDD recommended, pursuant to paragraph B.2.(b) of Appendix A to DEVB Technical Circular (Works) No. 6/2011, that HyD, as the responsible department, undertake emergency repair works to address the immediate danger. The works were completed in July of the same year. Subsequently, following detailed risk assessment and prioritisation, CEDD included the natural hillside catchment (primarily covering the section where emergency works had been completed and registered as a man-made slope) in the Programme in March 2022. Technical assessment revealed the need to further expand the scope to also cover the adjacent natural hillside catchment. The study and design of works are expected to commence in the first quarter of 2026.

Figures 25 and 26: Photos of joint inspection after landslide on South Lantau Road, Lantau Island in June 2021 (Courtesy of CEDD)

Figure 25

Figure 26

Landslide on Yiu Hing Road, Shau Kei Wan in September 2023 (involving a natural hillside catchment already included in consultancy contract under the Programme prior to the incident)

5.8 Additionally, we selected another landslide involving a natural hillside catchment that occurred during the torrential downpour in September 2023 (with the highest 24-hour rainfall in urban areas ranging from 500 to 800 millimetres) to demonstrate CEDD's follow-up on the Programme and post-landslide emergency response.

5.9 In July 2023, CEDD was preparing to include the natural hillside catchment on Yiu Hing Road, Shau Kei Wan in a consultancy contract under the Programme in accordance with its risk-based mechanism (see **para. 2.14**). It arranged for a newly appointed consultant to conduct detailed ground investigation and design risk mitigation works for the hillside in 2024.

5.10 However, during the extreme weather event on 8 September 2023, a severe landslide with a source area of nearly 2,000 square metres occurred on the hillside (see **figs. 27 and 28**). It was the largest rockfall on record in Hong Kong (Note: Analysis of the incident's causes is given in **paragraph 5.56**). Despite no casualties being reported, several large boulders detached from the hillside and rolled onto the traffic lanes, covering a large road section and crushing some private vehicles. The affected road section had to be fully closed as a result.

Figures 27 and 28: Photos of landslide on Yiu Hing Road, Shau Kei Wan in September 2023 (Courtesy of CEDD)

Figure 27

Figure 28

5.11 Following the incident, CEDD promptly collaborated with HyD to formulate a plan for emergency repair works, which were carried out in two phases. Upon completion of the first phase, HyD re-opened one traffic lane in March 2024 for one-way westbound traffic. The second phase primarily involved reinforcing the slope near the road surface with shotcrete, stabilising isolated boulders in the middle portion of the slope with the installation of rock nails, constructing concrete buttresses to stabilise the remnant tor at the crown of the slope, and repairing the surface of the traffic lane and footpath that were still closed (see **figs. 29 and 30**).

Figures 29 and 30: Photos of emergency repair works after landslide on Yiu Hing Road, Shau Kei Wan in September 2023 (Courtesy of CEDD)

Figure 29

Figure 30

5.12 The second phase was completed in June 2024. HyD fully re-opened the two traffic lanes on Yiu Hing Road and partially re-opened the footpath in the vicinity. Upon completing the two phases of repair works, HyD continued to carry out slope protection works, including the installation of metal protection netting in the middle portion of the slope, to protect the safety of road users. In March 2025, all works were completed and the remaining sections of footpath were re-opened.

5.13 While formulating the emergency recovery plan, CEDD also commenced in September 2023 a systematic investigation and study of the landslide (see **para. 5.52**). Its investigation revealed that during the torrential rain, the catchwater and streams near the hillside overflowed, resulting in large volumes of rainwater infiltrating the hillside along its specific rock joints and triggering the landslide.

5.14 Regarding the risk mitigation works under the Programme, CEDD awarded the consultancy contract in June 2024, and the consultant commenced the follow-up work in July 2024.

ANALYSIS OF LANDSLIDES INVOLVING GOVERNMENT MAN-MADE SLOPES

5.15 CEDD explained that most landslides on government man-made slopes were triggered by torrential rain, with the location, intensity and duration of rainfall all affecting the probability of landslide.

5.16 We have selected four maintenance departments, namely LandsD, HyD, WSD and ArchSD, with the largest number of government and mixed responsibility slopes under their purview (see **chapter 4**) to examine their maintenance work and post-landslide response. Particularly, we requested the departments to provide details of government man-made slopes involving at least one relatively serious landslide since 2014 (see **table 14**).

5.17 We note that all four departments have conducted Routine Maintenance Inspections and Engineer Inspections for Maintenance (see **table 14, columns (d) and (e)**) within the time frames as stipulated in the Guide to Slope Maintenance (see **para. 4.8**) for these slopes involving repeated landslides. However, most of these slopes are not included in the Programme, and some slopes had repeated landslides within three years after the first incident in 2014 (including slopes located at Wing Lung Road, Hang Hau; Pak Tam Road, Sai Kung; South Lantau Road, Lantau Island; Lower Shing Mun Reservoir; and Tai Lam Chung Catchwater).

Table 14: Statistics on government man-made slopes with at least one serious landslide since 2014

Main-tenance depart-ment (a)	Date and location of incident (Feature Ref. No.) (b)	Conse-quence-to-life category (c)	Date of Routine Maintenance Inspection before incident (d)	Date of Engineer Inspection for Maintenance before incident (e)	Inclusion in the Pro-gramme (f)	Date of inclusion in consultancy contract under the Programme (g)
LandsD	May 2014 Jun 2017 Lung Ha Wan Road, Sai Kung (12NW-D/C4)	3	Apr 2010 Jul 2012 Apr 2014 [#] Mar 2016	Dec 2004 Apr 2014 [#]	No	-
	May 2014 Jun 2021 Lung Ha Wan Road, Sai Kung (12NW-C/C207)	3	Apr 2010 Jul 2012 Jul 2018 Jun 2020	Jun 2005 Aug 2014	No	-
	May 2016 Jul 2017 Jul 2020 Jul 2021 Wing Lung Road, Hang Hau (12NW-C/C297)	3	[Note 1] Nov 2016 Nov 2018 Sep 2020	Dec 2009 Sep 2017	NA [^]	-
HyD	Jun 2020 Jun 2022 Pak Tam Road, Sai Kung (8NW-D/C5)	3	Jun 2017 Oct 2019 Oct 2021	Jun 2005 Jun 2015	Yes	Jun 2022
	Oct 2023 May 2024 South Lantau Road, Lantau Island (13NE-A/C74)	2	May 2022 May 2023 May 2024	Mar 2014 Apr 2019	Yes	Nov 2023
	Nov 2016 Sep 2023 Shek O Road (11SE-D/F47)	2	Nov 2014 Nov 2015 Nov 2021 Nov 2022	Oct 2009 Aug 2014 Feb 2020	NA [@]	-
WSD	Oct 2020 Sep 2023 Lower Shing Mun Reservoir (7SW-D/C808)	3	Mar 2021 Mar 2023	Mar 2015 Mar 2019	No	-

Main-tenance depart-ment (a)	Date and location of incident (Feature Ref. No.) (b)	Conse-quence-to-life category (c)	Date of Routine Maintenance Inspection before incident (d)	Date of Engineer Inspection for Maintenance before incident (e)	Inclusion in the Pro-gramme (f)	Date of inclusion in consultancy contract under the Programme (g)
	Aug 2018 Feb 2019 Tai Lam Chung Catchwater (6SE-A/CR187)	3	May 2015 Apr 2017	Nov 2002 Aug 2012	No	-
	Jul 2015 Aug 2019 High Island Reservoir, Sai Kung (8SE-D/C2)	3	Mar 2013 Feb 2015 Feb 2017 Feb 2019	Aug 2000 Jun 2010	No	-
ArchSD	Aug 2018 Sep 2023 Wo Hop Shek Cemetery (3SW-C/C412)	3	Apr 2017 Feb 2018 Mar 2022 Mar 2023	Jun 2001 [Note 2] Nov 2022	No	-
	Apr 2014 Sep 2023 Wo Hop Shek Cemetery (3SW-C/C631)	3	Sep 2012 * Sep 2013 Apr 2022 Apr 2023	Jul 2001 Jul 2011 Aug 2021	No	-

[Note 1]: LandsD stated that it was unable to locate the Routine Maintenance Inspection records from the two years preceding the 2016 incident.

[Note 2]: In 2011-2012, this slope was incorporated into the development project for Wo Hop Shek Columbarium and Garden of Remembrance, with site formation works carried out as per existing safety standards. Consequently, the subsequent Engineer Inspection for Maintenance was scheduled for ten years later (i.e. 2022).

* Regarding the government man-made slope at Wo Hop Shek Cemetery (Feature Ref. No. 3SW-C/C631), ArchSD stated that records of the Routine Maintenance Inspection conducted in September 2012 were lost due to a computer system failure.

The Engineer Inspection for Maintenance conducted in April 2014 already included the Routine Maintenance Inspection for the same year.

^ LandsD included the government man-made slopes on Wing Lung Road, Hang Hau (Feature Ref. No. 12NW-C/C297) in the Preventive Maintenance Programme in September 2021, with upgrading works completed in December the same year.

@ Since HyD has already included the government man-made slopes on Shek O Road (Feature Ref. No. 11SE-D/F47) in the Preventive Maintenance Programme in May 2024, it is not necessary to include it in the Landslip Prevention and Mitigation Programme.

Landslides on Shek O Road in November 2016 and September 2023 (Repeated Landslides)

5.18 Among these, the government man-made slope on Shek O Road (Feature Ref. No. 11SE-D/F47) under HyD's purview recorded a landslide in November 2016, followed by a second landslide during the September 2023 torrential rainstorm (see **figs. 31 to 34**). The slope covering an area of around 250 square metres was classified as consequence-to-life category 2. HyD stressed that prior to both incidents, it had arranged for consultants and contractors to complete inspection and maintenance work in accordance with established procedures (see **table 14, government man-made slope on Shek O Road, columns (d) and (e)**).

5.19 The primary cause of the November 2016 incident was extensive erosion due to heavy rainfall, though it did not affect Shek O Road above the slope. Following the incident, HyD arranged for contractors to carry out repair works as advised by CEDD. The works including backfilling the landslide area of around 80 square metres with no-fines concrete were completed in early January 2017.

Figures 31 and 32: Photos of landslide on Shek O Road in November 2016 (Courtesy of HyD)

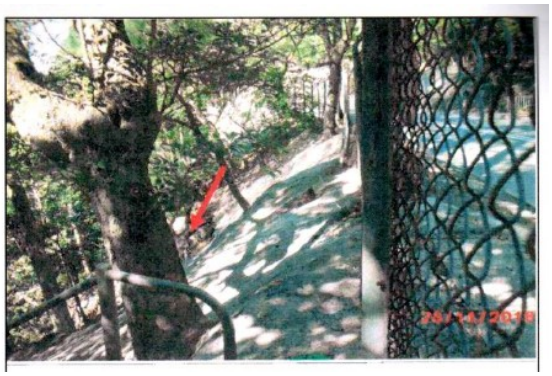

Figure 31

Figure 32

5.20 Regarding the landslide during the September 2023 torrential rainstorm, the affected slope area was around 200 square metres. It was a major landslide with a debris volume of about 650 cubic metres. The investigation revealed that the landslide was mainly caused by continuous heavy rain where large amounts of rainwater mixed with debris flowed into the streams and collected in the catchpits adjacent to Shek O Road. When the catchpits became blocked, the water overflowed onto Shek O Road and eroded the man-made slope.

Figures 33 and 34: Photos of landslide on Shek O Road in September 2023 (Courtesy of HyD)

Figure 33

Figure 34

5.21 According to records, HyD immediately inspected the site jointly with CEDD staff upon receiving the incident report. They found that the incident had caused the collapse of one traffic lane of Shek O Road on the hillside. The affected section was closed to all traffic.

5.22 In response, HyD, acting on CEDD's recommendations, first arranged for contractors to fill the collapsed area with crushed stones to stabilise the landslide debris, so that one traffic lane of the affected section could be re-opened to the public within two days. HyD subsequently arranged recovery works, including the construction of mini piles and concrete capping beams (see **figs. 35 and 36**), to further enhance the stability of the slope in question. By February 2024, the recovery works were largely completed, and the affected road section was fully re-opened.

Figures 35 and 36: Photos of recovery works undertaken by HyD after landslide on Shek O Road in September 2023 (Courtesy of HyD)

Figure 35

Figure 36

Landslides on Wing Lung Road, Hang Hau in May 2016, July 2017, July 2020 and July 2021 (Repeated Landslides)

5.23 Furthermore, four separate landslides occurred on the government man-made slope at Wing Lung Road, Hang Hau, Sai Kung (Feature Ref. No. 12NW-C/C297) under LandsD's purview at different parts of the slope within five years between 2016 and 2021. The slope about 150 metres long with an area of about 397 square metres was classified as consequence-to-life category 3. LandsD stated that it had arranged maintenance inspections for the slope within the time frame stipulated by the department (see **table 14, government man-made slope on Wing Lung Road, Hang Hau, columns (d) and (e)**). However, LandsD could not locate the Routine Maintenance Inspection records from the two years preceding the first landslide in May 2016.

5.24 On 30 May 2016, the first landslide with a debris volume of about 3 cubic metres occurred on the slope, affecting a small area of slope vegetation. CEDD conducted a site inspection on the same day, and provided LandsD with written recommendations the following day. LandsD was advised to cordon off the site and carry out emergency works, which mainly involved removing the collapsed debris, hard surfacing the affected area, and installing weepholes. The emergency works were completed on 6 July.

5.25 A year later, another landslide occurred on 19 July 2017 at a different location on the slope (see **fig. 37**), releasing a debris volume of about 5 cubic metres and again affecting only the vegetation on the slope surface. CEDD conducted a site inspection jointly with LandsD on 21 July and provided recommendations on the emergency works to be carried out, which mainly involved applying a shotcrete protective layer and installing weepholes. The emergency works were completed on 11 August.

Figure 37: Photos of landslide on Wing Lung Road, Hang Hau in July 2017 (Courtesy of LandsD)

Figure 37

5.26 On 3 July 2020, the third landslide occurred at another section of the slope (see **fig. 38**), releasing a debris volume of about 19 cubic metres and affecting a larger area of vegetation. Subsequently, CEDD conducted an inspection and recommended that LandsD remove the collapsed debris, pave the landslide site with hard surfacing, and install weepholes. The relevant works were completed on 16 November 2020.

5.27 A fourth landslide resulting in a downfall of debris at a volume of about 65 cubic metres occurred at another section of the slope on 20 July 2021 (see **fig. 39**). It was a major landslide. On the same day and 21 July, CEDD and LandsD conducted a site inspection. Following the inspection, CEDD recommended that LandsD first close off the site and remove the debris, then pave the exposed slope section with hard surfacing and install weepholes. In September 2021, LandsD included the slope in its preventive maintenance programme and installed soil nails for the entire slope. The stabilisation works were completed on 13 December 2021.

Figures 38 and 39: Photos of landslides on Wing Lung Road, Hang Hau in July 2020 and July 2021 (Courtesy of LandsD)

Figure 38

Figure 39

5.28 In addition to government man-made slopes with repeated landslides, we also requested CEDD and relevant maintenance departments to provide information on more serious landslides over recent years involving government man-made slopes classified as consequence-to-life category 1 or 2 (see **para. 4.7**) for review. We note that most of these slopes had not been included in the Programme prior to the incidents, or already included but required several years for study and works design.

Landslide on Ping Chi Street, Hung Hom in September 2023 (involving a government man-made slope included in the Programme after the incident)

5.29 Take the landslide that occurred on Ping Chi Street, Hung Hom near Fat Kwong Street Playground during the September 2023 torrential rainstorm as an example, the government man-made slope involved was maintained by ArchSD [14]

[14] Since June 2017, the maintenance responsibility of this man-made slope has been transferred from private owners to ArchSD.

(Feature Ref. No. 11NW-D/C83) and classified as consequence-to-life category 1, covering an area of around 2,238 square metres. The primary cause of the incident was persistent heavy rainfall causing water to infiltrate the soil on the slope, triggering a landslide that ultimately released a debris volume of around 150 cubic metres (with the landslide area covering about 130 square metres), which constituted a major landslide.

5.30 CEDD's Emergency Control Centre was notified of the incident by ArchSD on 10 September 2023 and confirmed that the traffic lanes of Ping Chi Street adjacent to the slope was obstructed. ArchSD's contractor was required to attend the site for emergency follow-up (including cordoning off the affected area, clearing the road surface and covering exposed debris with waterproof sheeting). The relevant work was completed that evening, and Ping Chi Street was subsequently re-opened. Given that ArchSD was following up on the incident, CEDD has initially allocated resources to other newly reported incidents awaiting attention as it had received numerous landslide reports during the same period. On 11 September, CEDD conducted a site inspection jointly with ArchSD and provided the latter with recommendations for emergency slope repairs, including shotcrete surface protection works (see **figs. 40 and 41**). In October 2023, ArchSD completed emergency repairs to the affected slope section as recommended by CEDD.

Figures 40 and 41: Photos of joint inspection after landslide on Ping Chi Street, Hung Hom in September 2023 (Courtesy of CEDD)

Figure 40

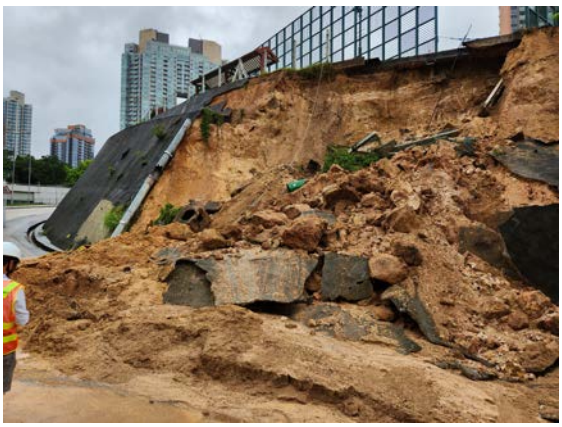

Figure 41

5.31 Following the incident, CEDD included the man-made slope in question in the consultancy contract under the Programme in October 2023. The Department completed the detailed design for upgrading works in December 2024 and commenced the relevant works in the same month, which was expected to be completed in December 2025.

Landslide on Clear Water Bay Road, Sai Kung in May 2024 (involving a government man-made slope included in the Programme after the incident)

5.32 Another landslide occurred near the junction of Clear Water Bay Road, Sai Kung and Wing Lung Road, Hang Hau involving a government man-made slope (Feature Ref. No. 12NW-C/F117) maintained by HyD, covering an area of around 1,027 square metres. This slope was classified as consequence-to-life category 2.

5.33 When the amber rainstorm warning signal was in force on 4 May 2024, a landslide occurred on the aforementioned slope, releasing a debris volume of about 280 cubic metres. The eastbound traffic lane of Clear Water Bay Road downslope had to be closed temporarily. Upon being notified of the incident on the same day, CEDD immediately conducted a site inspection with HyD and provided recommendations to the latter regarding contingency measures and repair works (including cordoning off the affected area and hard surfacing the landslide scar) (see **figs. 42 and 43**). Following completion of the emergency slope repair works, HyD fully re-opened the affected road section at 1am on 6 May.

Figures 42 and 43: Photos of joint inspection after landslide on Clear Water Bay Road, Sai Kung in May 2024 (Courtesy of CEDD)

Figure 42

Figure 43

5.34 Subsequently, HyD took forward CEDD's recommendations to carry out phase 2 of the upgrading works, which were completed on 11 May. In response to this landslide, CEDD reviewed its risk-based prioritisation of government man-made slopes and included this slope in the Programme in May 2024. Ground investigation on-site was completed in August 2025. At present, laboratory testing of soil and design of upgrading works are in progress. The upgrading works is expected to commence in mid-2026 and take six to nine months.

Landslide near Tai Po Road, Sha Tin in September 2023 (involving a government man-made slope with upgrading works commenced several years after inclusion in the Programme)

5.35 The last landside occurred at a residential estate near Tai Po Road, Sha Tin. The government man-made slope involved (Feature Ref. No. 7SW-D/CR65) under the purview of LandsD was classified as consequence-to-life category 1, covering an area of around 600 square metres.

5.36 When the black rainstorm warning signal was in force on 8 September 2023, a major landslide occurred on the abovementioned slope with a debris volume of around 500 cubic metres, resulting in obstruction of a private road. In the wake of the incident, the Police and the Fire Services Department ("FSD") evacuated the residents from the two buildings near the slope.

5.37 After receiving a report of the incident on the same day, CEDD's Emergency Control Centre immediately deployed staff to conduct joint inspection with LandsD and BD. It recommended enlarging the scope of evacuation to two more buildings, and advised on the emergency repair works (see **figs. 44 and 45**). After partial clearance of debris, CEDD inspected the site again with LandsD on 11 September, and confirmed that the emergency works were underway as advised by CEDD. After CEDD staff confirmed that the immediate danger posed by the man-made slope had been mitigated, evacuated residents were arranged to return to their home. All emergency repair works were completed by 21 October.

5.38 In August 2022 (i.e., prior to the landslide), CEDD had already included the slope in question in the Programme for study and works design, which were to be completed in 2025. Subject to the consent of private land owners in the vicinity, the upgrading works are expected to commence in the first quarter of 2026.

Figures 44 and 45: Photos of joint inspection after landslide on Tai Po Road, Sha Tin in September 2023 (Courtesy of CEDD)

Figure 44

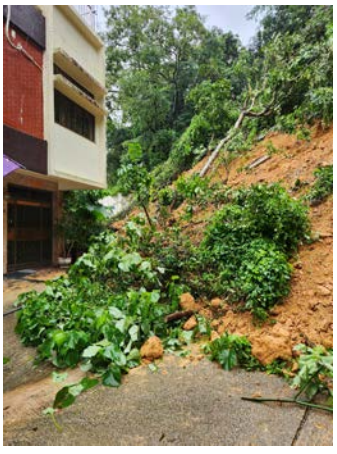

Figure 45

STRENGTHENING STRATEGIES TO COPE WITH EXTREME WEATHER

5.39 In the Policy Address 2023, the Chief Executive stressed that the Hong Kong Special Administrative Region Government should continuously strengthen its overall capacity to cope with extreme weather in terms of preparedness, early warning, emergency response and recovery. Instructed by the Chief Executive, the Chief Secretary for Administration has set up and chaired a cross-departmental steering committee. In response to the successive threats posed by super typhoons and torrential rainstorms since 2023, the committee has convened multiple meetings and stipulated four key strategies, namely advance preparedness, enhanced early warning, decisive emergency response and speedy recovery, with the aim of minimising the damage and impact caused by extreme weather. The parts of the four strategies relevant to this direct investigation operation are elaborated below.

5.40 For advance preparedness, CEDD had identified around 500 government man-made slopes adjacent to the sole vehicular access to communities or essential livelihood facilities before the 2024 rainy season. In addition to routine maintenance inspections, relevant maintenance departments were required to conduct special inspections for those slopes prior to the onset of the rainy season, thereby reducing the likelihood of incidents that could adversely affect the daily lives of residents. Those slopes distributing across the territory were under the purview of HyD (441 slopes), LandsD (42 slopes), ArchSD (39 slopes), WSD (32 slopes) and DSD (6 slopes).

5.41 During the inspections before the 2024 rainy season, relevant departments identified 22 slopes requiring follow-up, including the removal of vegetation from slope surfaces, repair of slope protective layers and channel cracks, and clearance of drainage channels and weepholes. All follow-up works were completed by June 2024. In addition to these pre-season inspections, all maintenance departments carried out special inspections in 2025 in response to heavy rainfall and typhoons, focusing on government man-made slopes with higher potential impact. Where necessary, immediate maintenance works were arranged to mitigate hazards.

5.42 CEDD has continued its publicity through public exhibitions, television announcements, radio interviews and media briefings. These efforts serve to remind private owners of the importance of undertaking slope maintenance prior to the onset of the rainy season, and encourage the public to familiarise themselves with the Landslide Self-help Tips.

5.43 For enhanced early warning, the authorities will continue to strengthen the dissemination of information on flooding, landslides and tree collapses through social media and other channels. In response to extreme weather conditions, CEDD, in collaboration with HKO, introduced the Special Landslip Advisory in 2024, supplementing the existing Landslip Warnings to remind the public of localised landslide risks. Furthermore, CEDD has developed a model for pilot use in mid-2025, which enhances the assessment of landslide risks and the issuance of Landslip Warnings

based on local rainfall data, landslide records and information on man-made slopes, combined with machine learning technology and big data analytics (see **chapter 3**).

5.44 As regards decisive emergency response and speedy recovery, the Security Bureau will activate the Emergency Monitoring and Support Centre in the event of severe and extreme weather conditions. Moreover, to ensure the effective handling of emergency work, the Government has expanded the number of contractors available for deployment. DEVB will activate the Emergency Response System to consolidate, organise and coordinate contractor resources across works departments. In cases of flooding, landslides or similar incidents, contractors will be mobilised swiftly to carry out clearance operations for restoring normalcy as soon as possible.

5.45 CEDD will continue to research and introduce a range of innovative initiatives, including drones (see **fig. 46**), quadruped climbing robots (commonly referred to as "robotic dogs") (see **fig. 47**) and LiDAR with remote sensing technology, to strengthen its capability in coping with landslide and post-hazard risks. In parallel, CEDD will further enhance the Common Operational Picture[15], such as incorporating real-time drone imagery and data queries and analysis powered by artificial intelligence, thereby improving the sharing of real-time information among departments.

Figures 46 and 47: Drone and quadruped climbing robot (Courtesy of CEDD)

Figure 46

Figure 47

[15] The Common Operational Picture is a cloud-based, map-centric electronic platform developed by CEDD for departments to share real-time emergency information related to natural hazards triggered by adverse weather. It facilitates monitoring and assessment of emergency situations and formulation of response strategies.

LANDSLIDE INVESTIGATION AND STUDY

Investigation of Major Landslides

5.46 CEDD has a Landslip Investigation Section dedicated to investigate the causes of major landslides, so as to enable appropriate follow-up by the authorities. A major landslide is defined as a failure releasing a debris volume of 50 cubic metres or above (Note: 50 cubic metres is approximately equivalent to the volume of a 28-seat minibus) with an impact on buildings or roads. During investigations, the Section pays attention to whether unauthorised building works or illegal occupation of government land are involved. Where necessary, CEDD refers such cases to the relevant authorities, such as BD and LandsD, for further action. Upon completion of an investigation, CEDD may issue new or update existing technical guidelines to specify the design and maintenance requirements for slopes.

5.47 In relation to an annual average of lower than 300 landslides reported in recent years, CEDD would carefully examine and screen each report to identify cases requiring detailed review. For those selected cases, CEDD records the background information of the slope, studies the circumstances of failure to establish possible causes, and gives priority to carrying out necessary upgrading works at the landslide site and nearby areas found to be unstable. On an annual basis, CEDD conducts a comprehensive analysis of landslide data and investigation findings, thereby consolidating experience in landslide prevention and mitigation. Where appropriate, it makes recommendations to improve the workflow of slope engineering operations in Hong Kong.

5.48 Between 2020 and 2024, CEDD initiated investigations into 17 major landslides (see **table 15**), with most involving natural hillside catchments (eight cases) and government man-made slopes (eight cases). The remaining case involved a private man-made slope.

5.49 For example, CEDD initiated investigations into two major landslides that occurred when the red and black rainstorm warning signals were respectively in force in June and October 2021. During these periods, CEDD received a total of 43 landslide reports, of which the most severe cases occurred at South Lantau Road (with a debris volume of around 2,000 cubic metres) in June 2021, and at Pa Mei, Tung Chung (with a debris volume of around 220 cubic metres) in October 2021.

Table 15: Statistics on CEDD's investigations into major landslides between 2020 and 2024

Year	No. of investigations into major landslides initiated within the same year #				No. of new guidelines issued based on investi-gation results	No. of existing guidelines updated based on investi-gation results
	Natural hillside catchment	Government man-made slope	Private man-made slope	Mixed responsibility slope		
2020 ^	0	0	0	0	0	0
2021	2	2	0	0	1	1
2022	0	2	0	0	0	0
2023	5	2	1	0	2	0
2024 *	1	2	0	0	0	0

\# The number of landslides is equal to the number of slopes involved.

^ CEDD did not initiate any investigation into major landslides because no such incidents with a debris volume exceeding 50 cubic metres and an impact on buildings and roads occurred in 2019 and 2020.

* Investigations into major landslides initiated in 2024 are still ongoing.

5.50 The landslide in June 2021 occurred on a natural hillside catchment adjacent to South Lantau Road and the government man-made slope[16] located above it. At the time, the said man-made slope had not yet been included in the Programme. Following the incident, CEDD initiated a major landslide investigation which revealed that a landslide previously occurring on the said man-made slope had resulted in obstruction of the catchwater and significant overflow of rainwater. The excess water cascaded down the lower man-made slope and natural hillside, ultimately discharging onto South Lantau Road and triggering the landslide. Based on the findings, CEDD identified around 150 government man-made slopes located alongside catchwater that could indirectly pose a moderate impact[17], and prioritised these slopes under the Programme. In parallel, CEDD recommended that WSD expedite preventive maintenance works for government man-made slopes adjacent to catchwater that could indirectly pose a low impact[18]. In March 2022, the slope involved in the incident was included in the

[16] The June 2021 incident occurred on the government man-made slope with Feature Ref. No. 13NE-B/CR158. Although it is also situated on South Lantau Road, it is not the same slope (Feature Ref. No. 3NE-A/C74) with recurrent incidents listed in **table 14**.

[17] A moderate impact refers to existing man-made slopes constructed prior to the establishment of the Geotechnical Control Office in 1977 and potentially affecting major infrastructure, frequently used roads, pedestrian walkways or public waiting areas; and man-made slopes built in the late 1970s to 1980s under previous techniques that relied primarily on slope flattening to improve stability, without the use of reinforcement steel bars or structural support.

[18] A low impact refers to slopes located on roads with low pedestrian or vehicular traffic density, in remote areas and near country parks; and man-made slopes constructed in compliance with current standards.

Programme for design of upgrading works, and the works were expected to commence in 2025.

5.51 As regards the major landslide occurred on the natural hillside catchment at Pa Mei, Tung Chung when the red and black rainstorm warning signals were in force in October 2021, CEDD noted that a flexible barrier (risk mitigation works) had been installed as early as December 2011 on the hillside catchment under the Programme. Following the incident, CEDD immediately recommended that LandsD carry out urgent repairs to the flexible barrier and remove the intercepted debris. It also advised HyD to undertake emergency works on the hillside catchment to mitigate imminent danger. Subsequently, CEDD initiated a landslide investigation confirming that the installation of the flexible barrier was effective in intercepting debris and alleviating the impact of landslides on facilities located downslope. In light of these findings, CEDD issued new technical guidelines to further strengthen the design of flexible barriers (see **table 15** for the number of new guidelines issued based on investigation results).

Systematic Investigation and Study on Landslides

5.52 In addition to major landslide investigations, CEDD also undertook a systematic investigation and study into a number of serious landslides occurred in September 2023, with a view to consolidating lessons learned and further refining and strengthening the Government's landslide prevention and mitigation work. The landslides under examination occurred at the following locations:

(1) Redhill Peninsula, Tai Tam;
(2) Kam Shue Road, Sai Kung;
(3) Yiu Hing Road, Shau Kei Wan (see **paras. 5.8 to 5.14**);
(4) Shek O Road (see **paras. 5.20 to 5.22**);
(5) Hong Chi Pinehill Village, Tai Po;
(6) Lei Pui Street, Shek Lei;
(7) Sassoon Road, Pok Fu Lam; and
(8) Sandy Ridge, Lo Wu.

5.53 In 2023, a total of 601 landslides were recorded in Hong Kong. Among them, around one-fifth (127 cases or 21.1%) were major incidents with a debris volume of 50 cubic metres or more. Most of the incidents affected transport infrastructure, including roads, footpaths and pedestrian walkways (364 cases or 55%). Nearly one-fifth of the incidents (108 cases or 16.3%) impacted nearby buildings, including village houses and registered squatter structures.

5.54 To determine the probable causes of the incidents, CEDD reviewed relevant materials, including geological investigation reports, as well as past maintenance and inspection records. Where available, eyewitnesses to the incidents were interviewed. CEDD also conducted site investigations (such as topographical surveys and terrain evaluation mapping) and data analysis (covering rainfall, soil properties and slope stability assessments).

5.55 Such investigation revealed that the landslides listed above were primarily triggered by extreme rainfall. During episodes of heavy rain, part of the surface runoff flowed rapidly across the slope possibly causing erosion of the slope face. Part of the rainwater also infiltrated into the slope and raised the groundwater level, reducing the shear strength of soils and slope stability, ultimately leading to landslides. In certain cases, landslides were caused by blockage of streams, catchwater or drainage channels, where debris and fallen leaves were carried by intense rainfall. When the rainfall amount exceeded system capacity, a large amount of water accumulated and overflowed at specific locations before discharging onto nearby slopes. This also resulted in surface erosion or elevated groundwater levels, both of which could trigger slope failure.

5.56 The landslide on Yiu Hing Road, Shau Kei Wan was the largest rockfall on record in Hong Kong. The primary cause was associated with the unique geological conditions and hydrological environment of the natural hillside catchment at the location. During the extreme rainfall in September 2023, flooding occurred in the river and catchwater channels above the hillside. A large amount of rainwater discharged through overflow weirs into the downstream channels and subsequently infiltrated the hillside through distinctive rock joints. The continuous increase in water pressure within the slope progressively reduced its stability, ultimately resulting in the landslide.

5.57 During the same period, a landslide occurred on Shek O Road, resulting in the complete closure of both traffic lanes for two days. This essentially isolated hundreds of Shek O residents, a situation comparable to the disruption to public travel caused by the 2022 landslide on Pak Tam Road, Sai Kung, which also led to the complete closure of the sole vehicular access. CEDD noted that the priority for upgrading works on the abovementioned government man-made slopes was relatively low under the current risk-based approach of the Programme. However, both slopes are located adjacent to the sole vehicular access, implying that any incident would have a greater impact on people's livelihood. After consolidating the landslide statistics for 2023, CEDD noted that of the 601 incidents recorded, 84 cases (or around 14%) occurred on slopes adjacent to the sole vehicular access.

5.58 Over the past, the authorities have adopted the "react to known hazard"[19] principle, under which natural hillside catchments with a history of collapse or landslide that pose a threat to nearby buildings and traffic corridors are systematically prioritised for risk mitigation works. However, CEDD's analysis of landslide records spanning the past 60 years revealed that 20% of incidents occurred on natural hillside catchments with no previous landslide history (including the hillside on Yiu Hing Road, Shau Kei Wan). This finding shows that the potential risks and impacts of natural hillside catchments which are located in proximity to important facilities should not be overlooked even if they have no record of past landslides.

[19] Over the past, the Government has adopted the "react to know hazard" principle, primarily focusing on conducting studies and risk mitigation works for natural hillside catchments with a history of collapse that pose a threat to existing buildings or traffic corridors.

5.59 Based on the findings of the abovementioned systematic landslide investigation and study, CEDD announced in May 2025 a series of forward-looking measures designed to further strengthen the resilience of slopes against extreme weather events in Hong Kong. The specific measures include:

(1) CEDD has reviewed and identified three sites under similar geological conditions and hydrological environment to Yiu Hing Road, Shau Kei Wan, where the natural hillside catchments pose potential risks to nearby buildings and traffic corridors. These sites within Tai Tam Country Park near Jardine's Lookout and Violet Hill, and at Beacon Hill near Tai Wo Ping are included in the Programme for assessment and design of suitable risk mitigation works;

(2) The coverage of the existing Category of Slopes will be expanded from man-made slopes to also include natural hillside catchments, with completion targeted within one year. The new Category of Slopes will record the basic geospatial information of each natural hillside catchment, together with landslide records and details of facilities affected by such incidents. This will facilitate CEDD's comprehensive review and assessment of natural hillside catchments not yet included in the Programme which may present relatively higher risks and require prioritisation;

(3) On the basis of the existing risk-based approach for selecting suitable man-made slopes under the Programme, particular attention will be given to slopes that may have greater potential impacts on people's livelihood, especially those located adjacent to the sole vehicular access. After assessing the population likely to be affected and the extent of traffic disruption in the event of slope failure, CEDD will systematically include those slopes in the Programme for safety screening studies and upgrading works in batches.

(4) Over three years from 2025, the annual targets of the Programme (see **para. 2.15**) will be gradually increased. Specifically, CEDD will increase the number of natural hillside catchments selected for risk mitigation works from 30 to 40, the number of government man-made slopes selected for upgrading works from 150 to 200, and the number of private man-made slopes selected for safety screening studies from 100 to 130 per year. The new targets are intended to address the additional natural hillside catchments and man-made slopes requiring prioritisation under the three new measures mentioned above.

5.60 CEDD indicated that the enhancement of the slope safety management system will require corresponding financial and manpower support. It is estimated that the overall increase of the revised annual targets is close to 33%. A transitional period of three years will be required for full implementation. The average annual

expenditure will rise from around $1.1 billion to $1.5 billion.

5.61 In addition to the forward-looking measures outlined in **paragraph 5.59**, CEDD is actively developing the Smart Slope Catalogue, targeted for rollout within 2026. It will expand the existing slope database to include records of prevention and mitigation works, maintenance and repair records, historical rainfall data, landslide records and relevant complaint records. The Catalogue will be effectively transformed from a simple "identity card" into a comprehensive "curriculum vitae" for each slope. CEDD explained that the development of the Smart Slope Catalogue will facilitate more effective application of artificial intelligence and big data analytics, thereby enhancing the efficiency of slope safety management, including prioritising prevention and mitigation works, selecting slopes for maintenance audits, and optimising the landslip warning system.

5.62 In 2025, CEDD participated in two pilot projects on Low-altitude Economy Regulatory Sandbox under the Transport and Logistics Bureau to explore the feasibility of deploying automated drones equipped with advanced remote sensing devices for real-time monitoring and data collection at designated locations or sites. CEDD will test the use of advanced remote sensing equipment, including LiDAR scanners, infrared thermal imaging cameras and extended functions for spatial data collection. Artificial intelligence will be applied for analysis to develop an innovative solution tailored for Hong Kong.

5.63 CEDD explained that automated drones have extensive applications in the three key areas of slope safety management: project management, slope monitoring and emergency response. In terms of project management, drones integrated with LiDAR scanning technology can precisely capture positioning data at works sites, enabling comprehensive remote monitoring of works progress. For slope monitoring, by establishing safe flight paths, drones can execute automated missions at preset times. The aerial imagery captured at different intervals facilitate CEDD's routine surveillance of man-made slopes, extensive natural hillsides, and risk mitigation measures (such as flexible and rigid barriers). For emergency response, traditional emergency vehicles may be hindered by traffic congestion or road damage from arriving at incident sites. Drones, however, can navigate over obstacles to reach incident sites directly, enabling swift rescue operations and data collection.

6

COMMENTS AND RECOMMENDATIONS

OUR COMMENTS

6.1 The Hong Kong Special Administrative Region is characterised by its hilly terrain and scarcity of land, where over 60% of land area is covered by natural hillsides. Coupled with the high population density, buildings and public transport facilities are often constructed along hillsides, resulting in a vast number of man-made slopes in various sizes. Upon continuous heavy rain or extreme rainstorms, there may be landslide risks in both natural hillsides and man-made slopes, posing potential threats to people's daily activities, lives and property.

6.2 In 1977, the Government launched the Landslip Preventive Measures Programme (see **paras. 2.8 to 2.12**), primarily targeting man-made slopes, to address landslide risks in Hong Kong. In 2010, the Programme (see **paras. 2.13 to 2.23**) was launched under the lead of CEDD to dovetail with the Landslip Preventive Measures Programme upon its completion.

6.3 Under the Programme, CEDD, as the Government's technical adviser for regulation of slope safety, adopts a risk-based approach to identify suitable government and private man-made slopes for upgrading works and safety screening studies respectively. Should safety screening studies reveal significant distress or potential hazards on the private man-made slopes, CEDD will refer such cases to BD for further action under the Buildings Ordinance (see **para. 2.20**). CEDD has also extended the scope of the Programme from man-made slopes to include natural hillside catchments.

6.4 Over the decades since the launch of these two programmes, CEDD has carried out various types of landslide prevention and mitigation works as well as safety screening studies on thousands of slopes. Currently, the overall landslide risk in Hong Kong is substantially lower than that prior to the launch of the Landslip Preventive Measures Programme in 1977. Although landslides still occur every year in Hong Kong, the annual average of around 214 incidents recorded over the past decade (2015 to 2024) is nearly one-third below the annual average of around 300 incidents recorded in the past (see **para. 5.1**). The continuous effort and achievement of CEDD in

monitoring and regulating slope safety over the years is commendable.

6.5 In addition to the hard work of CEDD, the effective maintenance of slope safety and stability also relies on slope owners or responsible parties properly undertaking maintenance and repairs for man-made slopes under their management. In this direct investigation operation, the Office not only examined CEDD's overall prevention and mitigation work, but also scrutinised the routine maintenance of government man-made slopes. For such purpose, four departments with maintenance responsibility for a large majority of government man-made slopes and the highest number of slopes involved in landslides are included in our investigation, namely LandsD, HyD, WSD and ArchSD.

6.6 Overall, the Office considers that with CEDD's continuous efforts in implementing the Programme and regulating slope safety over the past few decades, the landslide risks of Hong Kong's slopes at present are substantially lower than in over ten years ago. In this regard, the Office highly commends CEDD's work. The Office is also pleased to note that during this investigation, the current-term Government has formulated a number of forward-looking measures (see **para. 5.59**) to continuously strengthen the overall capacity in coping with extreme weather in four key areas, namely preparedness, early warning, emergency response and recovery (see **para. 5.39**). Nevertheless, as global climate change intensifies, slope safety in Hong Kong still faces new challenges and risks. CEDD should continually keep up with an innovative spirit and strive for excellence to safeguard the monitoring and regulation of slope safety in Hong Kong. As regards the various departments with maintenance responsibility for government man-made slopes, the Office considers them to have carried out slope maintenance and repairs in accordance with their respective purview and the technical guide issued by CEDD. Following landslide incidents, these departments have also closely followed up (including seeking advice from CEDD), and arranged emergency inspections and necessary repairs. Our comments regarding the work of the five departments under investigation are elaborated in several areas, including the Programme, safety management of natural hillside catchments and government man-made slopes, application of technologies and inter-departmental collaboration.

Landslip Prevention and Mitigation Programme

6.7 In 2010, CEDD launched the Programme with the annual targets to identify 150 government man-made slopes for upgrading works and 100 private man-made slopes for safety screening studies according to a risk-based approach. Under the Programme, as of December 2024, CEDD had completed upgrading works and safety screening studies for 2,227 government man-made slopes and 1,434 private man-made slopes respectively (see **para. 2.21**). Concurrently, CEDD extended the Programme to identify 30 natural hillside catchments annually for risk mitigation works based on the "react to known hazard" principle. As of December 2024, CEDD had cumulatively completed risk mitigation works for 489 natural hillside catchments (see **table 1**). CEDD was able to meet the pre-set annual targets of completed works and safety screening studies.

6.8 CEDD explained that the above annual targets were set for the purpose of controlling landslide risks, while giving due consideration to multiple factors including the inconvenience to the public caused by the works, as well as the situation and manpower within the geotechnical engineering sector (see **para. 2.22**).

6.9 CEDD added that it would periodically review its risk-based criteria for identification and inclusion of slopes in the Programme (see **para. 2.23**). After completing a systematic investigation and study of a series of landslides triggered by extreme rainstorms in September 2023, it has proposed several adjustments to the Programme (see **para. 5.59**): (1) selecting three sites under similar geological conditions to Yiu Hing Road, Shau Kei Wan, where a landslide occurred in September 2023, for inclusion in the Programme; (2) prioritising the man-made slopes adjacent to the sole vehicular access with greater impact on people's livelihood under the risk-based approach; and (3) progressively increasing the annual targets for upgrading and risk mitigation works and safety screening studies.

6.10 The Office considers it positive and commendable for CEDD to conduct timely review and adjust the Programme's operational directions to ensure its validity and keep pace with changing circumstances. Launched in 2010 to dovetail with the Landslip Preventive Measures Programme, the Programme has been operating effectively for nearly 15 years as the Government's integral and long-term measure in response to landslide risks arising from climate change, particularly extreme weather events.

6.11 Given that the Programme has been launched for quite a long time and extreme weather events have become increasingly frequent and unpredictable in recent years, we recommend that CEDD, while reviewing and adjusting the Programme's directions in response to individual major incidents, also conduct periodic comprehensive reviews of the Programme (Note: CEDD had reported the results of periodic reviews of the Programme to the Legislative Council in 2015 and 2021, see **para. 2.22**). We believe that a comprehensive review can facilitate the formulation of forward-looking operational directions, which will not only greatly benefit CEDD's landslide prevention and mitigation work but also further enhance the entire Programme's sustainability. We recommend that CEDD continue to conduct periodic comprehensive reviews of the Programme depending on actual circumstances, such as the latest climate conditions and the trend of landslides in Hong Kong.

6.12 As outlined in **paragraph 6.9**, the various adjustments to the Programme proposed by CEDD involve significant extent of alteration to the existing Programme and additional resources. We understand that it takes time to implement these adjustments which require long-term planning, including resource allocation, risk assessment of slopes and design of works. Consequently, CEDD should consider mapping out a schedule for phased implementation of all the adjustments according to priority and feasibility, and closely monitor whether the adjustments are implemented as scheduled. Meanwhile, we also recommend that CEDD review from time to time whether the adjustments can achieve the intended objectives and outcomes in line with

the changing environment.

6.13 One of the adjustments proposed by CEDD to the Programme is the inclusion of three sites under similar geological conditions to Yiu Hing Road, Shau Kei Wan, where a landslide occurred in September 2023. While acknowledging this adjustment proposed by CEDD, we note that the Yiu Hing Road incident was the largest rockfall on record in Hong Kong. Moreover, the natural hillside concerned was situated along a major traffic corridor used by residents (see **para. 5.10**), and thus had a relatively severe impact on the community and livelihood. Considering the severity of possible incidents and the potential impact on the community and livelihood, we recommend that CEDD actively explore the feasibility of expediting risk mitigation works for the three sites already included in the Programme under similar geological conditions to Yiu Hing Road.

6.14 Secondly, we are pleased to note that CEDD will also progressively increase the annual target of upgrading works from 150 to 200 government man-made slopes (see **para. 5.59(4)**). Currently, upgrading works under the Programme are led by CEDD. After CEDD's selection of government slopes according to a risk-based approach, design of upgrading works will be undertaken by consultants and construction will be carried out by contractors. Prior to the commencement of works, CEDD will apply to LandsD for temporary land allocation (see **para. 2.16**) to take over the relevant slopes. Upon review of a landslide occurred in September 2023 on a government man-made slope in Sha Tin (see **paras. 5.35 to 5.38**), we note that CEDD had already included the slope in the Programme for study and design of upgrading works prior to the incident. However, CEDD expected to commence works only in the first quarter of 2026. In other words, there was a gap of at least two years between the inclusion of the slope in the Programme and the commencement of upgrading works. The Office is not inclined to comment on the study and works design after the inclusion of slopes in the Programme which involves professional judgement in the geotechnical field.

6.15 However, our review of landslides revealed that repeated incidents took place in some government man-made slopes within three years (see **para. 5.17 and table 14**). Hence, even if the government department with maintenance responsibility has carried out emergency works after the first incident, this does not necessarily entail full mitigation of the potential landslide risks. In this light, we recommend that CEDD examine the feasibility of further streamlining or even reducing the administrative procedures after the inclusion of government man-made slopes in the Programme, thereby further expediting its implementation.

6.16 Taking a step further, to align with its gradual increase of the annual target of upgrading works for government man-made slopes, we recommend that CEDD explore any room for collaboration with maintenance departments to carry out upgrading works under the Programme. For example, CEDD can undertake the works design, while the relevant maintenance department can carry out the works. This is because each government man-made slope has a designated department responsible for its routine maintenance, and all such departments should be familiar with the structure and

condition of the slopes under their purview. This arrangement should help streamline procedures by, for example, obviating the need for CEDD to apply for temporary land allocation and enhance the cost-effectiveness of resource utilisation.

6.17 In addition to the proposed adjustments to the Programme, we note that CEDD is also actively developing the Smart Slope Catalogue to enhance the effectiveness of slope safety management (see **para. 5.61**). We understand that it may be difficult to pursue the Smart Slope Catalogue in one go as its development and rollout involve substantial research, data collation and administrative work. As such, we recommend that CEDD consider a phased rollout, followed by examinations and necessary revisions based on experience obtained from each phase. CEDD may also systematically sum up and consolidate experience in each phase to ensure complete rollout of the Catalogue within 2026. In the long run, CEDD should enhance the management of landslide prevention and mitigation works and slope maintenance audits as well as the planning of post-landslide responses through the gradual increase of slope monitoring and management data (such as the maintenance records from the Centralised Slope Maintenance Database to be launched later (see **para. 4.20**)), coupled with artificial intelligence and big data analytics. Meanwhile, CEDD should continue to apply new technologies with the data applications of the Smart Slope Catalogue to optimise slope maintenance and the landslip warning system.

6.18 The Programme was launched to reduce the overall landslide risk in Hong Kong. However, as and when there is continuous heavy rain or extreme rainstorms, the threat of landslides to the local community inevitably increases. Therefore, while implementing the Programme, CEDD should enhance public awareness of slope safety and understanding of Hong Kong's landslide risks through publicity and education to maximise the effectiveness of its work. In this regard, we note that CEDD has disseminated information on slope safety and maintenance through television, radio, social media and seminars (see **para. 2.29**). It has also established the Community Advisory Unit to assist private owners in fulfilling their slope maintenance responsibility (see **para. 2.30**). Given the inconvenience inevitably brought by landslide prevention and mitigation works, CEDD should enlist the understanding and support of affected residents by highlighting the importance of such works for public safety through publicity and education.

Safety Management of Government Man-made Slopes

6.19 Based on ownership and maintenance responsibility, man-made slopes can be categorised into government or private slopes. Regardless of ownership, the departments with maintenance responsibility for government slopes and owners of private slopes are obliged to carry out Routine Maintenance Inspections and Engineer Inspections for Maintenance in accordance with CEDD's Guide to Slope Maintenance (see **para. 2.7(2)**). Data from CEDD shows that between 2015 and 2024, there were 882 landslides involving government slopes and 117 involving private slopes in Hong Kong (see **table 9**), which represents a noticeable difference.

6.20 Undeniably, there are far more government man-made slopes than private slopes[20] (see **para. 2.5**), so the higher number of incidents involving government man-made slopes is understandable. However, discounting the actual difference in the number of incidents involving the two kinds of slopes, we notice that the failure rate of government man-made slopes[21] was still higher than that of private man-made slopes[22] by one to three times between 2020 and 2024 (see **para. 5.5, tables 10 and 11**). We also note that the consequence-to-life category of most government man-made slopes with landslides over the past five years was the lower category 2 or 3 (see **para. 5.4 and table 12**). Furthermore, the failure rates of both government and private man-made slopes remained at a very low level of less than 1% each year. Nevertheless, we consider that the relatively higher failure rate of government man-made slopes still warrants the Government's continuous attention.

6.21 Admittedly, our review of landslide cases involving government man-made slopes did not reveal any inadequacies on the part of the departments in slope maintenance and repairs. During site inspections, we also found no irregularities in the inspections carried out by the departments' consultants and contractors. However, in response to our request for information, LandsD was unable to locate the Routine Maintenance Inspection records from the two years preceding the landslide occurred in 2016 on Wing Lung Road, Hang Hau, Sai Kung (see **para. 5.23**). To ensure proper retention of information, LandsD started planning in 2014 to fully digitise the slope maintenance records of the department for centralised storage in an online register. In September 2016, it launched the Slope Maintenance Information System, which has been in use since then[23]. Separately, LandsD indicated that it will align with and use the Centralised Slope Maintenance Database to be launched by CEDD later (see **para. 4.20**), such as regularly uploading slope maintenance records or interfacing with its existing information systems to share maintenance records. We consider that proper compilation and retention of slope maintenance records are essential for departments to monitor slope safety and carry out landslide prevention and mitigation work. Therefore, we recommend that all maintenance departments (including LandsD, HyD, WSD and ArchSD) make effective use of CEDD's Centralised Slope Maintenance Database to be launched later by regularly uploading slope maintenance records for CEDD's data analytics and ensuring the proper retention of information. The departments concerned should also regularly remind consultants, contractors and departmental staff of the importance of recording and maintaining slope maintenance

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[20] As at December 2024, there were 38,656 government man-made slopes across the territory, more than double the number (15,878) of private man-made slopes.

[21] (Number of government man-made slopes with landslides / Total number of government man-made slopes) × 100%

[22] (Number of private man-made slopes with landslides / Total number of private man-made slopes) × 100%

[23] LandsD stated that the new system not only effectively consolidates all maintenance data submitted by consultants and provides secure data backups, but also facilitates access to maintenance records and the entire departmental approval process. Through integrated data management, it enhances operational efficiency while improving data consistency and security, thereby enabling departments to retrieve and analyse slope maintenance information more effectively.

data in accordance with established guidelines.

6.22 On another front, we recommend that CEDD continue to take note of the difference in the failure rates between government and private man-made slopes, examine the underlying cause and formulate proper counter-measures where necessary. If any areas for improvement are revealed in slope maintenance undertaken by maintenance departments, CEDD should continue to issue technical guidelines for their compliance. Taking a step further, CEDD should continue to monitor the number of landslides involving government man-made slopes and conduct timely reviews when any unusual upward trend is detected to ensure the precision and effectiveness of the Government's landslide prevention and mitigation work.

6.23 In addition, we have the following two key observations upon review of a number of landslides involving government man-made slopes.

6.24 Firstly, we note that among the government man-made slopes with repeated landslides of a more serious nature since 2014, a vast majority of them had not been included in the Programme. Some of them recorded repeated landslides within three years since the first incident, including the government man-made slopes on Wing Lung Road, Hang Hau and Pak Tam Road, Sai Kung; South Lantau Road, Lantau Island; Lower Shing Mun Reservoir, Sha Tin; and Tai Lam Chung Catchwater, Tun Mun (see **para. 5.17 and table 14**). Particularly, four landslides occurred at different parts of the slope on Wing Lung Road, Hang Hau within five years (in 2016, 2017, 2020 and 2021) (see **paras. 5.23 to 5.27**). Although the consequence-to-life category of all these slopes was not the highest category 1, and some of the incidents were not large-scale, the recurrence of incidents inevitably raises concerns about the potential risks and structural safety of these slopes.

6.25 We recommend that CEDD review any room to optimise the current selection criteria for inclusion of government man-made slopes in the Programme to undertake upgrading works, such as according more flexibility in prioritising slopes with repeated landslides under the Programme based on actual circumstances. If CEDD concludes after review that no changes or additions to the selection criteria are necessary, it may continue to assess whether the emergency maintenance works on these government slopes with repeated landslides should be further enhanced to prevent recurrence more effectively.

6.26 Secondly, we have selected several serious landslides that occurred on government man-made slopes in consequence-to-life category 1 or 2 for scrutiny. We note that CEDD included many of these slopes in the Programme immediately after the incidents (see **paras. 5.29 to 5.31, 5.32 to 5.34**). We reckon that it is justifiable to prioritise these slopes for landslide prevention and mitigation work as they have higher consequence-to-life categories, representing greater risks to lives and property when landslides occur.

6.27 However, to strengthen the effectiveness of landslide prevention and mitigation work, we recommend that CEDD continue with its systematic review on the key factors for including these government slopes in the Programme. It should draw on these factors as a reference to promptly identify other government man-made slopes with similar characteristics for inclusion in the Programme before incidents occur, thereby further enhancing the Programme's prevention and mitigation capacity.

Safety Management of Natural Hillside Catchments

6.28 Over 60% of Hong Kong's land area is covered by natural hillside catchments. Natural hillside catchments refer to slopes without artificial alteration in structure. These hillsides in general do not require regular inspection or maintenance (see **para. 2.3**), and hence the Government has not assigned any maintenance departments for them. Prevention and mitigation work for natural hillside catchments relies primarily on CEDD's "react to known hazard" principle (see **para. 2.14**), whereby those with higher potential risks are identified for inclusion in the Programme to carry out risk mitigation works (mainly flexible barriers and rigid barriers).

6.29 We note that the purpose of CEDD's risk mitigation works on natural hillside catchments is not to reinforce the slope structure, but rather to create a buffer in the event of failure by blocking or intercepting debris or large boulders and allow sufficient time for residents to evacuate and retreat, thereby reducing casualties and damage to nearby buildings and infrastructure (see **para. 2.19**).

6.30 Data from CEDD showed that between 2015 and 2024, there were 507 landslide incidents involving natural hillside catchments, accounting for 23.7% of all incidents during the same period, at a rate just lower than that involving government man-made slopes (see **paras. 5.4 and table 9**). These figures reflect the potential risks posed by natural hillsides and should not be taken lightly. Therefore, we recommend that CEDD continue to closely monitor the number of landslides involving natural hillside catchments and examine the reasons promptly should there be any unusual rising trend observed, thereby addressing the problem early.

6.31 After reviewing nine serious landslides that occurred since 2008 (including the incident on Yiu Hing Road, Shau Kei Wan in September 2023) (see **paras. 5.8 to 5.14**), we found that most of them involved natural hillside catchments. A majority of them had not been included in the Programme before the incidents, or even if they had been so included in the Programme, they were accorded a relatively low priority such that the actual study and design of works had yet to commence by a consultancy contract before the incidents (see **table 13**). Given that the Government mainly relies on the Programme to control landslide risks associated with natural hillside catchments, we recommend that CEDD continue to regularly review any room to optimise the criteria for identifying natural hillside catchments for inclusion in the Programme, so that those with potential risks can be identified by it earlier. In conducting this review, CEDD should continue to consult the Slope Safety Technical Review Board and explore collaboration with academic institutions to conduct relevant researches.

6.32 Additionally, we note that in response to findings from a recently completed systematic landslide investigation and study, CEDD has identified territory-wide three sites under similar geological conditions and hydrological environment to Yiu Hing Road, Shau Kei Wan. Natural hillside catchments at these sites, which pose potential risks to existing buildings and traffic corridors, are included in the Programme (see **paras. 5.59(1)**). In this regard, we recommend that if specific geological conditions and hydrological environment contribute to occurrence of landslides on natural hillsides again, CEDD should likewise seriously review whether there are other similar natural hillside catchments that require prioritisation, and promptly identify and include them in the Programme for detailed assessment and design of appropriate risk mitigation works.

Application of Technologies

6.33 As mentioned in **paragraph 6.1**, over 60% of land area in Hong Kong is covered by natural hillsides, along with more than 61,000 man-made slopes as of December 2024 (see **para. 2.5**). Given the vast number of slopes, CEDD should, in addition to long-term planning and a sustainable programme to address the increasing landslide risks brought about by climate change, adopt innovative technologies proactively and extensively to strengthen slope risk control and enhance the effectiveness of its landslide prevention and mitigation work.

6.34 We are pleased to note that over the years, CEDD has applied innovative technologies for monitoring and regulating slope safety in various aspects, and has collaborated with several tertiary institutions to initiate related research projects in such aspects as monitoring landslides on natural hillside catchments, recovery work after landslides and dissemination of slope information (see **paras. 2.24 to 2.28**). Based on its systematic landslide investigation and study completed recently, CEDD is also actively expanding its existing slope database and developing the Smart Slope Catalogue (see **para. 5.61**), with plans to expand the existing Catalogue of Slopes to include natural hillside catchments (see **para. 5.59(2)**). In addition, CEDD is exploring the use of automated drones for works management, slope monitoring and contingency response through the two pilot projects on Low-altitude Economy Regulatory Sandbox under the Transport and Logistics Bureau (see **paras. 5.62 and 5.63**).

6.35 We consider that CEDD deserves recognition in keeping abreast of the times in the application of innovative technologies, thereby achieving continuous progress in the territory's landslide prevention and mitigation work. We recommend that CEDD continue to closely monitor technological developments related to slope safety, and explore the feasibility of collaborating with local universities and relevant academic or research institutions to initiate research projects concerning the monitoring of slope safety, thereby further integrating technologies into slope safety work. Regarding its plan to expand the coverage of the Catalogue of Slopes to include natural hillside catchments, we recommend that CEDD study how the expanded catalogue can support the further development of the Programme and slope safety monitoring.

Inter-departmental Collaboration

6.36 Given that there were more than 38,000 government man-made slopes in Hong Kong as of December 2024 (see **para. 2.5**), the maintenance responsibilities are shared among various departments. Our review of the four selected maintenance departments revealed that they have complied with the Guide to Slope Maintenance to schedule inspections based on the consequence-to-life category of each slope (see **paras. 4.10 and 4.11**); they have also consulted CEDD on post-landslide response actions (see **paras. 5.18 to 5.38**). In addition to the routine management of government slopes, CEDD has set up an inter-departmental platform and organises meetings regularly (see **para. 4.24**) to facilitate collaboration in monitoring and ensuring slope safety.

6.37 Since the inspection and maintenance of government man-made slopes and post-landslide response actions involve geotechnical expertise, CEDD has seconded professional staff to each of the four maintenance departments to provide technical support. CEDD also deploys staff to conduct site inspections and provide suggestions for contingency response after landslides. The four departments themselves have assigned professional staff to oversee maintenance of their slopes. We note that the ratio of professional staff (i.e., the average number of slopes managed per professional officer) varies considerably from department to department (see **para. 4.17 and table 7**). We recommend that each maintenance department review its current professional staff complement and determine whether there is any need for adjustment or redeployment. Where necessary, the departments may seek professional advice from CEDD to ensure adequate staffing for operational needs.

6.38 CEDD also conducts slope maintenance audits to assess whether departments have properly maintained and repaired their slopes. We are pleased to note that in the audit cycle ended in late 2023, CEDD did not discover any non-conforming practices among the maintenance departments (see **para. 4.12**). Nonetheless, we note that the existing audits mainly focus on slope maintenance and inspection. Given that a significant number of landslides involving government man-made slopes still occur each year, we recommend that CEDD explore expanding the scope of audit to include post-incident investigation and response, in order to review the performance of departments from multiple perspectives and identify possible areas for improvement. This would help the authorities to learn from experience and nip the landslide risks in the bud as far as possible. At the same time, CEDD can refine its audit work through the insights gained from examining the follow-up actions taken by different departments after landslide incidents.

6.39 We consider that the existing collaboration mechanism among relevant departments is effective for properly discharging their maintenance responsibility for government man-made slopes. However, given the ever-changing climate conditions, all departments should continue deepening their collaboration to create synergy in enhancing slope safety and reducing landslide risks. On this basis, all relevant departments may make use of the Centralised Slope Maintenance Database being

developed by CEDD and the Smart Slope Catalogue for data analytics, in order to monitor the latest situations of slope maintenance, share common maintenance issues, and assess the impact of heavy rainfall on slopes. This should facilitate their planning of routine maintenance inspections and special inspections after adverse weather events (see **para. 5.41**), leading to higher efficiency.

6.40 Furthermore, CEDD should continue to encourage its professional staff seconded to various departments to maintain close communication and exchange insights gained from managing government man-made slopes. Their observations and experiences can help review whether slope management practices and procedures are consistent across departments. These officers can also serve as a bridge between CEDD and the frontline staff responsible for slope management within their seconded departments to foster the exchange of views and sharing of experience.

RECOMMENDATIONS

6.41 In the light of the above, The Ombudsman makes recommendations in five key areas: the Programme, safety management of government man-made slopes, safety management of natural hillside catchments, application of technologies and inter-departmental collaboration. Details are as follows:

Regarding the Landslip Prevention and Mitigation Programme

(1) While the Programme has been operating effectively, given the increasing occurrence of extreme weather events in Hong Kong, CEDD, while reviewing and adjusting the Programme's directions in response to individual major landslides, should continue to conduct periodic comprehensive reviews of the Programme to further enhance its overall sustainability (see **para. 6.11**);

(2) CEDD should map out a schedule for phased implementation of the proposed adjustments to the Programme based on the outcomes of its systematic landslide investigation and study (see **para. 6.12**);

(3) Following recommendation (2), CEDD should implement the adjustments by phases according to priority and feasibility, and closely monitor whether all the adjustments are implemented as scheduled (see **para. 6.12**);

(4) Following recommendation (2), CEDD should review from time to time whether the adjustments proposed for the Programme can achieve the intended objectives and outcomes in line with the changing environment (see **para. 6.12**);

(5) CEDD should actively explore the feasibility of expediting risk mitigation works for the three sites already included in the Programme with similar geological conditions as Yiu Hing Road, Shau Kei Wan (see **para. 6.13**);

(6) CEDD may examine the feasibility of further streamlining or even reducing the administrative procedures after the inclusion of government man-made slopes in the Programme, thereby further expediting its implementation (see **para. 6.15**);

(7) CEDD may explore any room for collaboration with maintenance departments to carry out upgrading works under the Programme, thereby enhancing the cost-effectiveness of resource utilisation (see **para. 6.16**);

(8) CEDD may consider a phased rollout of the Smart Slope Catalogue, followed by examinations and necessary revisions based on experience obtained from each phase for complete rollout (see **para. 6.17**);

(9) Following recommendation (8), CEDD may systematically sum up and consolidate experience in each phase to ensure complete rollout of the Smart Slope Catalogue within 2026 (see **para. 6.17**);

(10) In the long run, CEDD should continue to enhance the management of landslide prevention and mitigation works and slope maintenance audits as well as the planning of post-landslide responses through the gradual increase of slope monitoring and management data, coupled with artificial intelligence and big data analytics (see **para. 6.17**);

(11) Following recommendation (10), CEDD should continue to apply new technologies with the data applications of the Smart Slope Catalogue to optimise slope maintenance and the landslip warning system (see **para. 6.17**);

(12) CEDD should continue to strengthen publicity and education to enhance public awareness of slope safety and understanding of Hong Kong's landslide risks, and to enlist the understanding and support of affected residents by highlighting the importance of landslide prevention and mitigation works for public safety, thereby maximising its effectiveness (see **para. 6.18**);

Safety Management of Government Man-made Slopes

(13) Relevant maintenance departments (including LandsD, HyD, WSD and ArchSD) should regularly upload slope maintenance records to the Centralised Slope Maintenance Database to be launched by CEDD later

for CEDD's data analytics and ensuring the proper retention of information (see **para. 6.21**);

(14) Relevant maintenance departments (including LandsD, HyD, WSD and ArchSD) should regularly remind consultants, contractors and departmental staff of the importance of recording and maintaining slope maintenance data in accordance with established guidelines (see **para. 6.21**);

(15) CEDD should continue to take note of any considerable difference in the failure rates between government and private man-made slopes, examine the underlying causes and formulate proper counter-measures where necessary (see **para. 6.22**);

(16) Following recommendation (15), if its examination reveals any areas for improvement in the maintenance of government man-made slopes on the part of the maintenance departments, CEDD should continue to issue technical guidelines for their compliance (see **para. 6.22**);

(17) CEDD should continue to monitor the number of landslides involving government man-made slopes, conduct timely reviews when any unusual upward trend is detected to ensure the precision and effectiveness of the Government's landslide prevention and mitigation work (see **para. 6.22**);

(18) CEDD should continue with its regular review for any room to optimise the current selection criteria for inclusion of government man-made slopes in the Programme for upgrading works (for example, according more flexibility in prioritising slopes with repeated landslides under the Programme based on actual circumstances) (see **para. 6.25**);

(19) Following recommendation (18), if CEDD concludes after review that no changes or additions to the selection criteria are necessary, it may continue to assess whether the emergency maintenance works on these government slopes with repeated landslides should be further enhanced to prevent recurrence more effectively (see **para. 6.25**);

(20) In respect of the several cases examined by the Office of government man-made slopes in consequence-to-life category 1 or 2 which were included in the Programme after serious landslides, CEDD should continue with its systematic review on the key factors for their inclusion in the Programme, and draw on these factors as a reference to promptly identify other government slopes with similar characteristics for inclusion in the Programme, thereby further enhancing the Programme's prevention and mitigation capacity (see **para. 6.27**);

Safety Management of Natural Hillside Catchments

(21) CEDD should continue to closely monitor the number of landslides involving natural hillsides catchments and examine the reasons promptly should there be any unusual rising trend observed (see **para. 6.30**);

(22) CEDD should continue to review regularly any room to optimise the criteria for identifying natural hillside catchments for inclusion in the Programme, so that those with potential risks can be identified earlier (see **para. 6.31**);

(23) Following recommendation (22), in conducting reviews, CEDD should continue to consult the Slope Safety Technical Review Board and explore collaboration with academic institutions for research (see **para. 6.31**);

(24) If specific geological conditions and hydrological environment contribute to occurrence of landslides on natural hillsides again, CEDD should likewise seriously review whether there are other similar natural hillside catchments that require prioritisation (see **para. 6.32**);

(25) Following recommendation (24), if natural hillside catchments requiring prioritisation are revealed, CEDD should promptly identify and include them in the Programme for detailed assessment and design of appropriate risk mitigation works (see **para. 6.32**);

Application of Technologies

(26) CEDD should continue to closely monitor technological developments related to slope safety, and explore the feasibility of collaborating with local universities and relevant academic or research institutions to initiate research projects concerning the monitoring of slope safety, thereby further integrating technologies into slope safety (see **para. 6.35**);

(27) Regarding its plan to expand the coverage of the Catalogue of Slopes to include natural hillside catchments, CEDD should study how the expanded catalogue can support the further development of the Programme and slope safety monitoring (see **para. 6.35**);

Inter-departmental Collaboration

(28) Each maintenance department (including LandsD, HyD, WSD and ArchSD) should review its current professional staff complement and determine whether there is any need for adjustment or redeployment.

Where necessary, the departments may seek professional advice from CEDD to ensure adequate staffing for operational needs (see **para. 6.37**);

(29) CEDD should explore expanding the scope of slope maintenance audits to include post-incident investigation and response actions involving government man-made slopes, with a view to reviewing the performance of maintenance departments from multiple perspectives and identifying possible areas for improvement, thereby learning from experience and nipping the landslide risks in the bud (see **para. 6.38**);

(30) Given the ever-changing climate conditions, all relevant departments (including CEDD, LandsD, HyD, WSD and ArchSD) should continue to deepen their collaboration to create synergy in enhancing slope safety and reducing landslide risks (see **para. 6.39**);

(31) All relevant departments (including LandsD, HyD, WSD and ArchSD) may make use of the Centralised Slope Maintenance Database being developed by CEDD and the Smart Slope Catalogue for data analytics, so as to monitor the latest situations of slope maintenance, share common maintenance issues, and assess the impact of heavy rainfall on slopes. This should facilitate their planning of routine maintenance inspections and special inspections after adverse weather events, leading to higher efficiency (see **para. 6.39**); and

(32) CEDD should continue to encourage its professional staff seconded to various departments to maintain close communication and exchange insights gained from managing government man-made slopes. Their observations and experiences can help review whether slope management practices and procedures are consistent across departments. These officers can also serve as a bridge between CEDD and the frontline staff responsible for slope management within their seconded departments to foster the exchange of views and sharing of experience (see **para. 6.40**).

ACKNOWLEDGEMENTS

6.42 The Ombudsman thanks CEDD, LandsD, HyD, WSD and ArchSD for their full cooperation in the course of this investigation, and members of the public with a concern about this topic for submitting their valuable opinions.

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