STUDY ON THE LANDSCAPE TREATMENT FOR DEBRIS-RESISTING BARRIERS

GEO REPORT No. 256

AECOM Asia Company Limited

GEOTECHNICAL ENGINEERING OFFICE
CIVIL ENGINEERING AND DEVELOPMENT DEPARTMENT
THE GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

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PREFACE

In keeping with our policy of releasing information which may be of general interest to the geotechnical profession and the public, we make available selected internal reports in a series of publications termed the GEO Report series. The GEO Reports can be downloaded from the website of the Civil Engineering and Development Department (http://www.cedd.gov.hk) on the Internet. Printed copies are also available for some GEO Reports. For printed copies, a charge is made to cover the cost of printing.

The Geotechnical Engineering Office also produces documents specifically for publication. These include guidance documents and results of comprehensive reviews. These publications and the printed GEO Reports may be obtained from the Government's Information Services Department. Information on how to purchase these documents is given on the second last page of this report.

R.K.S. Chan
Head, Geotechnical Engineering Office
December 2010

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FOREWORD

This report provides design principles and guidelines on good practice for landscape treatments for debris-resisting barriers to ensure that the debris-resisting barriers to be constructed in Hong Kong are of high standard of landscape design and visual interest in responsive to adjacent site context.

The design principles and guidelines are intended to assist geotechnical engineers and other design professionals, e.g. landscape architects, in designing and implementing landscape treatments for debris-resisting barriers.

This report was prepared as part of the natural terrain hazards mitigation works design and construction consultancy for the Geotechnical Engineering Office, Civil Engineering and Development Department under Agreement No. CE 9/2007(GE), Natural Terrain Hazards Mitigation Works at North Lantau Expressway and Yu Tung Road near Tung Chung Eastern Interchange.

This report identifies the types of debris-resisting barriers for mitigation of natural terrain landslide hazards in Hong Kong and reviews the local and international practices on landscape treatments for debris-resisting barriers. This report outlines the landscape design objectives for debris-resisting barriers and explores the possible landscape treatments for various types of debris-resisting barriers. The merits and limitations on the application of various landscape treatments for debris-resisting barriers are assessed in terms of practicability, cost-effectiveness and sustainability. This report also presents a series of landscape design principles and guidelines for debris-resisting barriers. Worked examples are included to demonstrate how site specific engineering and landscape issues are dealt with during the design process.

Patrick A. Chao
Regional Managing Director, Geotechnical
AECOM Asia Company Limited

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1. INTRODUCTION

AECOM Asia Company Limited (AACL) was appointed by the Civil Engineering and Development Department (CEDD) of the Government of the Hong Kong Special Administrative Region (HKSAR) under Agreement No. CE 9/2007(GE) to carry out a study on the landscape treatment for debris-resisting barriers to be used as natural terrain hazard mitigation measures or any other similar purposes in the context of landslip prevention. The main tasks of the study include:

(1) Review of both local and international practices on the landscape treatment for debris-resisting barriers.

(2) Assessment of the merits and limitations of applying different techniques/practices of landscape treatment for debris-resisting barriers, including the practicability, cost-effectiveness and sustainability.

(3) Preparation of design guidelines on the landscape treatment for debris-resisting barriers.

This report presents a study on landscape treatment for debris-resisting barriers by reviewing the current techniques of landscape treatment for different types of debris-resisting barriers in Hong Kong and other countries. The merits and constraints of different techniques and design guidelines on each landscape treatment will be discussed. Worked examples are included to illustrate the application of these guidelines in real situations.

2. TYPES OF DEBRIS-RESISTING BARRIERS

According to GEO REPORT No. 182 - "Use of Standardised Debris-Resisting Barriers for Mitigation of Natural Terrain Landslide Hazards", four types of standardised barrier walls have been developed to cater for different scales and different types of natural terrain landslide events. The barrier walls are summarized as follow:-

Type 1 - Reinforced concrete barriers generally designed to resist large-scale debris flow events of up to 600 m^3.

Type 2 - Gabion units in conjunction with an L-shaped reinforced concrete wall frame. The design volume is up to 300 m^3.

Type 3 - Reinforced gabion units with two different arrangements: Type 3A comprises a reinforced gabion shell and gabion core and Type 3B comprises a reinforced gabion shell and rockfill core. The design volume is up to 150 m^3.

Type 4 - Tensioned wire mesh fences to mitigate open hillslope landslides up to 100 m^3, especially for rock boulders fall.

3. REVIEW OF LOCAL AND INTERNATIONAL PRACTICES ON LANDSCAPE TREATMENT FOR DEBRIS-RESISTING BARRIERS

Desk study information searched from sources of internet, technical papers/reports on the previous natural terrain hazard mitigation studies/projects both in local and international have been carried out and summarized as follow:-

3.1 Local Practices on Landscape Treatment

Different types of debris-resisting barriers in Hong Kong have been reviewed and it is noted that debris-resisting barriers are located in a variety of site context such as rural areas, countryside and residential areas. No particular landscape treatment had been implemented for these debris-resisting barriers. The main landscape treatment for the debris-resisting barriers is planting of shrubs and trees in front of the barrier walls and tensioned wire mesh fences or planting of climbers at the barrier wall surfaces. The arrangement of the debris-resisting barriers and its descriptions are detailed in Appendix A.

Based on the above findings, many of the debris-resisting barrier walls are located near urban fringes, developed areas or highways. It is noticed that there are attempts to provide aesthetic and landscape treatments to debris-resisting barrier walls, particularly for those within a close proximity to adjacent developments, such as feature at 147B, Argyle Street. However, in general, a systematic aesthetic and landscape design approach is missing.

3.2 International Practices on Landscape Treatment

Most international case studies are predominately located at countryside or sparsely populated areas whereby the aesthetic landscape treatments of the barrier walls come as secondary importance comparing with the first priority of geotechnical engineering consideration in feasibility, durability and safety. In most circumstances, the proposed structure should regard its natural environment like ecological sensitive locations, such as national parks; where native flora and fauna should be protected with mitigation measures. Some previous barrier walls construction and associated landscaping treatment works are briefly described in Appendix B.

Based on the above findings, it is noticed that many overseas examples do not have any hard and soft landscape treatments. Since many of these structures are located in highly remote areas, there are limited Visually Sensitive Receivers (VSRs) who can see these structures. As such, most designs of the debris-resisting barriers have mainly emphasized on functional requirements while the landscape and aesthetic quality has not been considered.

4. LANDSCAPE DESIGN OBJECTIVES

The landscape design of a debris-resisting barrier should attain the following objectives, subject to meeting the geotechnical and safety requirements as well as the need to minimize maintenance commitments:

(a) ***Preservation of existing vegetation*** - Existing individual trees or tree groups should be preserved as much as possible based on an integrated landscape and engineering solution. Trees with high amenity value and survival rate which are unavoidably affected by the works shall be transplanted where possible and practical.

(b) ***Responsive design to surrounding landscape settings*** - Where possible, the design, deposition and vertical profile of the debris-resisting barriers including proposed landscape design treatments should be responsive and compatible to the broad variations in surrounding landform and topography.

(c) ***Visual aesthetic and harmony*** - Proposed engineering structures in terms of tonal quality, colour and texture shall be blended into the surroundings in order to create visual harmony between the artificial and natural landscapes so as to minimize potential adverse visual impact.

(d) ***Self-sustainable with minimal maintenance*** - The selection of landscape treatment should be self-sustainable after establishment period of the contract with minimal ongoing maintenance commitment.

(e) ***Enhancing biodiversity*** - Proposed landscape treatment should aim at enhancing biodiversity. Selection of soft landscape should make reference to the existing planting materials found on site. Native species should be used where possible.

(f) ***Aesthetic principles*** - Basic considerations of good aesthetic design should include general principles of unity and coherence, proportion and scale, pattern and texture, rhythm and complexity, colour and Albedo (or reflectivity). Details should make reference to the guidance given in GEO Publication No. 1/2000, Page 19, Table 1.3 "General Aesthetic Principles in Landscape Design".

5. TYPES OF LANDSCAPE TREATMENT FOR DIFFERENT DEBRIS-RESISTING BARRIERS

5.1 Types of Landscape Treatment

General types of landscape treatment for debris-resisting barriers include the following items:

- Retention of existing tree
- Screen planting as visual buffer
- Planting in crest and toe planter
- Climber on wall surface

- Texture and finishes on wall
- Planting on gabion wall
- Shrubs/grasscrete on surface structure
- Mural/artwork
- Colour treatment for exposed structure
- Use of in-situ (locally found) material

5.2 Merits and Limitations of Landscape Treatment

Different landscape treatments when applied to debris-resisting barriers can have their merits and limitations. These can be assessed in terms of three parameters, namely practicability, cost-effectiveness and sustainability. The assessment should be carried out based on the magnitude of each parameter. Details of each parameter are summarized in the following table:

Table 5.2.1 - Details of Parameters to Assessment on the Application of Landscape Treatments

Parameters	Considerations
Practicability	• The physical extent of project (e.g. site area, accessibility) • Optimal engineering design (e.g. wall alignment to minimize extent of tree felling works)
Cost-effectiveness	• Estimated cost of capital work and maintenance of features • Liaise with maintenance agent for chosen design and plan resources accordingly • The scope of project
Sustainability	• Contribution to environmental sustainability (e.g. vegetation helping to eliminate greenhouse gases and provide habitat for insects and birds) • Use of in-situ natural materials (e.g. rocks and vegetation) to minimize use of non-sustainable resources and reduce visual impact • Preservation of existing vegetation • Planting with self-supporting species which are able to regenerate naturally

For the purpose of assessment, the magnitude of each parameter is categorised as follows:

High (√√√): highly practical/cost-effectiveness/sustainable

Medium (√√): moderately practical/cost-effectiveness/sustainable

Low (√): only slightly practical/cost-effectiveness/sustainable

5.3 Assessment of Merits and Limitations on the Application of Common Landscape Treatments

Relationships between different types of debris-resisting barriers and landscape treatments in terms of practicability, cost-effectiveness and sustainability are listed in the following table:

Table 5.3.1 - Assessment of Merits and Limitations on the Application of Generic Landscape Treatments

			Retention of existing tree	Screen planting as visual buffer	Planting in crest and toe planter	Climber on wall surface	Texture and finishes on wall	Planting on gabion wall	Shrubs/ grasscrete on surface structure	Mural/ artwork	Colour treatment for exposed structure	Use of in-situ material
Debris-resisting Barriers	**(1) Reinforced Concrete Barrier Wall**	Practicability	√	√√√	√√	√√√	√√√	N/A	√√	√√√	√√√	√√
		Cost-effectiveness	√	√√√	√√	√√√	√√√	N/A	√√	√√	√√√	√√
		Sustainability	√	√√	√√	√√	√	N/A	√√	√	√	√√√
	(2) Gabion Units inside a Reinforced Concrete Wall	Practicability	√	√√√	√√	√√√	√√√	√√	√√√	√√√	√√√	√√√
		Cost-effectiveness	√	√√√	√√	√√√	√√√	√√	√√	√√	√√√	√√
		Sustainability	√	√√	√√	√√	√	√√	√√	√	√	√√√
	(3) Reinforced Gabion Units	Practicability	√√	√√√	√√	√√√	N/A	√√	N/A	√√	N/A	√√√
		Cost-effectiveness	√√	√√√	√√	√√√	N/A	√√	N/A	√√	N/A	√√√
		Sustainability	√√	√√	√√	√√	N/A	√√	N/A	√	N/A	√√√
	(4) Tensioned Wire Mesh Fence	Practicability	√√√	√√	N/A	√√√	N/A	N/A	N/A	N/A	N/A	N/A
		Cost-effectiveness	√√√	√√	N/A	√√√	N/A	N/A	N/A	N/A	N/A	N/A
		Sustainability	√√√	√√	N/A	√√	N/A	N/A	N/A	N/A	N/A	N/A

This table briefly assesses the merits and limitations for common debris-resisting barrier types with various landscape treatments in terms of practicability, cost-effectiveness and sustainability. This assessment aims to provide an overall guide and reference for the use of landscape treatments to various debris-resisting barriers. However, it is not the purpose of this table to illustrate how individual site context will affect the selection and implementation of landscape treatments.

Reinforced Concrete Wall (1) - This type of barriers is generally large in scale. It is often impractical and not cost-effective to make changes to proposed engineering structure to accommodate with existing trees. Landscape treatments such as screen planting and climbers are effective ways to visually mitigate the perceived scale of the structure.

Gabion Units inside a Reinforced Concrete Wall (2) - This type of barriers is generally large in scale and not cost-effective to make changes to proposed engineering structure to accommodate with existing trees. The use of planting to screen and to visually mitigate the perceived scale of the structure is desirable.

Reinforced Gabion Unit (3) - Gabion wall is finer in texture when compared to concrete wall and therefore is less visually intrusive. This type of barriers is more flexible when compared to type 1 and 2 in term of its placement. The use of screen planting and climbers is cost-effective to mitigate the visual impact of this type of barrier.

Tensioned Wire Mesh Fence (4) - This type of barriers is visually permeable. The placement of the barrier and its associated structure is relatively easy. It is also cost-effective to make arrangement to accommodate particular site context. However, the application of some landscape treatments is constrained such as making use of in-situ material and use of artwork.

6. LANDSCAPE DESIGN PRINCIPLES AND GUIDELINES

6.1 Design Consideration

6.1.1 Topography

The design of the debris barrier should complement with the existing topography. ***Terracing profile*** can be proposed when using a series of barrier wall system along the valley profile. Similarly, terracing profile is also applicable to gabion barrier system. See Figure 6.1.1 and Figure 6.1.2.

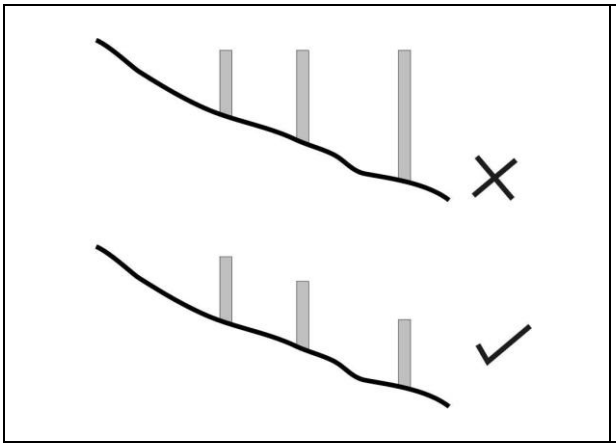

Figure 6.1.1 - Terracing Profile for Concrete Barrier Wall

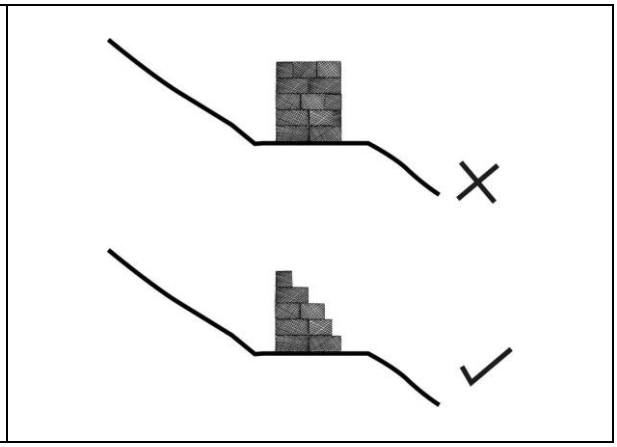

Figure 6.1.2 - Terracing Profile for Gabion Units

The edge of the debris barrier system is the most visually obvious indication of man-made structure. Figure 6.1.3 shows a barrier system with no visual mitigation measures.

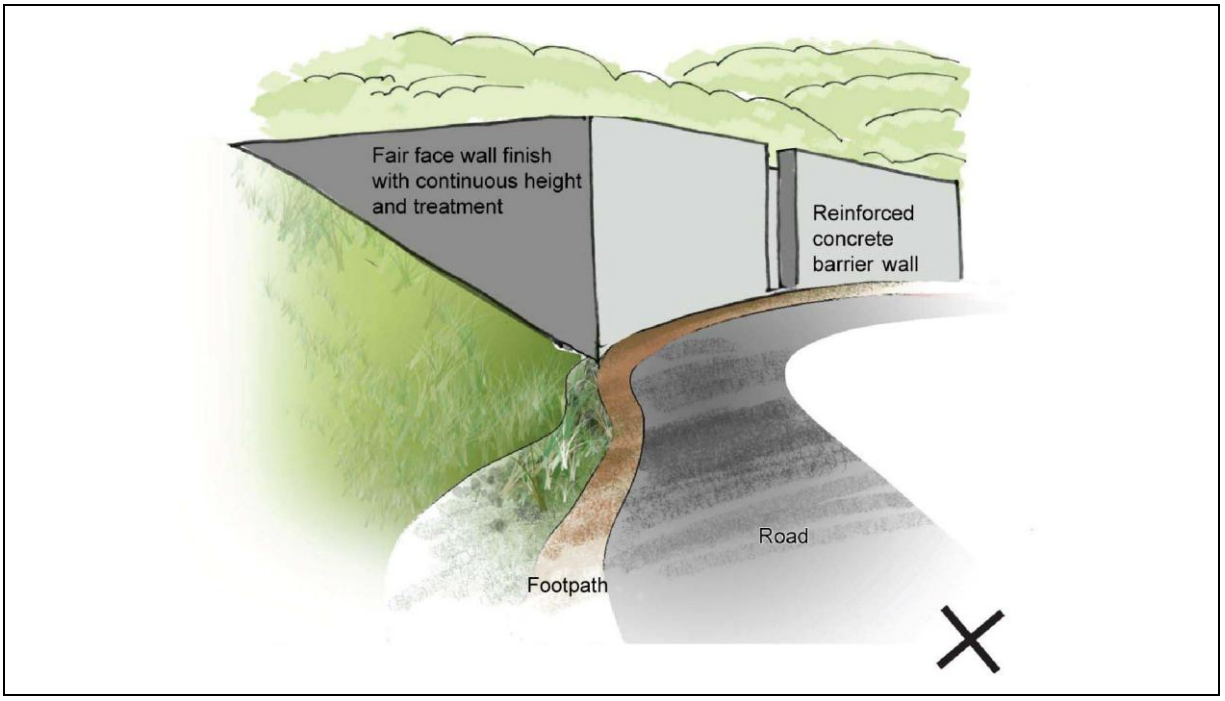

Figure 6.1.3 - Fair Face Barrier Wall with Continuous Height

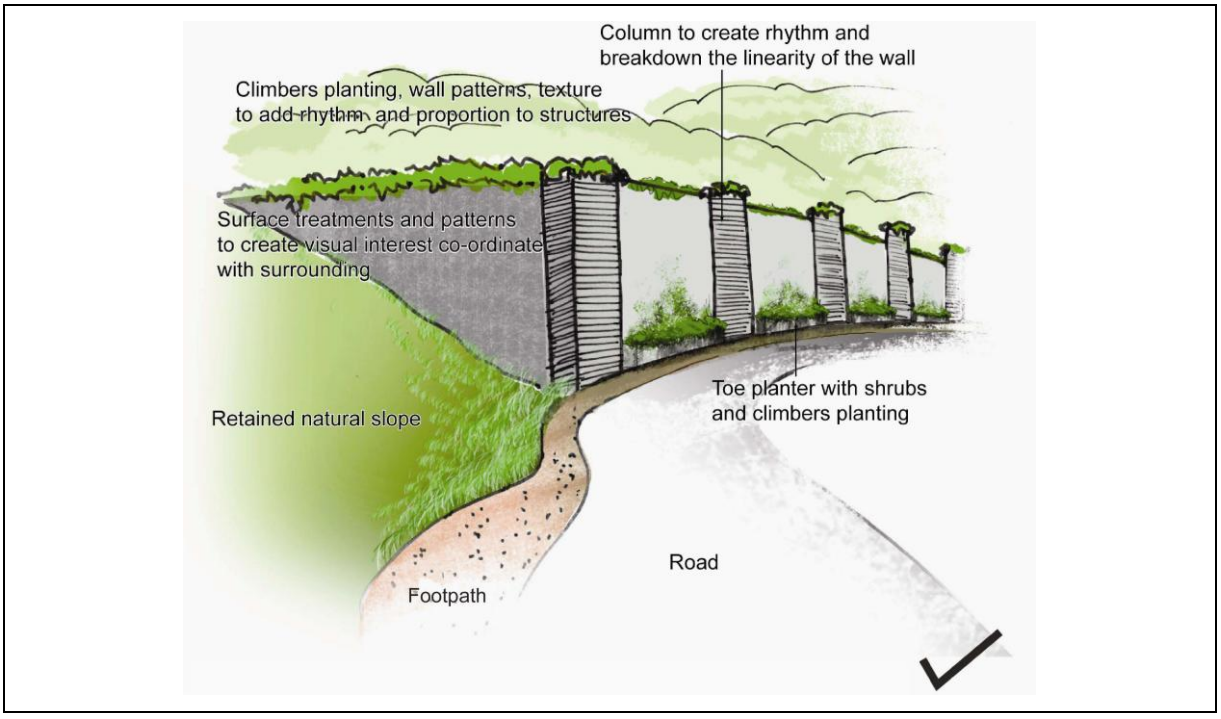

Figure 6.1.4 - Barrier Wall with Column to Breakdown Horizontal Scale

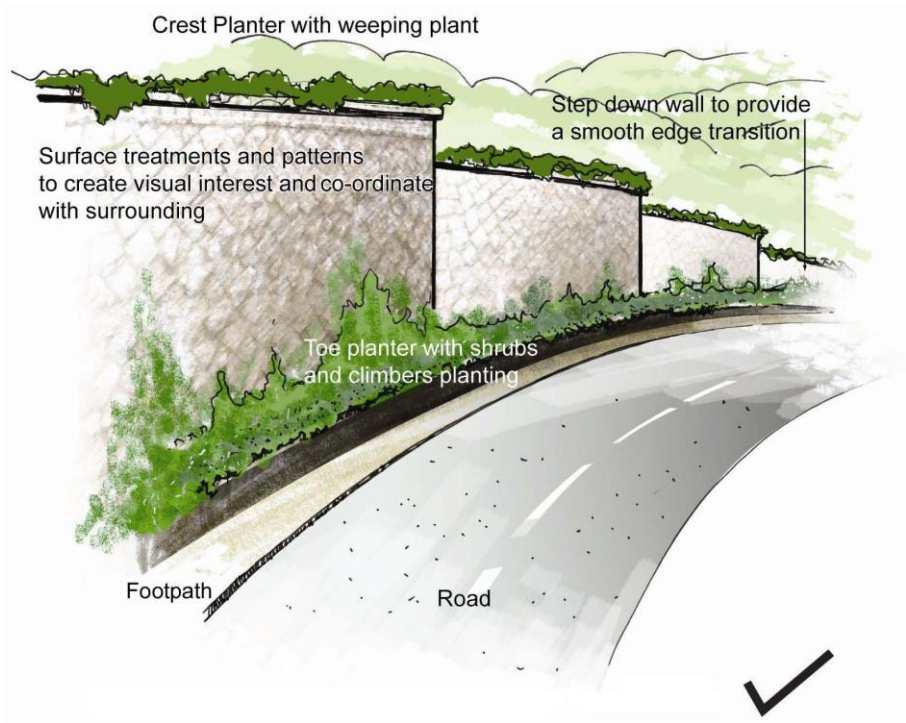

Figure 6.1.5 - Barrier Wall with Step Down Edge Treatment

Figure 6.1.4 illustrates the use of columns to reduce the perceived scale of the barrier. The use of treatment along the edges can also soften the structure.

A ***smooth edge transition*** can be proposed to make the profile less abrupt and reduce the visual bulkiness of the structure. The transition is achieved by aligning proposed structures to existing topography. Differing the wall height can also contribute to a sense of dynamic and movement, which can lead to a more subtle transition. See Figure 6.1.5.

6.1.2 Adjacent Site Context and Visually Sensitive Receivers (VSRs)

One of the overall landscape design intentions is to make the proposed debris-resisting barrier visually compatible to the adjacent landscape context and minimize adverse visual impact to the adjacent Visually Sensitive Receivers (VSRs). As such, the existing landscape context, characters and possible VSRs should be reviewed and considered at the beginning of the project. The design of the debris barrier should be responsive to the adjacent landscape setting, whether it is within urban fringes, along highways or adjacent to high rise development areas. Particular design attention or treatment should be emphasised at locations where most of the VSRs can frequently view the structure. Using existing boulders found on site as feature wall surface treatments to match with the adjacent natural terrain should be considered. See Figure 6.1.6.

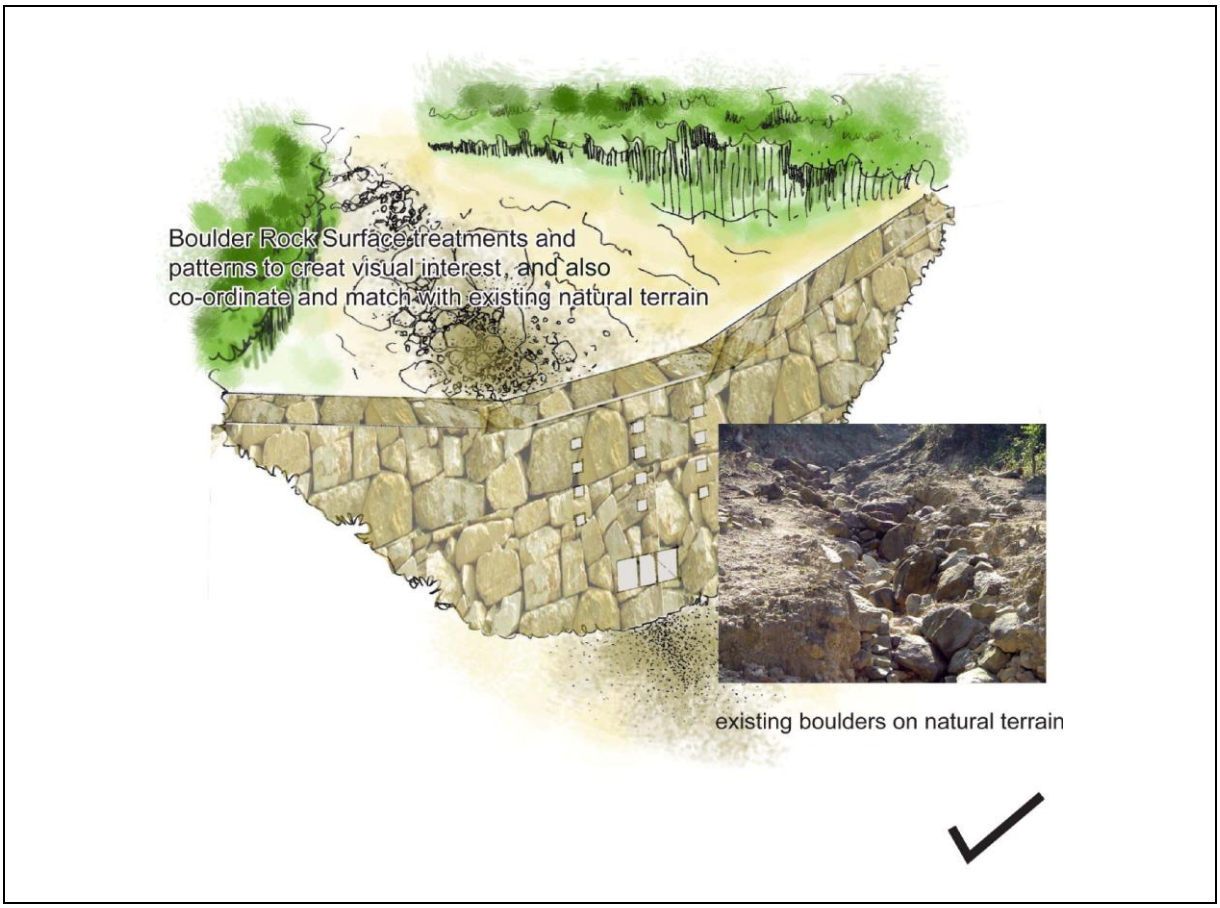

Figure 6.1.6 - Use of Existing Boulders Found on Site as Wall Finishes

6.1.3 Existing Vegetation

Engineering design should endeavour to preserve existing trees or tree groups found on site as much as possible and practical. Alternative engineering designs in terms of design approach, cost-effectiveness and tree preservation should also be examined for the selection of preferred engineering scheme. If conflicts between proposed works and existing trees are unavoidable, tree preservation, transplanting and felling proposal shall be considered in accordance with ETWB TC 3/2006 - Tree Preservation.

Mature and healthy trees with high survival rate that are unavoidably affected by proposed works should be transplanted within the contract works area as far as possible and practical. Technical guidance on tree transplanting refers to Tree Planting and Maintenance in Hong Kong (SIL Tech, 1991).

6.2 Visual Treatment on Debris-Resisting Barriers

(a) Reinforced Concrete Wall and Gabion Units inside a Reinforced Concrete Wall

Reinforced concrete barrier wall is the most bulky and visually intrusive structure among other types of barriers. The use of wall terracing, regularly spaced

vertical elements, distinctive coping features and planting on toe and crest should be considered to break up the apparent size of the wall. Details shall make reference to Page 40, Figure 3.4 of GEO Publication 1/2000. See Figure 6.2.1 and 6.2.2.

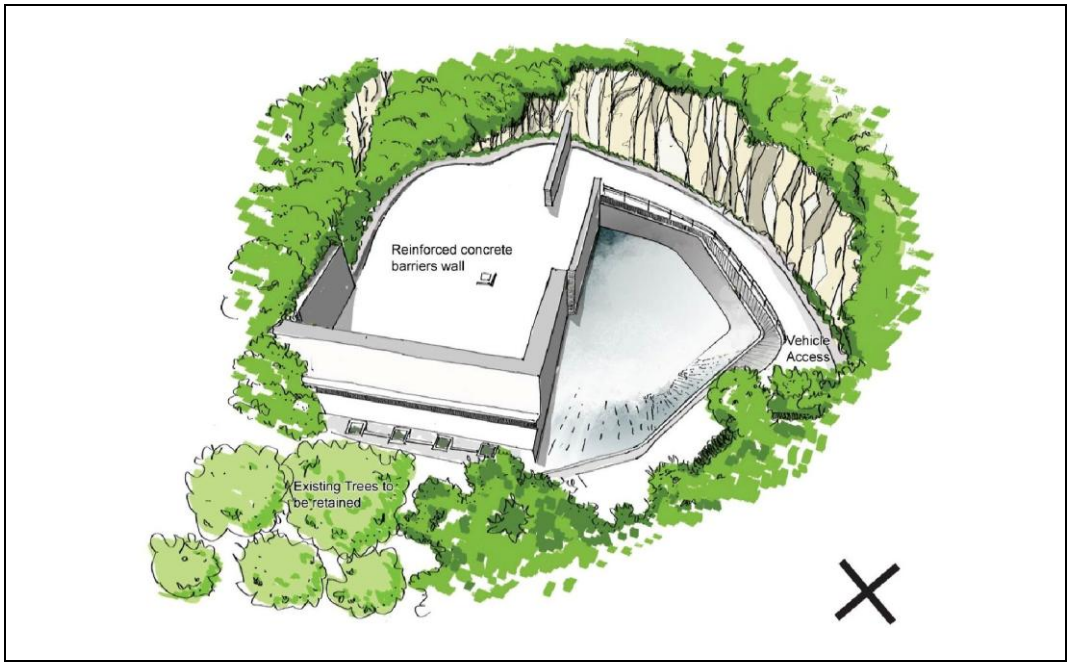

Figure 6.2.1 - Reinforced Concrete Barrier Wall without any Treatment

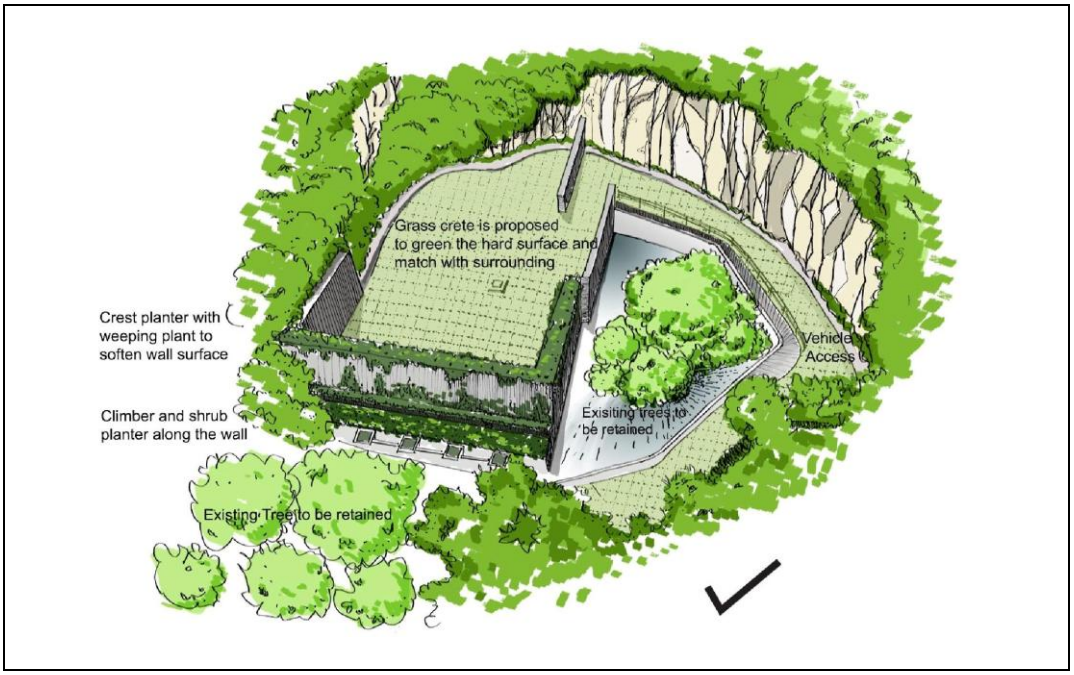

Figure 6.2.2 - Reinforced Concrete Barrier Wall with Landscape Treatment

The design of the wall finishes should be appropriate to the site context. Simple ribbed finishes, rough textured finishes or concrete panel with bold pattern are considered more applicable in locations near high speed road or in locations where people can only see the feature from a distance. However, in prominent locations, special patterns and finishes should be considered. See Figure 6.2.3.

Figure 6.2.3 - Example of Wall Treatment along Highway

Masonry wall finish is appropriate in many landscape settings. The size of units should be chosen in relation to the scale of the feature and the type of VSRs, whether they are travelling in high speed or whether they are viewing the feature at a fixed location. See Figure 6.2.4.

Figure 6.2.4 - Example of Masonry Facing

Random rubble patterns are more appropriate to rural locations whilst square, bonded and coursed patterns or dressed finishes are more appropriate to urban locations or urban fringes. See Figure 6.2.5.

Figure 6.2.5 - Example of Rubble Wall Pattern

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Murals and artworks finish should only be applied to debris barrier wall in very prominent locations. See Figure 6.2.6.

Figure 6.2.6 - Example of Murals and Artworks

For such provision, agreement should be sought from the future maintenance department in the detailed design stage prior to implementation. As the designs of the murals and artworks are very subjective, it is recommended that relevant stakeholders should be consulted during the design process.

(b) Reinforced Gabion Unit

Reinforced gabion barrier is less visually intrusive than concrete wall as it has a relatively finer texture. Design consideration should emphasise more on the deposition and profile of the unit to be blended in with the adjacent topography as mentioned in previous section. See Figure 6.2.7. Planters should be integrated with the proposed gabion structure such that shrubs and climbers can soften the structure. See Figure 6.2.8.

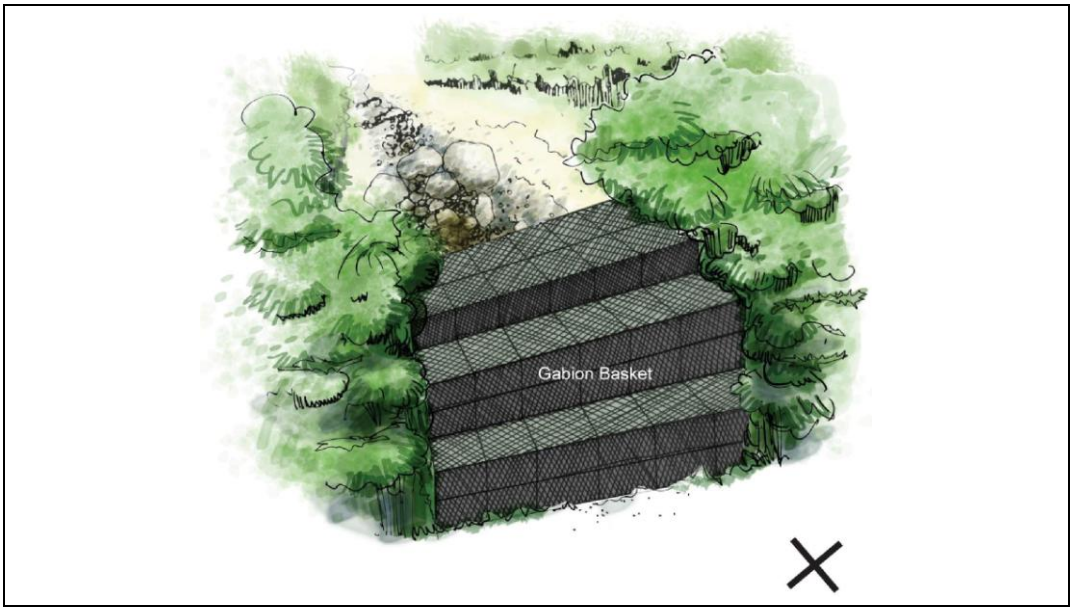

Figure 6.2.7 - Gabion Unit without any Planting Treatment

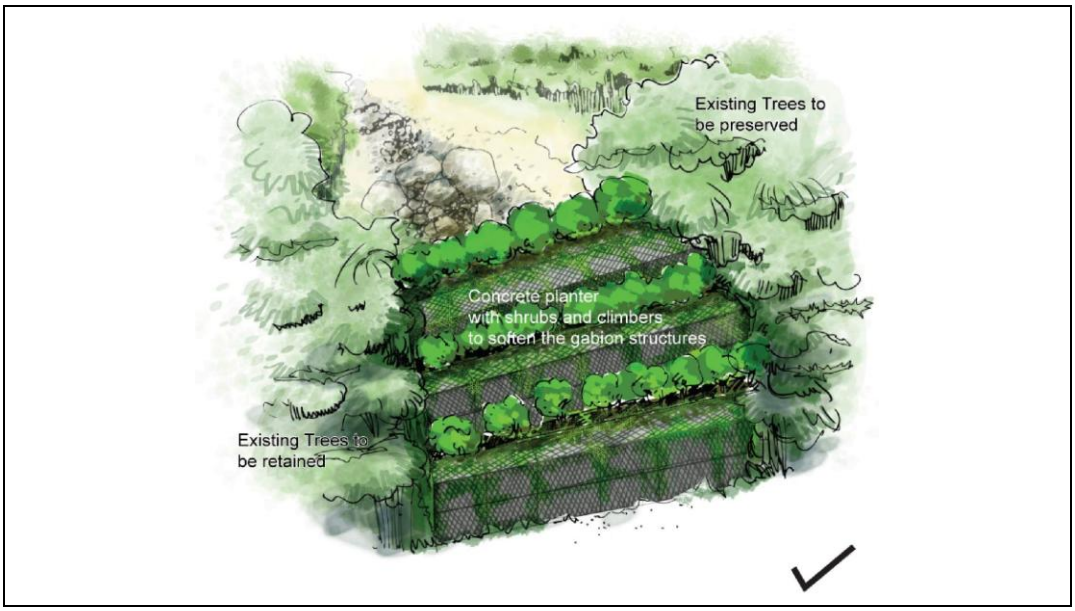

Figure 6.2.8 - Gabion Unit Integrated with Planters

(c) Tensioned Wire Mesh Fence

Tensioned wire mesh fence is the least visually intrusive debris barrier due to its scale and visual permeability. This type of barrier creates minimal disturbance to the existing vegetation. During construction, the foundation for post and anchor foundation should be carefully located to preserve existing trees and vegetation as much as possible. The colour of the post and wire mesh should be subtle. Bright colour is not recommended. See Figure 6.3.4.

6.3 Implementation

All planting should be designed to be self-sustainable where possible with minimal ongoing horticultural maintenance. As many of the debris-resisting barriers are located in natural terrain with natural vegetation, ornamental planting may not be applicable to natural landscape settings. Hence, proposed planting should be self-supporting and able to regenerate naturally, thereby minimizing long-term ongoing maintenance.

Planting should be provided to soften or screen the reinforced concrete barrier wall where space is available without affecting the operation and maintenance requirement of the debris-resisting barrier. Such provision should be allowed in the engineering design of the barrier. Screen tree planting can be provided in front of the barrier wall where space is available. If space is not available for tree planting, at least shrubs and climbers should be provided to soften the visual impact of the proposed structure. However, for concrete wall which does not have space for tree planting, crest planter with weeping plants and climbers can be proposed to soften the visual impact of the structure. See Figure 6.3.1.

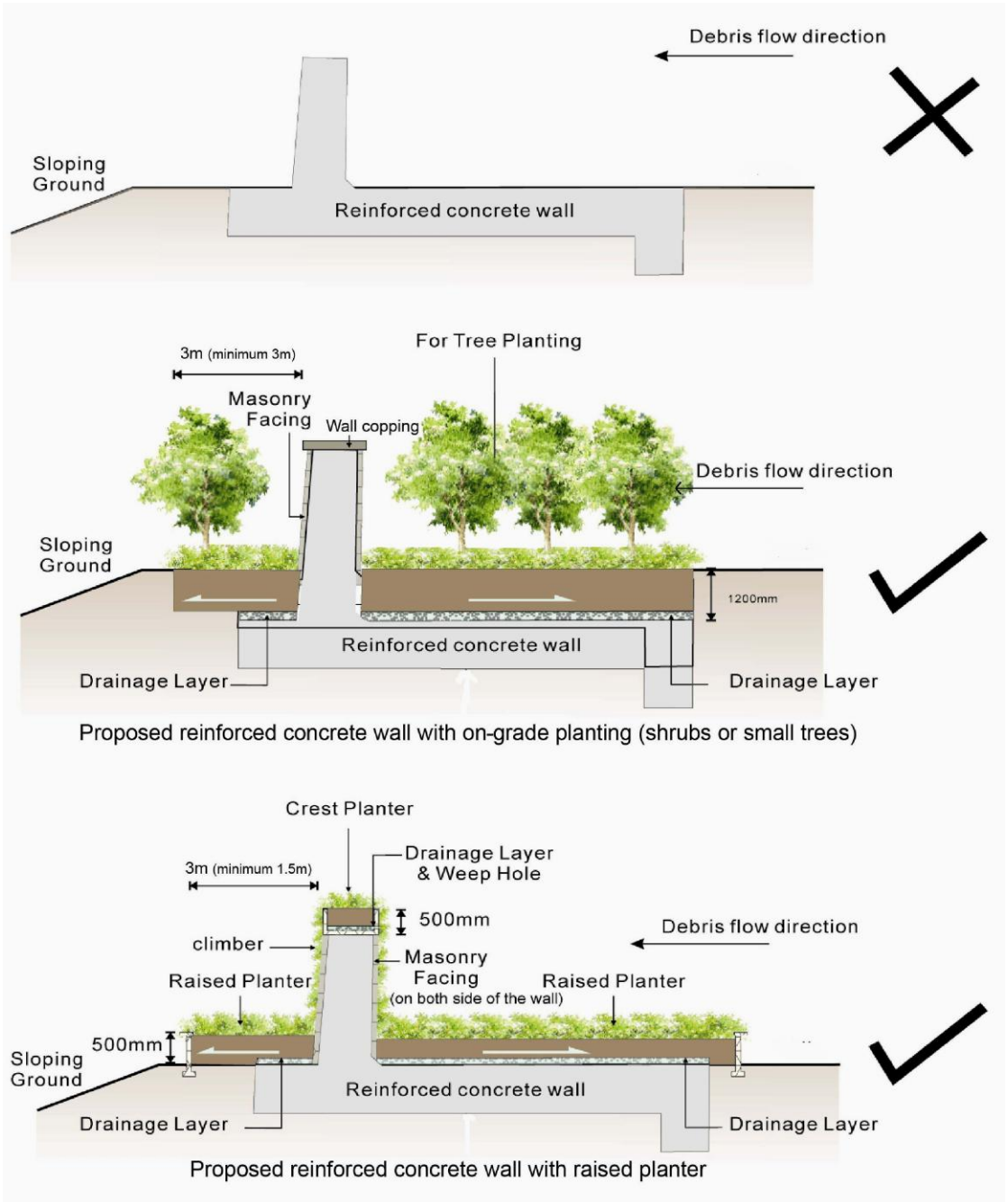

Figure 6.3.1 - Reinforced Concrete Barrier

Planter with drainage system should be integrated with the gabion units inside a reinforced concrete wall. Similarly, where space is available, screen tree planting should be provided. Nevertheless, shrubs and climbers should be provided at toe or crest to soften the visual impact of the structure. See Figure 6.3.2.

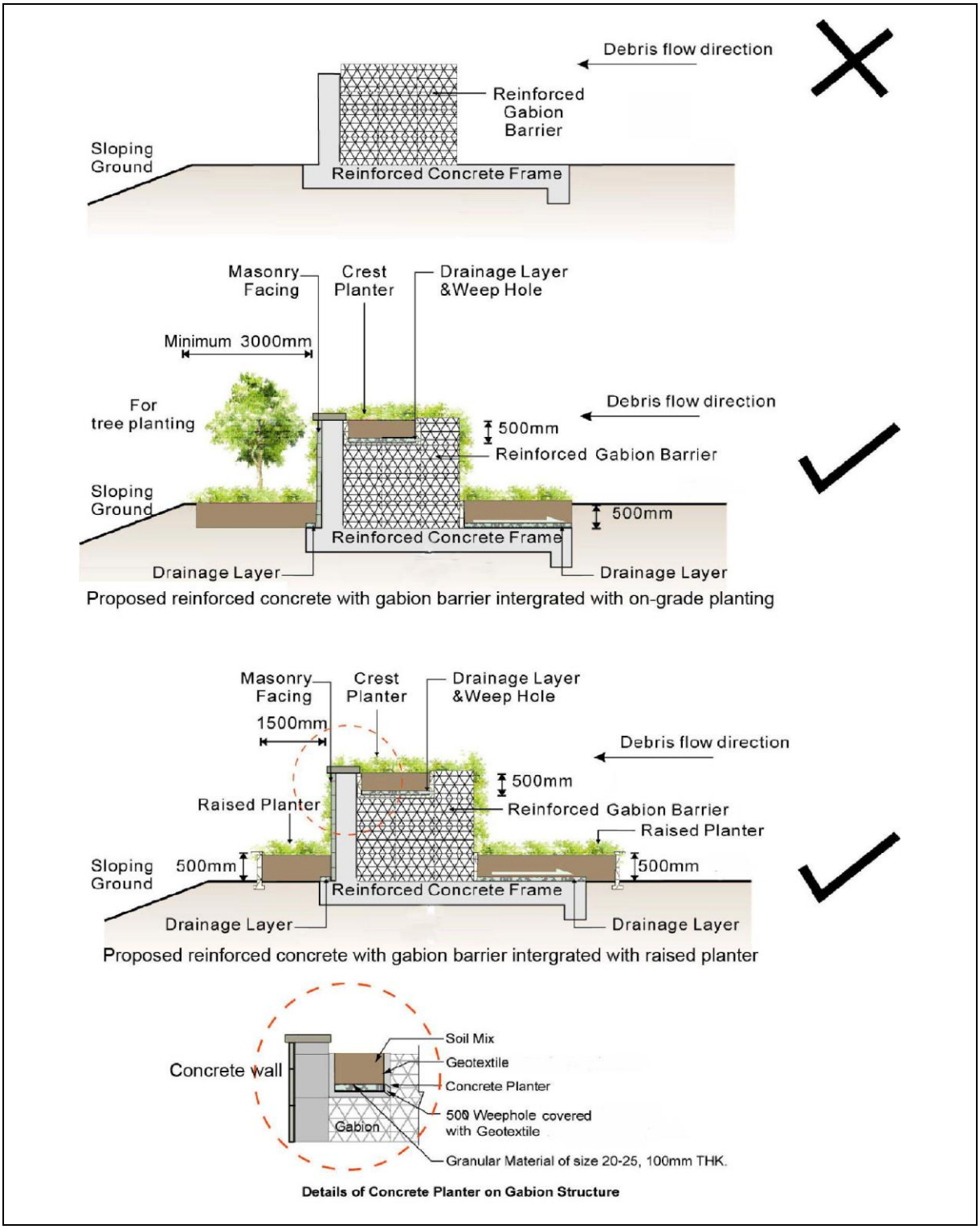

Figure 6.3.2 - Reinforced Gabion Barrier with Reinforced Concrete Frame

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Planting should be provided to all reinforced gabion barriers. Concrete planters with free drainage system shall be integrated in the gabion system. Ground cover planting and climbers should be planted to soften the visual impact of the system. See Figure 6.3.3.

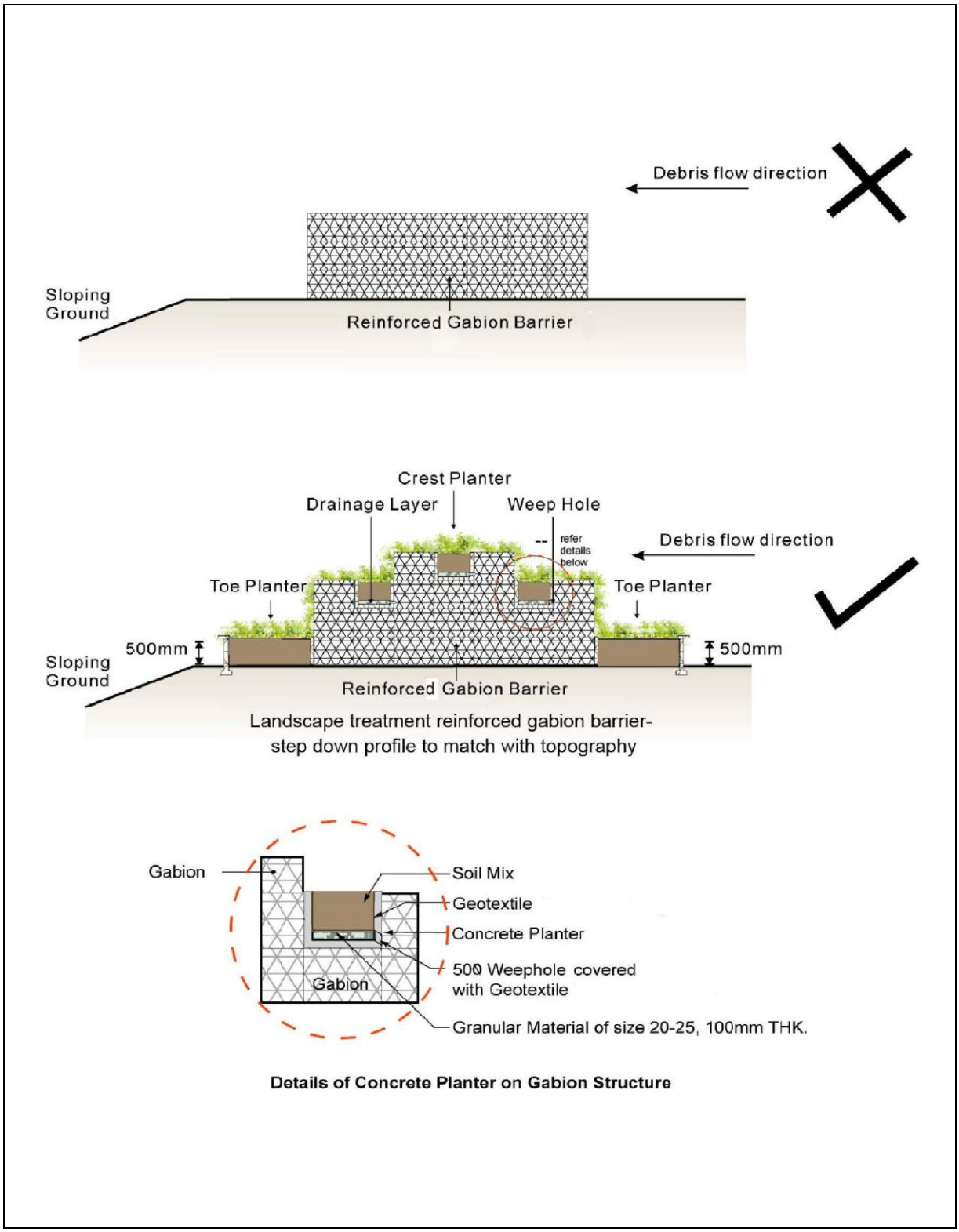

Figure 6.3.3 - Reinforced Gabion Barrier

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There may not be enough space for trees and shrub planting. However, climbers should be provided on the wire mesh to maximise greening. See Figure 6.3.4.

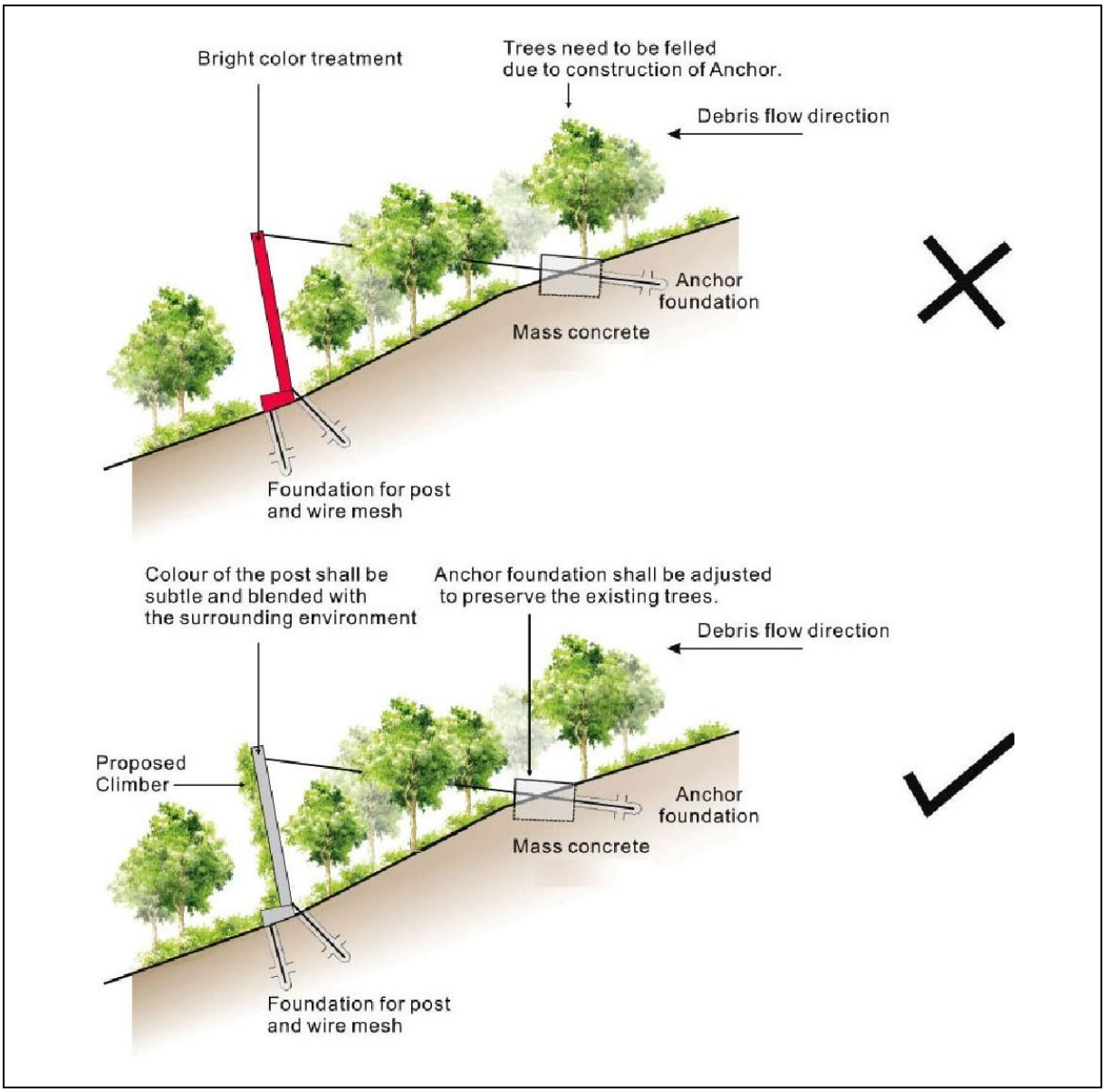

Figure 6.3.4 - Tensioned Wire Mesh Fence

Planting species should make reference to the objectives of the landscape design, soil, water availability and micro-climate of the site. Details of the suitability of plant species for different uses, and their tolerance to different site conditions should refer to Appendix H of GEO Publication 1/2000.

Planting should be selected to encourage opportunities for roosting and feeding for birds and the creation of insect habitats so as to enhance bio-diversity. This can be achieved through the use of native plant species. The list of native plant species which assists in enhancing bio-diversity should refer to Appendix H of GEO Publication 1/2000.

7. CONCLUSIONS

To conclude, this report has identified different types of standardised debris-resisting barriers for mitigation of natural terrain landslide hazards in Hong Kong. Extensive literature review for both local and international practices has been conducted on landscape treatments for debris-resisting barrier (Appendix A and B respectively). Most international cases studied do not include any landscape treatments to visually mitigate the proposed feature. While most of the barriers are located in sparsely populated areas, the aesthetic quality of the barriers is often not in consideration. Different types of debris-resisting barriers in Hong Kong are also reviewed. No standardised landscape treatments are applied to the barriers. Although there are attempts to provide aesthetic and landscape treatments for the barriers in visually sensitive area, it is evident that a systemic aesthetic and landscape design approach is missing.

This report aims to fill such gap by demonstrating how appropriate landscape treatments can be incorporated with proposed structure to create visual interest. General landscape treatment design objectives for the debris-resisting barrier are outlined. Assessment of merits and limitations on the application of landscape treatments for various debris-resisting barriers are highlighted and illustrated. The comparison in terms of practicability, cost-effectiveness and sustainability for different types of barriers is made. The report then presents a series of landscape design principles and guidelines for debris-resisting barriers.

To illustrate how site specific engineering and landscape issues are dealt with during the design process of debris-resisting barrier, sites which possess different context (roadside, residential and rural) have been included in worked examples (Appendix C). Rationale for the application of particular landscape treatment is provided as an example and reference. Landscape treatment should be designed to meet site-specific parameters and to achieve objectives stated in this report and other related government guidelines.

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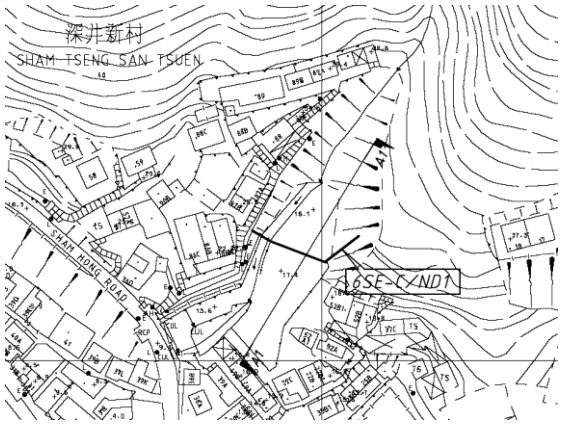
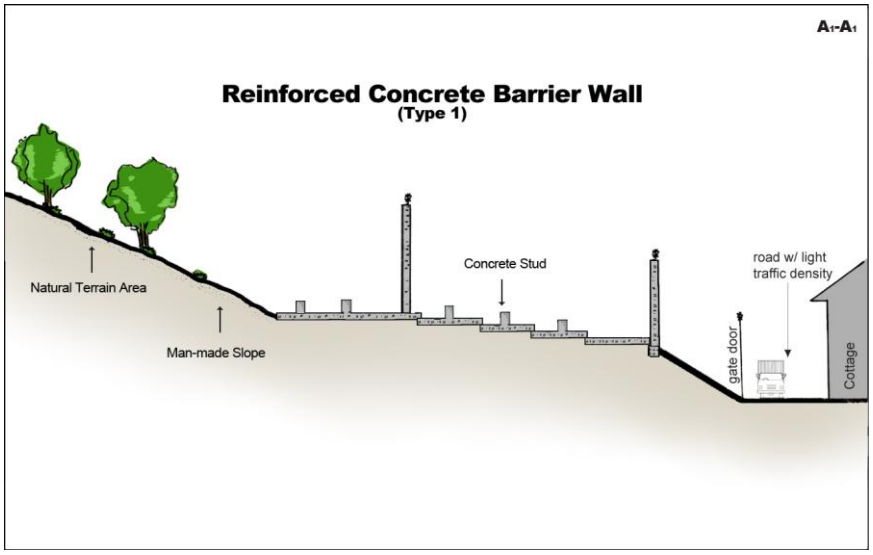
APPENDIX A

EXAMPLES FROM LOCAL PRACTICES

Example A1

Location: Sham Tseng San Tsuen, Sham Tseng, Tsuen Wah (Type 1 - Reinforced Concrete Barrier wall)





The debris-resisting barrier at Sham Tseng San Tsuen, Sham Tseng, Tsuen Wan, consists of fair face concrete blocks and barrier walls. There is no landscape treatment provided for the barrier.

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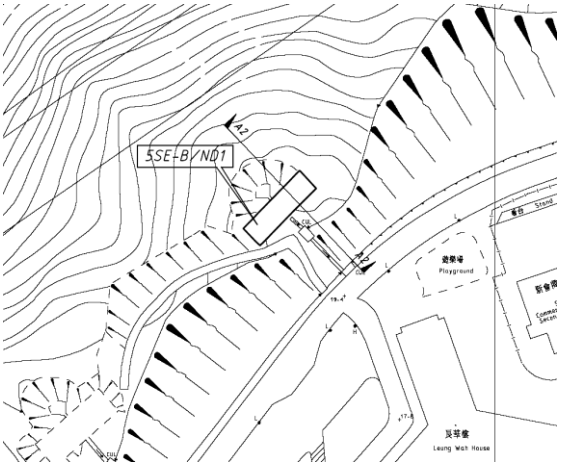
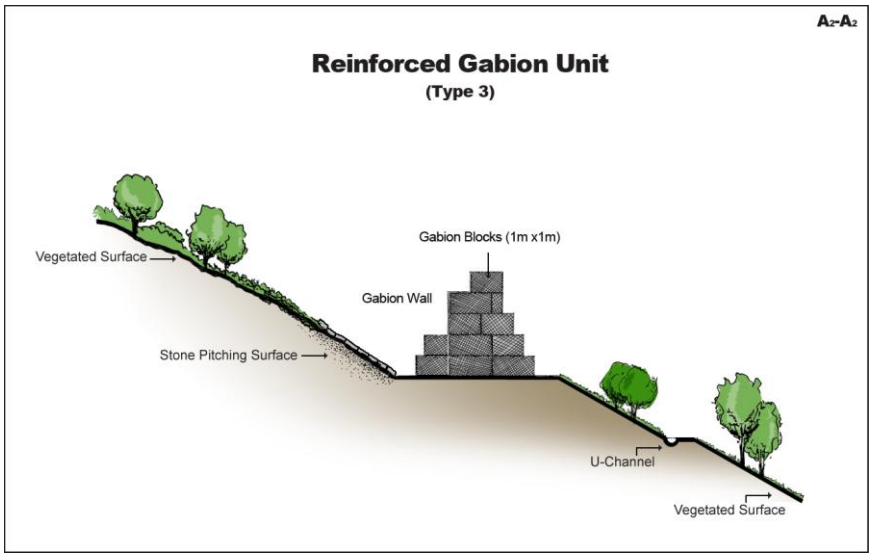
Example A2

Location: Leung King Estate, Tuen Mun (Type 3 - Reinforced Gabion Unit)





The debris-resisting barrier at the North-west of Leung Wah House, Leung King Estate, Tuen Mun is a gabion structure consisted of 1 m x 1 m gabion blocks. There is no landscape treatment provided for the barrier.

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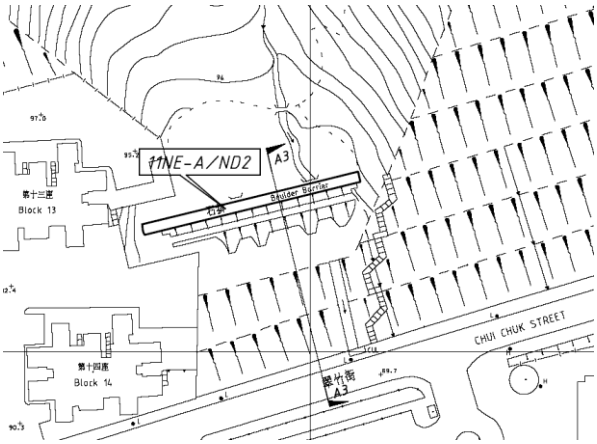
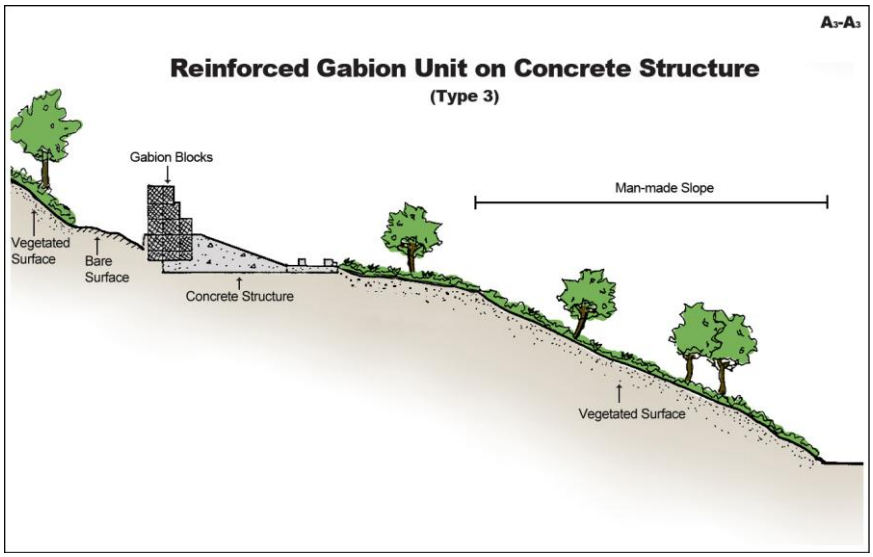
Example A3

Location: Tsz Wan Shan, Kowloon (Type 3 - Reinforced Gabion Unit)





The debris-resisting barrier at the east of Block 13, Chui Chuk Garden, Tze Wan Shan is a gabion structure. There is no landscape treatment provided for the barrier.

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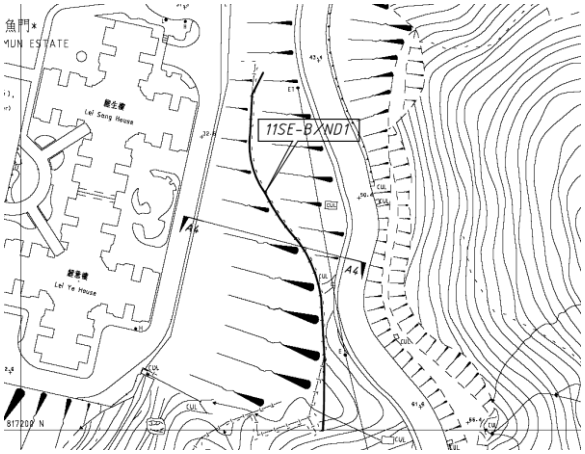
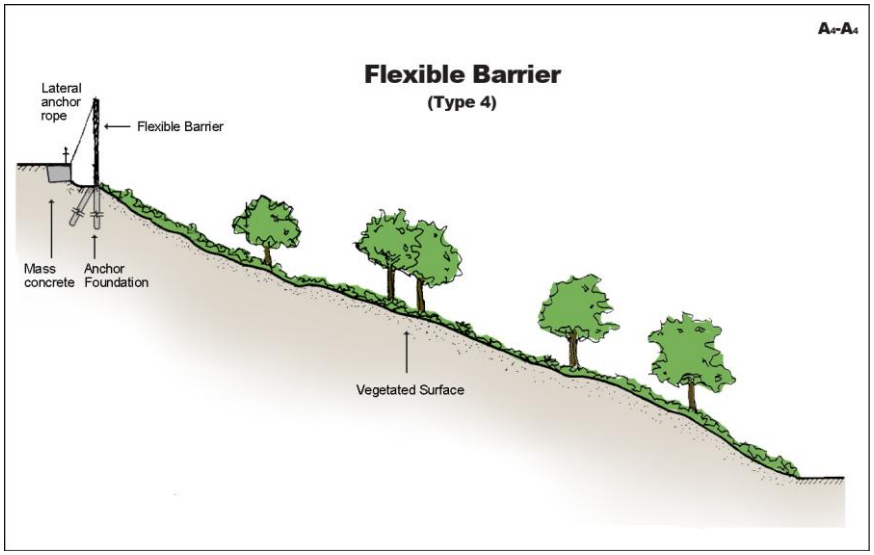
Example A4

Location: Lei Yue Mun Housing Area Phase 1 (Type 4 - Flexible Barrier)

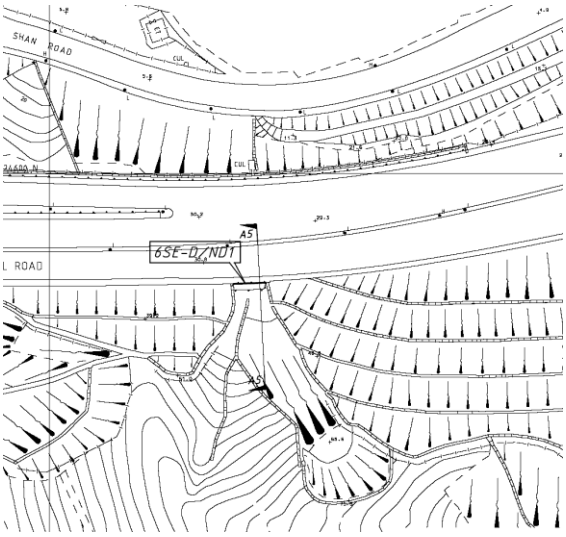


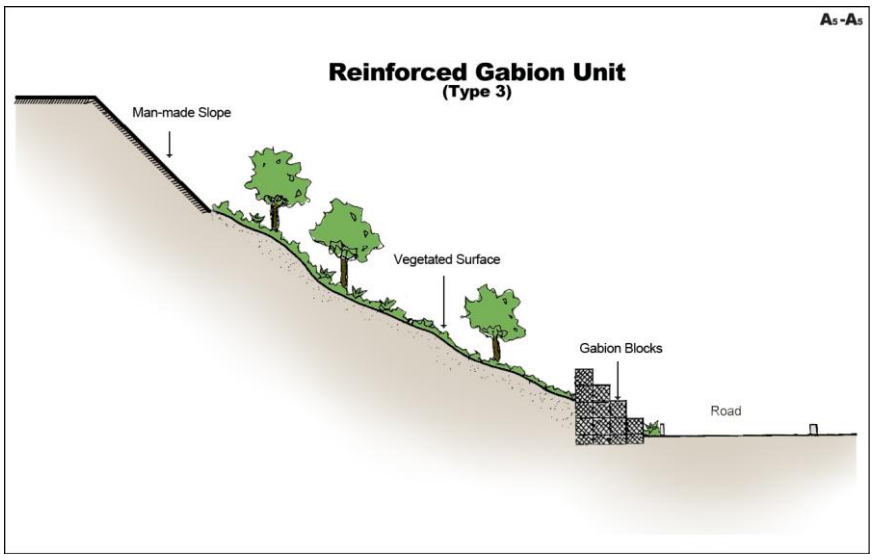


The debris-resisting barrier at Lei Yue Mun Housing Area, Phase 1 is a tensioned wire mesh fence. The greyish colour used on the structural columns and mesh fence is very subtle. There is no soft landscape treatment provided for the barrier.

Example A5

Location: Tsing Yi North Coastal Road, Cheung Shue Tau, Tsing Yi
(Type 3 - Reinforced Gabion Unit)





The debris-resisting barrier at West Bound of Tsing Yi, North Costal Road, Cheung Shue Tau, Tsing Yi is a gabion structure. The colour and text of the gabion structure are not coherent with the vegetated slope behind. It is noticed that there is no landscape treatment provided for the barrier.

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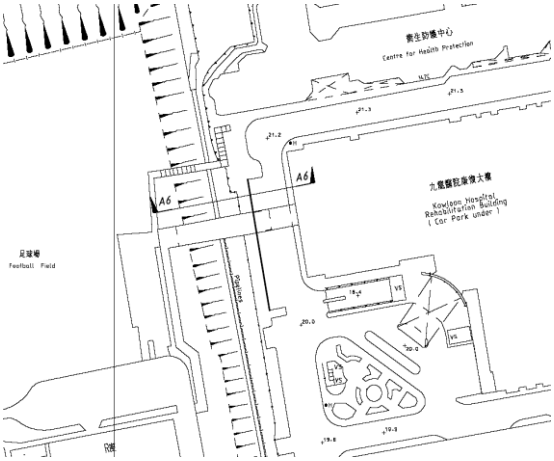
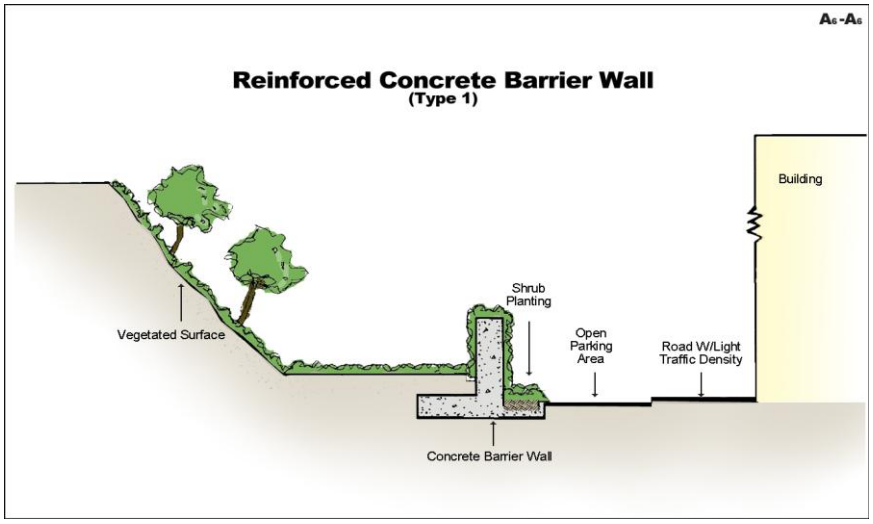
Example A6

Location: 147B, Argyle Street, Kowloon (Type 1 - Reinforced Concrete Barrier wall)

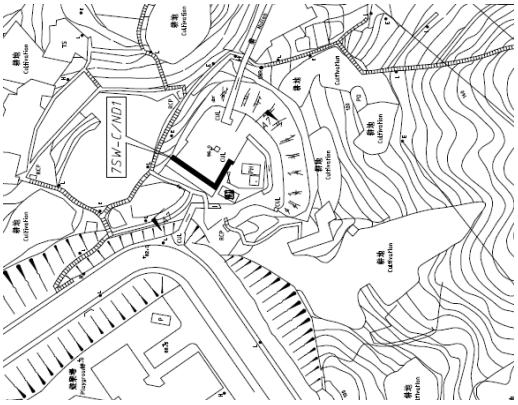


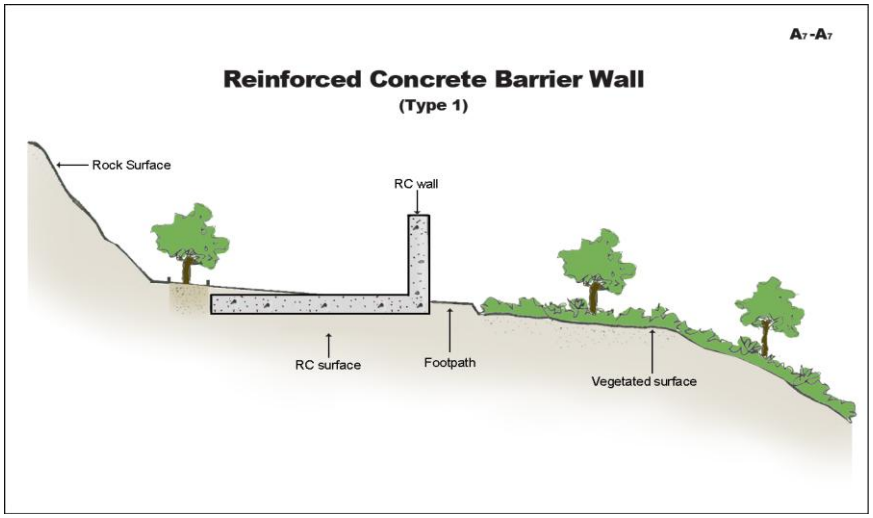


The debris-resisting barrier at 147B, Argyle Street, near Kowloon Medical Rehabilitation Centre and Hospital Authority Building is a reinforced concrete wall. Wall tiles (with colour and texture similar to the paving material used in adjacent footpath) are used as the finishing of the structure facing adjacent development. On-grade planter (~1 m wide) with shrub planting and climbers on wall is provided as soft landscape treatments. It is considered that the aesthetic wall treatment and soft landscape treatment provided have successfully mitigated the visual impact of the barrier wall.

Example A7

Location: Lei Pu Street, Kwai Chung (Type 1 - Reinforced Concrete Barrier wall)





The debris-resisting barrier at Lei Pui Street is a reinforced concrete wall barrier. One existing tree is preserved in-situ within tree ring. A concrete surface access is provided to the east of the structure. The proposed landscape treatment does not effectively blend in with the adjacent landscape setting. It is noticed that there is no hard and soft landscape treatment provided for the barrier.

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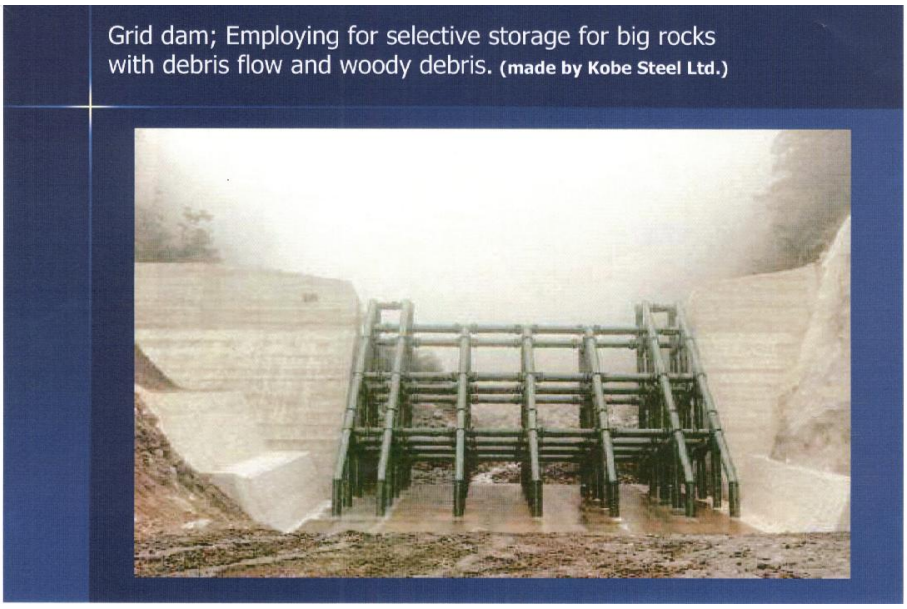
APPENDIX B

EXAMPLES FROM INTERNATIONAL PRACTICES

Example B1

Location: Otanazawa, Japan (Type 1 - Reinforced Concrete Barrier wall)



The debris-resisting barrier in Otanazawa, Japan is a Reinforced Concrete Wall with Steel Grid Dam. The Grid Dam is painted in black. There is no other hard and soft landscape treatment provided for the debris barrier.

Example B2

Location: Kamikamborizawa (Mt. Yakedake), Japan (Concrete Baffles)

The debris-resisting barrier in Kamikamborizawa (Mt. Yakedake), Japan, is a debris flow breaker screen. There is no hard and soft landscape treatment provided for the debris barrier.

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Example B3

Location: Yotagiri River, Japan (Steel Cell Dam)

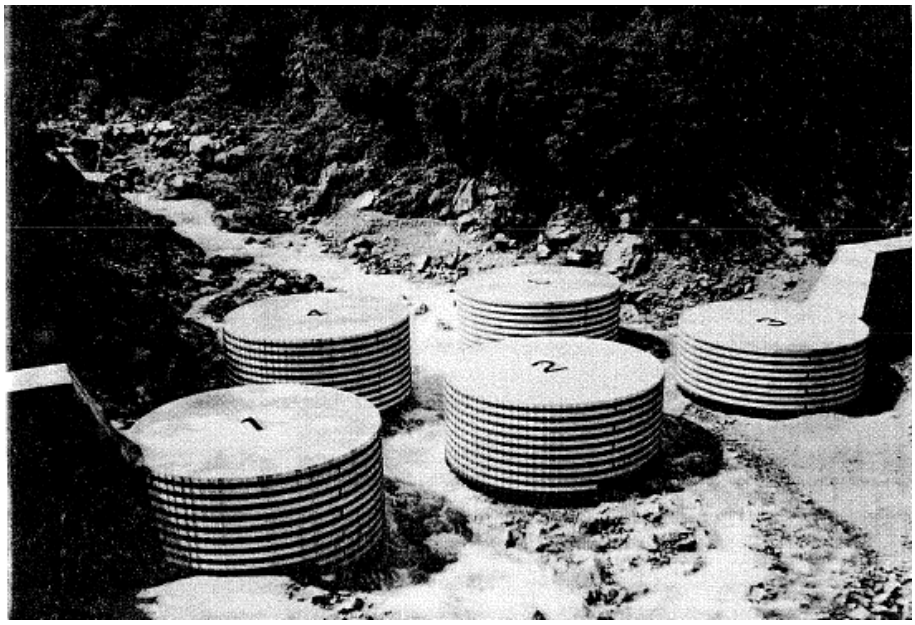
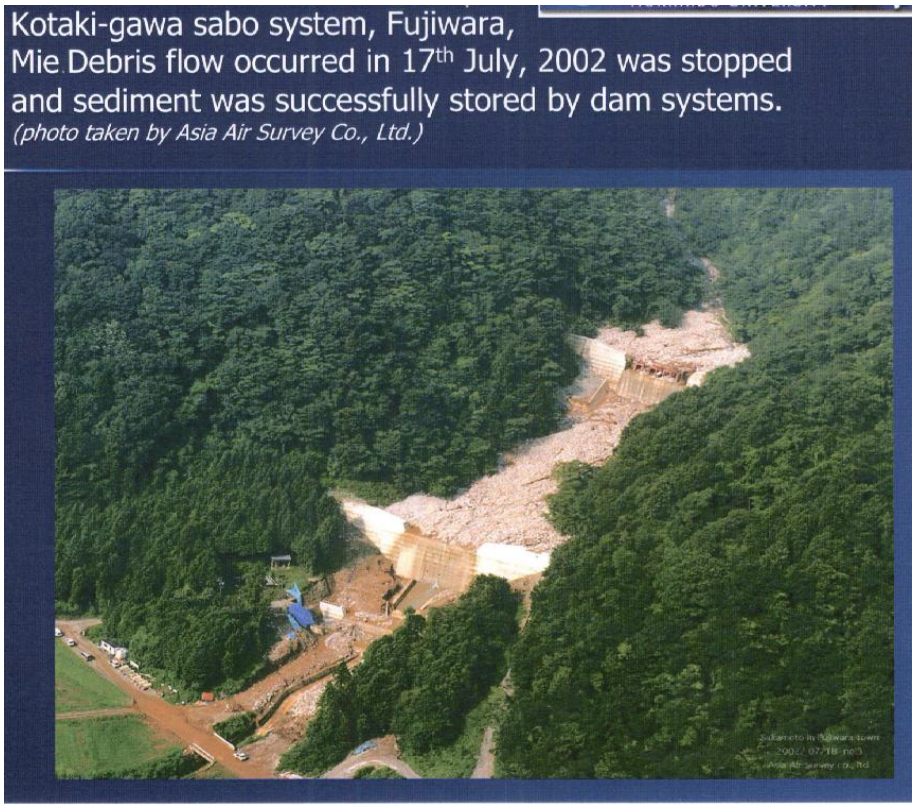


Photo 3 Yotagiri River steel cell dam

The debris-resisting barrier in Yotagiri River, Japan is a Steel-made cell dam. There is no hard and soft landscape treatment provided for the debris barrier.

Example B4

Location: Fuji River, Japan (Reinforced Concrete Wall)



The debris-resisting barrier in Fuji River, Japan is a Reinforced Concrete Wall. Masonry finishing is used for the wall surface. There is no soft landscape treatment provided for the debris barrier.

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Example B5

Location: Aobandoni, Japan (Tensioned Wire Mesh Barrier)

The debris-resisting barrier is located in Aobandoni, Japan.

No landscape treatment is applied.

Example B6

Location: San Bernardino Mountains, USA (Tensioned Wire Mesh Barrier)

The debris-resisting barrier is located in San Bernardino Mountain, USA. The barren landscape setting is caused by fire.

The colouration (brown) of all wire mesh and associated components minimises the visual impact of the barrier.

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APPENDIX C

WORKED EXAMPLES

The worked examples of debris-resisting barriers consist of 3 scenarios of roadside, residential and rural settings. They are intended to illustrate how relevant engineering and landscape issues should be dealt with during the design process. Hence, it should be considered as a guideline and design principle. Design options can vary greatly due to particular site context.

Each worked example demonstrates and highlights 3 typical and common engineering structures and landscape solutions of debris-resisting barrier under different landscape contexts and settings. Assessment and selection of landscape treatments will be governed by its site opportunities and constraints. Assessment of overall practicability, cost effectiveness and sustainability is presented and followed by a brief discussion.

However, solutions in any project should be designed to meet site-specific requirements and parameters. It is essential that both geotechnical engineers and landscape architects should work together as a team to develop an integrated solution taking into account the ultimate appearance of the site and its surrounding. Detailed design process should make reference to the recommendations given in this report as well as other related government guidelines. Checklist of landscape considerations in the design process is given in the following table:

Table C1 - Checklist of Landscape Considerations

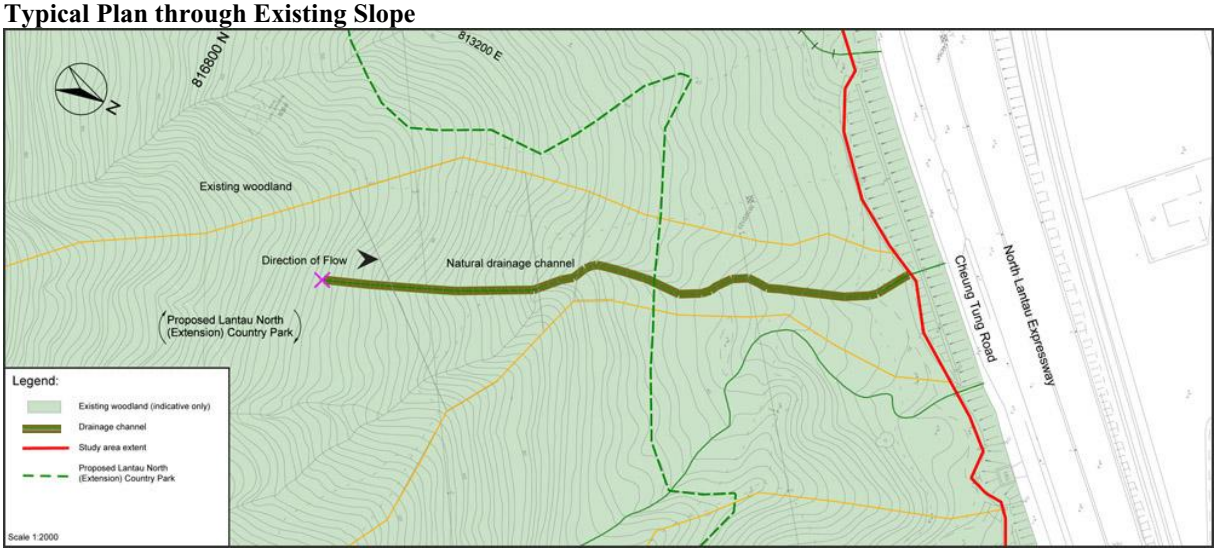
	Landscape Considerations Checklist
Topography, Existing Vegetation and Planting Opportunities	Rounding transition between new and existing slopes • Terracing • Retain existing healthy trees in position • Tree protection and minimise tree felling and transplanting • Construction of toe and crest planters • Limit impact on existing vegetation around the proposed structure • Prescriptive use of vegetative cover for slopes
Visual Treatment of Engineering Elements	Co-ordination with existing landscape elements with engineering design • Toe and crest planters finishes to match hard surface finishes and complement surrounding landscape • Planting and surface erosion control matting • Aesthetic design (arrangement, size and colour) of exposed engineering components such as soil nail heads • Maintain simplicity - the fewer the number of engineering and/ or landscape techniques will lead to more coherent in its outlook • Efforts should be made to blend in the built elements into their surroundings in order to create harmony between the artificial and natural landscape
Visual Treatment of Access, Drainage etc.	• Alignment of steps and railings to be co-ordinated with overall design • Recess steps channels and catch pits into slope profile • Colouration or cladding of exposed drainage elements to match complement wall finishes
Planting Design and Implementation	Trees, climbers and groundcover plants for planters • Measures to protect existing vegetation to be retained • Wall and planter finishes • Soiling, planting and establishment works • Shrubs planting • Ecological context and sustainability • Tolerances to exposure, shade and drought • The use of native plants will be beneficial to fauna and flora community and will therefore enhance bio-diversity • Consider micro-climate and bio-diversity of the site • Plants selection to minimise litter generation and frequency for periodic inspection and maintenance
Maintenance	• Trim climbers/groundcover plants in toe planters • Clearance of drainage channels • Thinning of exotic tree species on native woodland planting • Keep drainage channels clear

Worked Example A - Feature near Roadside

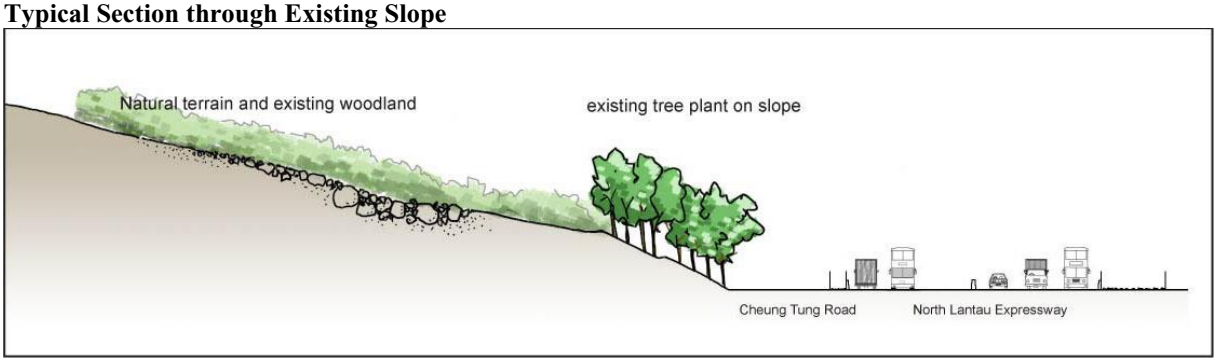
Key Issues/ Objectives Parameter		Landscape Objectives	Typical example of existing conditions
Landscape Context (Urban/ Urban Fringe/ Roadside/Rural)	Roadside	· Preservation of Existing Vegetation · Responsive Design to surrounding landscape settings and minimise visual impact for road users · Visual Aesthetic and Harmony · Self-sustainable with minimal maintenance · Enhancing Biodiversity · Adhere to aesthetic principle	
Consequence-of –life (Ref WBTC No. 13/99)	1	Geotechnical considerations given priority	
Size (Small/Medium/ Large)	Large	Emphasis on detailed landscape treatment to create visual interest and variety	

The area possesses a close proximity to the North Lantau Expressway. However, road users have a limited view to the proposed site due to dense and mature tree planting on the slope. The design should try to obtain a balance between the engineering and landscaping perspective.

Typical Plan through Existing Slope



Typical Section through Existing Slope



Assessment of Existing Conditions/ Site Constraints

- Barren landscape with medium size boulders and limited vegetation cover along existing drainage channel
- Dense and natural vegetation cover in drainage catchment
- Close proximity to highways. Views screened by dense vegetation
- Medium range view from residential properties

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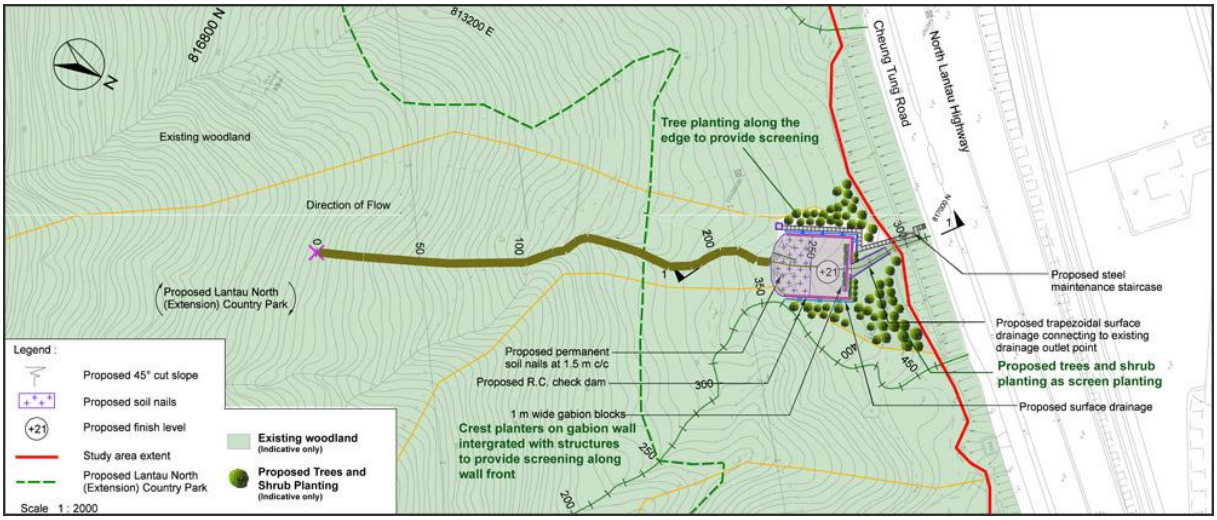
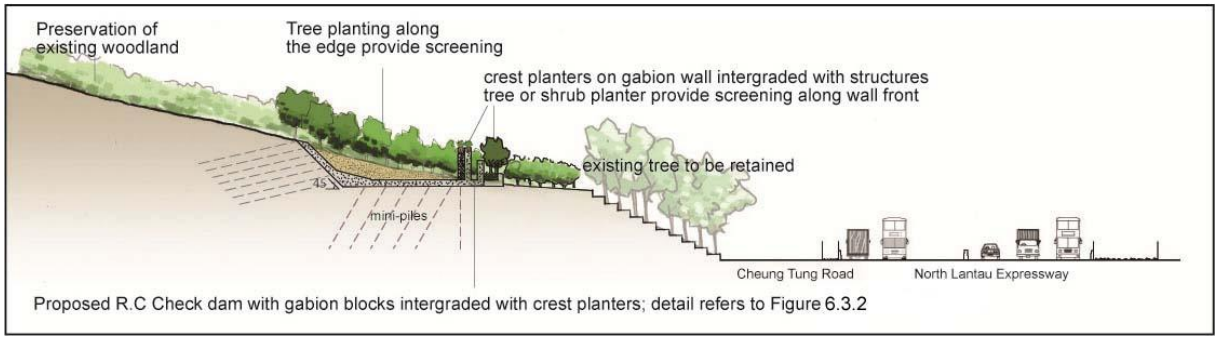
Worked Example A
Solution Overview

Option 1 - Reinforced Concrete Barrier Wall near Roadside

Proposed check dam at the toe of the stream course (30 m x 30 m x 5 m). Extensive site formation work will be required for the construction of such structure. From the engineering and maintenance point of view, this scheme offers complete and safe retention of debris in a contained space, hence allowing relatively easy removal of debris.



Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 1

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Considerations
Retention of existing tree	√√	√√	√√	• Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√√	√√	• Proposed planting to create visual buffer • To screen proposed structure from road users
Planting in crest and toe planter	√√	√√	√√	• Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√√	√√√	√√	• Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure

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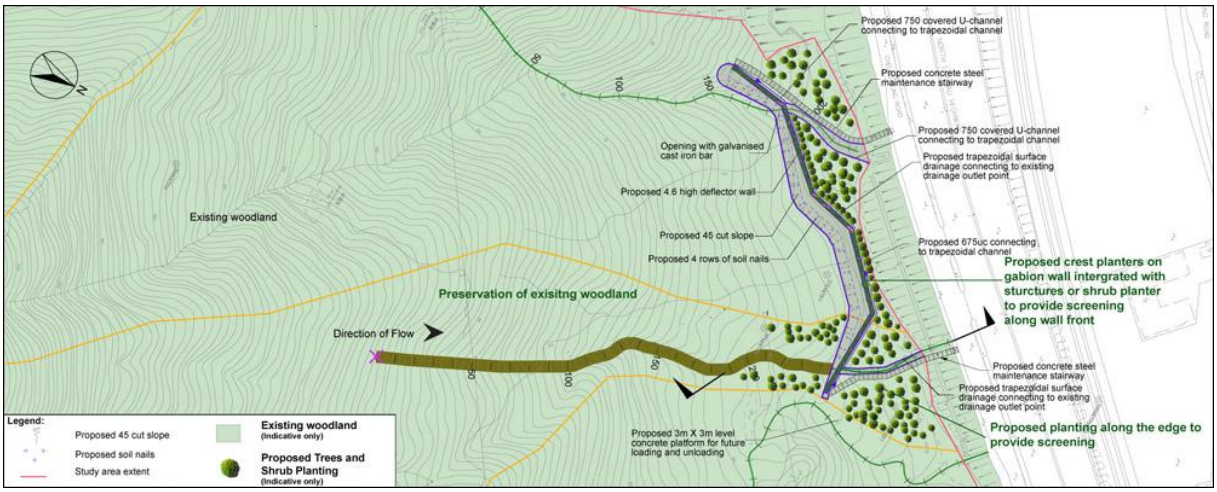
Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Considerations
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√√	√	√√	● Not cost-effective and practical in roadside setting as views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√√	√	√	● Not practical in this location given screened view by trees
Colour treatment for exposed concrete structure	√√√	√√	√	● Subtle colour to blend in with surrounding environment
Use of in situ (locally found) material	√√√	√√	√√√	● The use of boulders to local materials on wall surface is desirable

√√√ High √√ Moderate √ Low

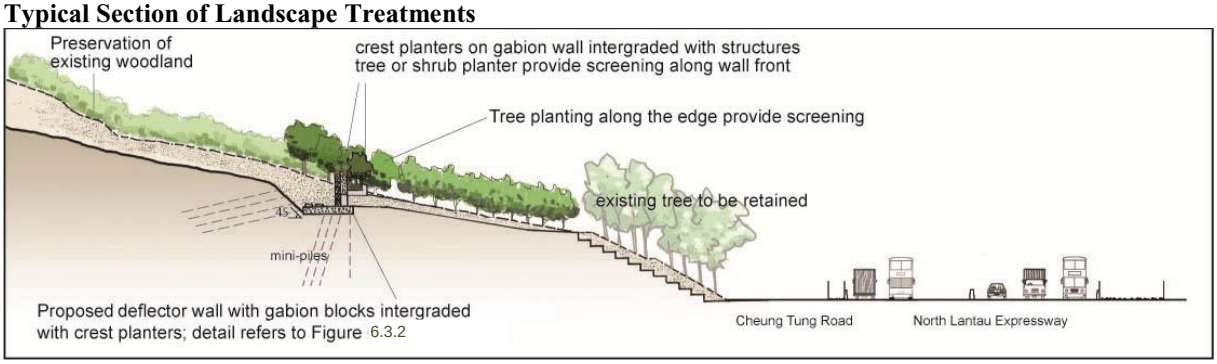
Worked Example A

Option 2 - Reinforced Deflector Wall and Deposition Pond near Roadside

This proposed option involves a deflector wall with a deposition pond at the toe of the existing stream course. The alignment of the deflector wall follows the natural blend in the stream course. The deflector wall is designed and indented to direct debris into a containment area rather than resisting large impact loads. No extensive earthwork is required and hence a lower construction cost from the engineering point of view.



Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 2

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√	√	√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√√	√√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical

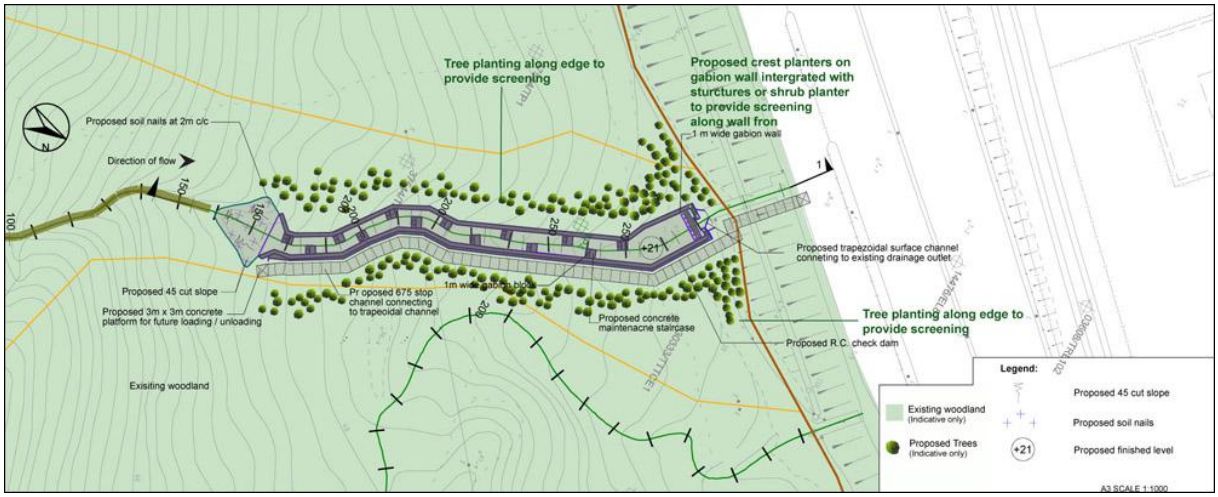
Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Planting on gabion wall	√√	√√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√√	√	√√	● Not cost-effective and practical in roadside setting views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√√	√	√	● Not cost-effective in an roadside setting
Colour treatment for exposed concrete structure	√√√	√√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√√	√	√√√	● The use of boulders to local materials on wall surface is desirable, but associated cost may be relatively high due to the size of proposed structure

√√√ High √√ Moderate √ Low

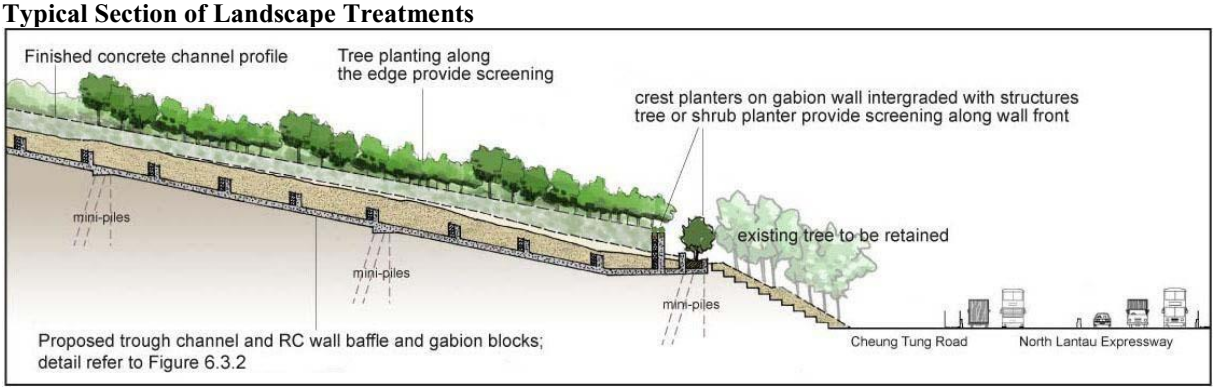
Worked Example A

Option 3 - Trough Channel and Wall Baffle near Roadside

The third option for the site is the construction of a rectangular shape trough channel with baffle along the stream course with a barrier wall at the base of the stream course. To cater for the required deign debris volume, the proposed structure will run along the existing drainage channel up to about 100 m long and with depth of 6-7 m, below the existing stream course level. Substantial earthworks and excavation will be required along the 100 m proposed profile on existing drainage channel.



Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 3

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Considerations
Retention of existing tree	√√√	√√√	√√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√	√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√√	√√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√	√	√√	● Not cost-effective

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Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Considerations
Planting on gabion wall	√√	√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√	√	√√	● Not cost-effective and practical in roadside setting views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√	√	√	● Not practical in an roadside setting
Colour treatment for exposed concrete structure	√√√	√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√	√	√√√	● Not practical and high cost associated with this design option

√√√ High √√ Moderate √ Low

Option Assessment:
The area possesses a close proximity to the North Lantau Expressway and the main Visually Sensitive Receiver (VSR) will be the road users.

Option 1 is the least visually intrusive solution comparing to Options 2 and 3.
Option 1 offers the least visual interruptions and such interruptions can be easily mitigated by screen planting.
Option 3 offers the least interruptions to existing trees and vegetation as it runs along the barren stream course.

The maintenance commitments for Options 2 and 3 are substantially higher than Option 1 given in scale of proposed structure.

As discussed, Option 1 will be the preferred option from a landscaping point of view.

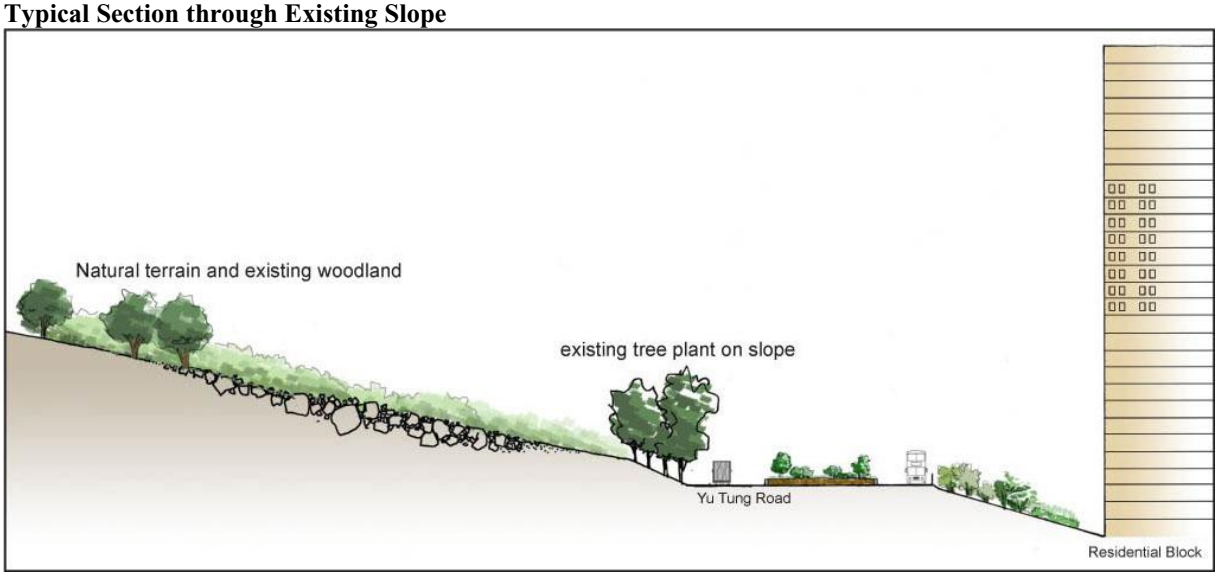
Worked Example B - Feature near Residential Area

Key Issues/ Objectives Parameter		Landscape Objectives	Typical example of existing conditions
Landscape Context (Urban/ Urban Fringe/ Roadside/Rural)	Residential	· Preservation of Existing Vegetation · Responsive Design to surrounding landscape settings and minimise visual impact to residents · Visual Aesthetic and Harmony · Self-sustainable with minimal maintenance · Enhancing Biodiversity · Adhere to aesthetic principle	
Consequence-of –life (Ref WBTC No. 13/99)	1	Geotechnical considerations given priority	
Size (Small/Medium/ Large)	Large	Emphasis on detailed landscape treatment to create visual interest and variety	

The area is very close to the high-rise residential block and so the visual impact of the proposed structure will be a major concern in the assessment process. Man-made slope is located next to the existing drainage channel.

Typical Plan through Existing Slope

Typical Section through Existing Slope



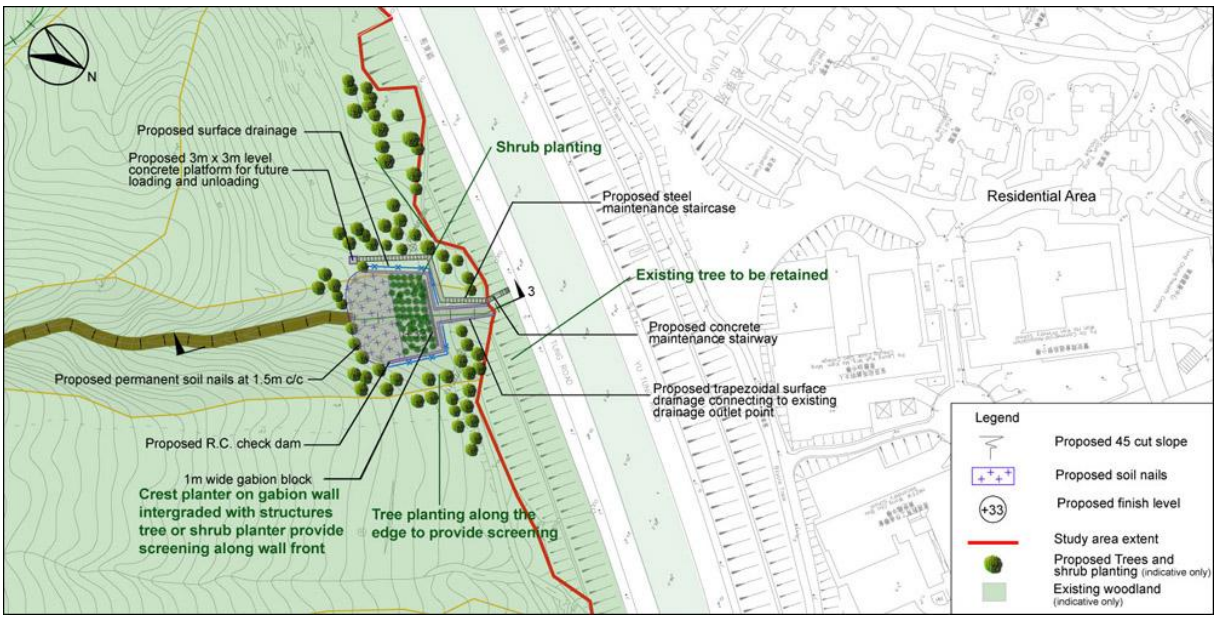
Assessment of Existing Conditions/ Site Constraints

- Barren landscape with medium-large sized boulders and limited vegetation cover along existing drainage channel
- Medium range view from local residential properties (high rise) and community facilities (schools)
- Sensitivity is highly given by the sensitive receivers
- Hydro-seeding in nearby slopes
- Dense shrub and woodland in catchment area
- Dense and mature roadside planting along Yu Tung Road

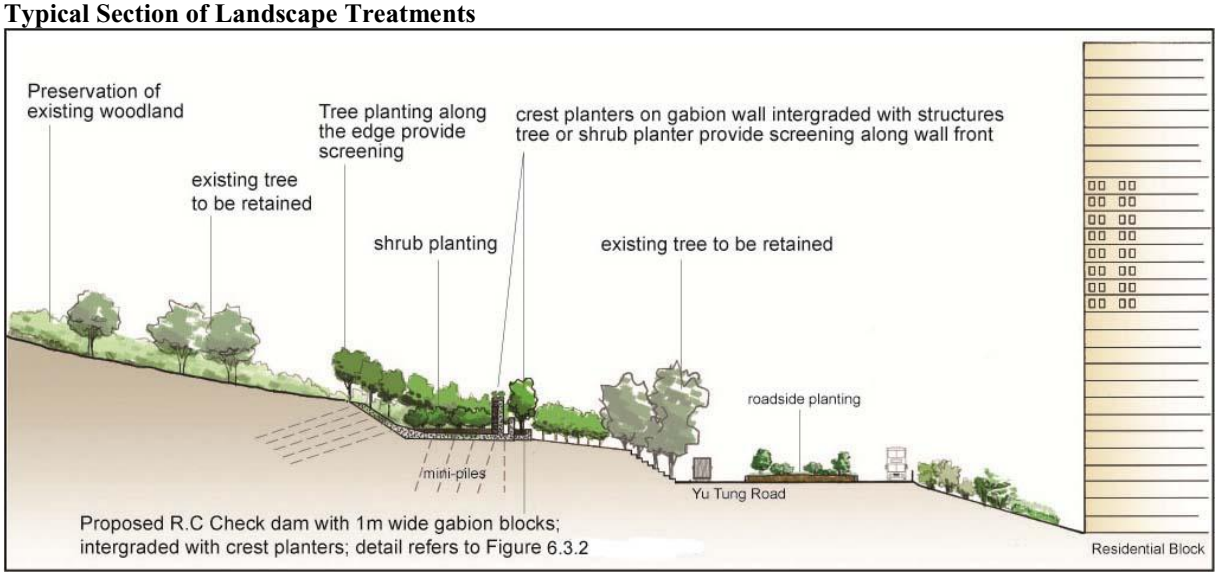
Worked Example B
Solution Overview

Option 1 - Reinforced Concrete Barrier Wall near Residential Area

Proposed check dam at the toe of the stream course (34 m x 25 m x 4 m). Site formation works with cutting of natural slope will be required.



Typical Section of Landscape Treatments



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Assessment of Application of Landscape Treatment and Consideration - Option 1

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√	√√	√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√√√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√√	√√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√√√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√√	√√√	√√	● Not cost-effective to mitigate the proposed structure due to the high sensitivity residential area
Mural/ artwork	√√√	√√	√	● Not practical in this setting
Colour treatment for exposed concrete structure	√√√	√√√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√√√	√√	√√√	● The use of boulders to local materials on wall surface is desirable

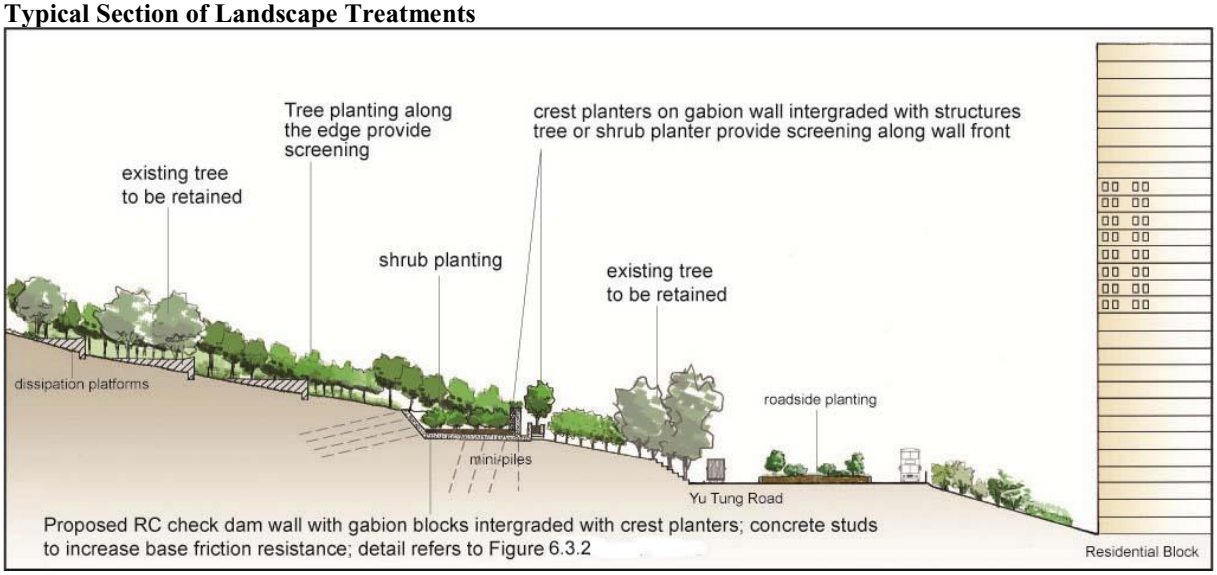
√√√ High √√ Moderate √ Low

Worked Example B

Option 2 - Energy Dissipation Platforms near Residential Area

Three dispension and energy dissipation platforms are proposed at upstream area. The platforms could help protect the stream course from possible erosion and reduce potential for debris entrainment. A nominal impact barrier is provided at the end of the stream course. The excavation works required for the platform are minimal. As some of debris and impact loads will be taken up by the platforms upstream, the size required for the check dam at toe of the area could be smaller and hence the required excavation works will be relatively less in comparison with Option 1.

Typical Section of Landscape Treatments



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Assessment of Application of Landscape Treatment and Consideration - Option 2

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√	√√	√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√	√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√√√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√√	√√	√√	● Cost-effective to mitigate the proposed structure due to the high sensitivity residential area
Mural/ artwork	√√	√√	√	● Not practical in this location
Colour treatment for exposed concrete structure	√√√	√√√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√√√	√√	√√√	● The use of boulders to local materials on wall surface is desirable

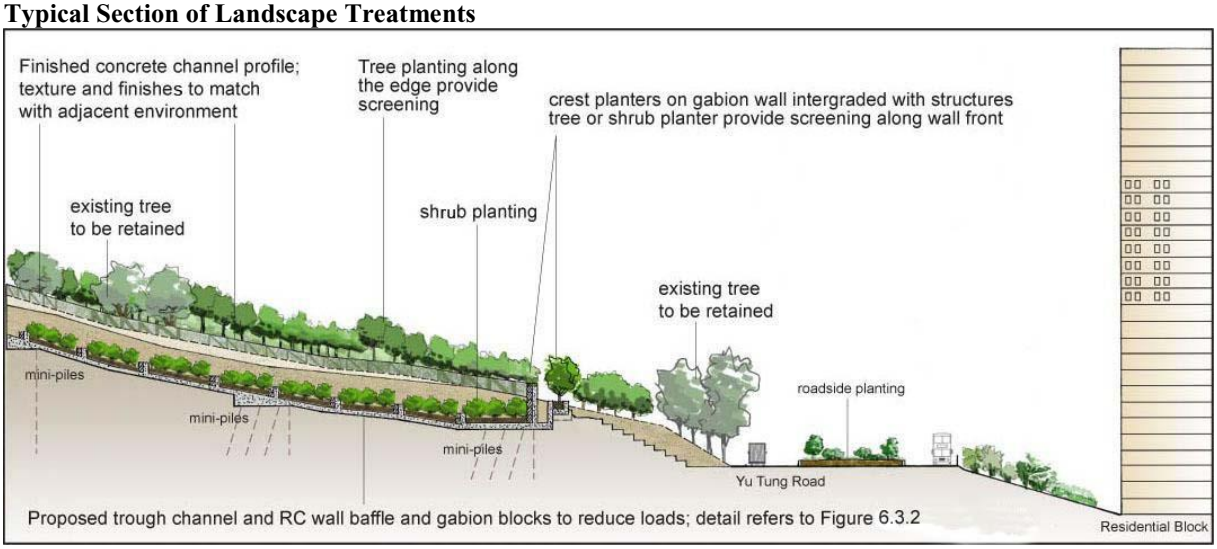
√√√ High √√ Moderate √ Low

Worked Example B

Option 3 - Trough Channel and Wall Baffle near Residential Area

This option involves the construction of a trough channel with baffle along the stream course with a check dam at the base of the stream course. The overall length of the channel will be 130 m and 6.5 m depth below existing stream course level. Substantial earthworks and excavation will be required along the 130 m proposed profile on existing drainage channel. Substantial amount of excavation materials will be generated during the construction. Maintenance and debris removal works will be difficult to carry out as well as maintenance of proposed screening planting.

Typical Section of Landscape Treatments



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Assessment of Application of Landscape Treatment and Consideration - Option 3

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√√	√√√	√√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation
Climber on wall surface	√√	√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√	√√	√√	● Cost-effective to mitigate the proposed structure due to the high sensitivity residential area
Mural/ artwork	√	√	√	● Not practical in this setting
Colour treatment for exposed concrete structure	√√	√√√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√	√	√√√	● Not practical and high cost associated with this design option

√√√ High √√ Moderate √ Low

Option Assessment:
Given the proximity of this site to residential blocks, the visual impact of the proposed structure must be carefully addressed. The design of the structure should be mitigated by landscape measures outlined in the report.

Options 1 and 2 are less visually intrusive than Option 3 due to the scale of the proposed structure. Option 3 offers the least interruptions to any existing trees and vegetation as it runs along the stream course. But with no significant and rare trees nearby, the advantage of tree preservation cannot be fully utilized. It is relatively difficult to visually mitigate Option 3 due to the massive scale. Option 1 is the smallest in scale and offers the least visual interruptions to the nearby VSRs.

Trees will be proposed near the structure for screening purpose and therefore provide a subtle transition from the surrounding to enhance the overall visual quality. Selection of plant species should aim to minimise on-going maintenance commitment.

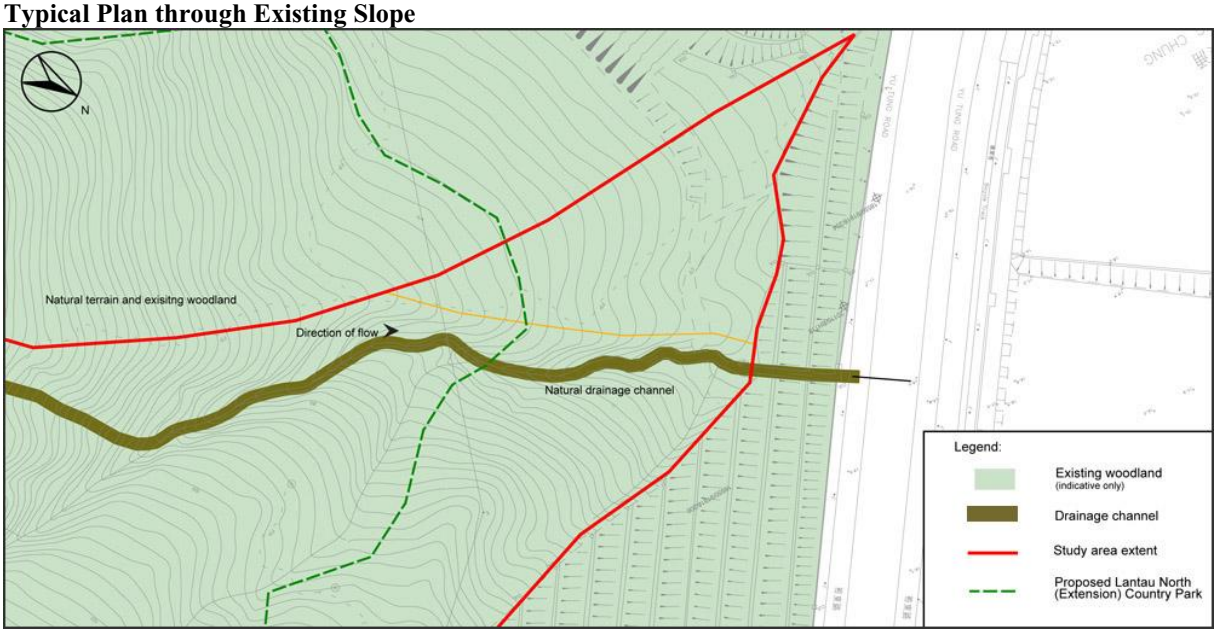
As discussed, Option 1 will be the preferred option from a landscaping point of view.

Worked Example C - Feature near Rural Area

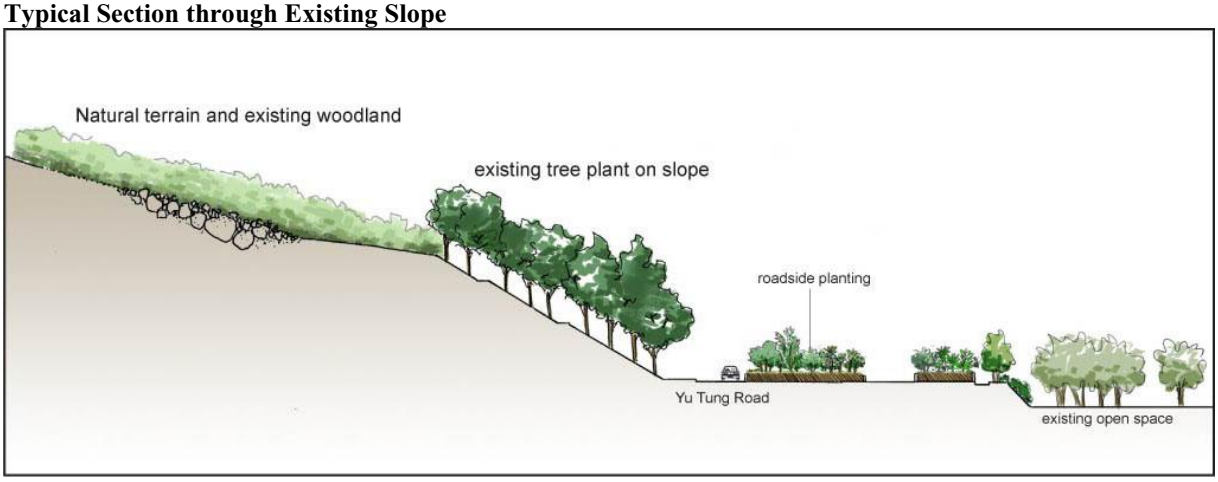
Key Issues/ Objectives Parameter		Landscape Objective	Typical example of existing conditions
Landscape Context (Urban/ Urban Fringe/ Roadside/Rural)	Rural	· Preservation of Existing Vegetation · Responsive Design to surrounding landscape settings · Visual Aesthetic and Harmony · Self-sustainable with minimal maintenance · Enhancing Biodiversity · Adhere to aesthetic principle	
Consequence-of –life (Ref WBTC No. 13/99)	1	Geotechnical considerations given priority	
Size (Small/Medium/ Large)	Large	Emphasis on detailed landscape treatment to create visual interest and variety	

The catchment is situated in a rural setting with no direct views from residential nearby. As such, larger structure may be feasible in order to successfully retain debris.

Typical Plan through Existing Slope



Typical Section through Existing Slope

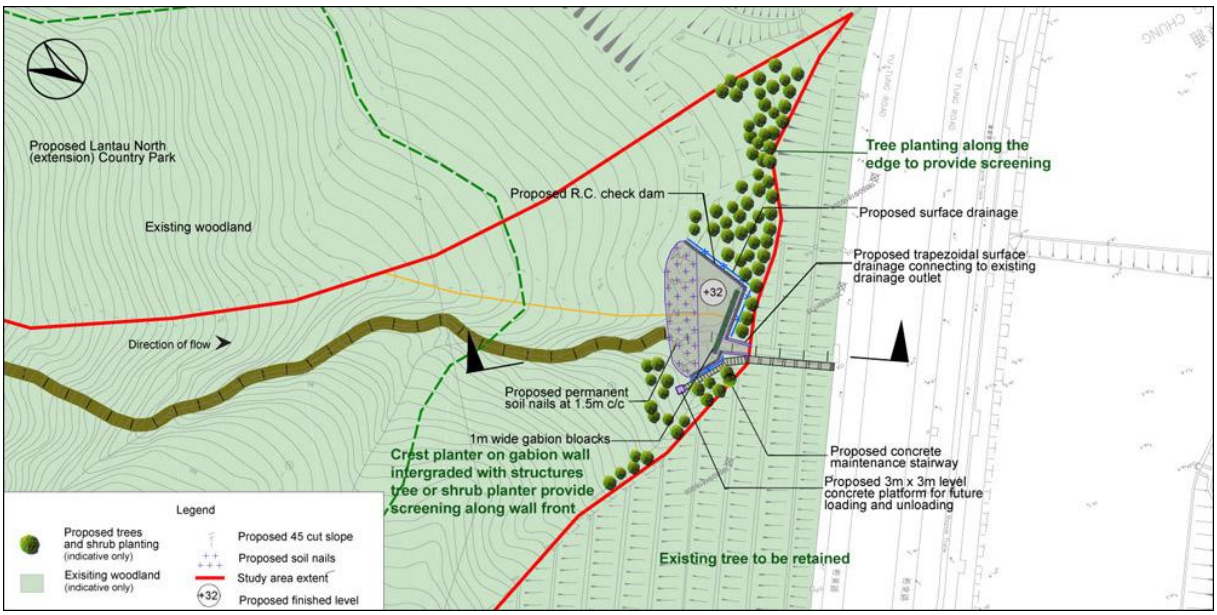


Assessment of Existing Conditions/ Site Constraints

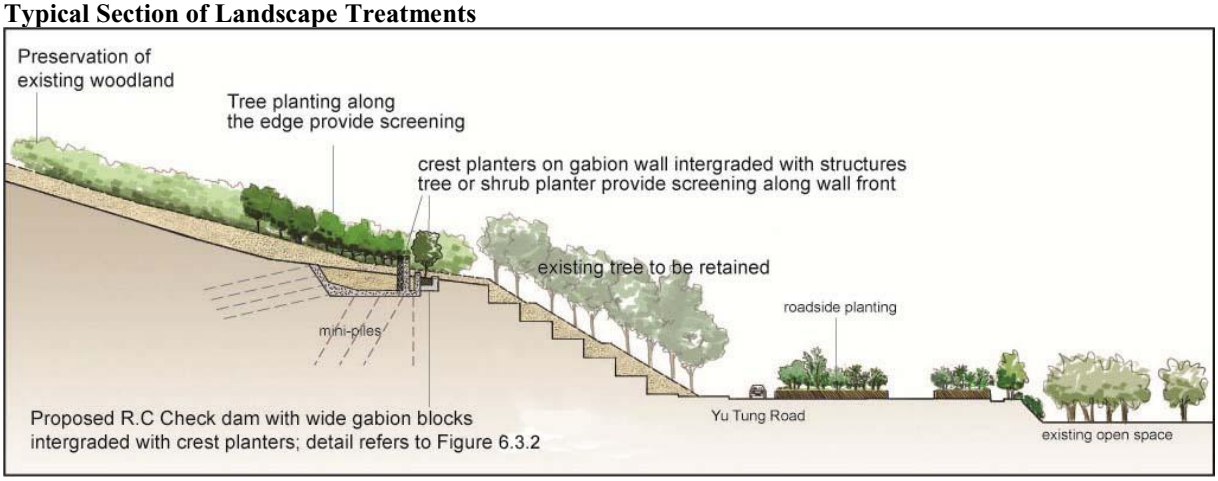
- Barren landscape with medium size boulders and limited vegetation cover along existing drainage channel
- No direct view from residential properties, screened views for road users
- Rural and natural landscape setting with medium sensitivity
- Dense scrub and woodland in catchment area

Worked Example C
Solution Overview

Option 1 - Reinforced Concrete Barrier Wall in Rural Area
This scheme involves the construction of a barrier wall at existing ground and stream course level at the toe of the catchment. Site formation works with cutting of natural slope are required.



Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 1

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√	√√	√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation

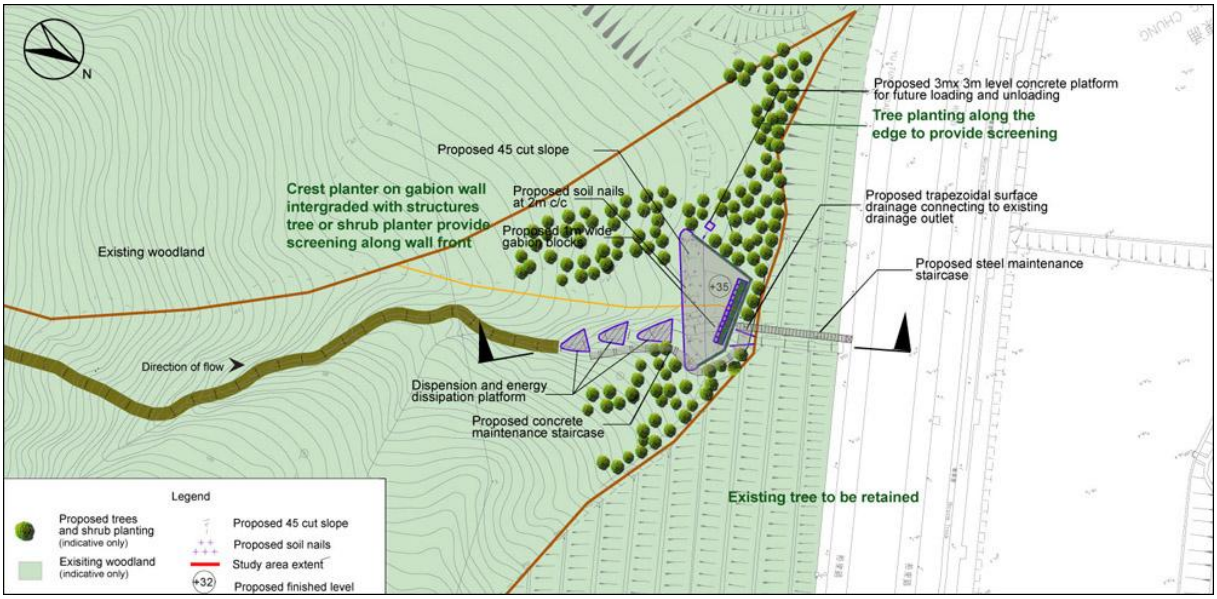
Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Climber on wall surface	√√√	√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√√	√	√√	● Not cost-effective and practical in roadside setting views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√√	√	√	● Not practical in an rural setting
Colour treatment for exposed concrete structure	√√√	√√	√√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√√	√	√√√	● Sustainable but not cost effective in rural context

√√√ High √√ Moderate √ Low

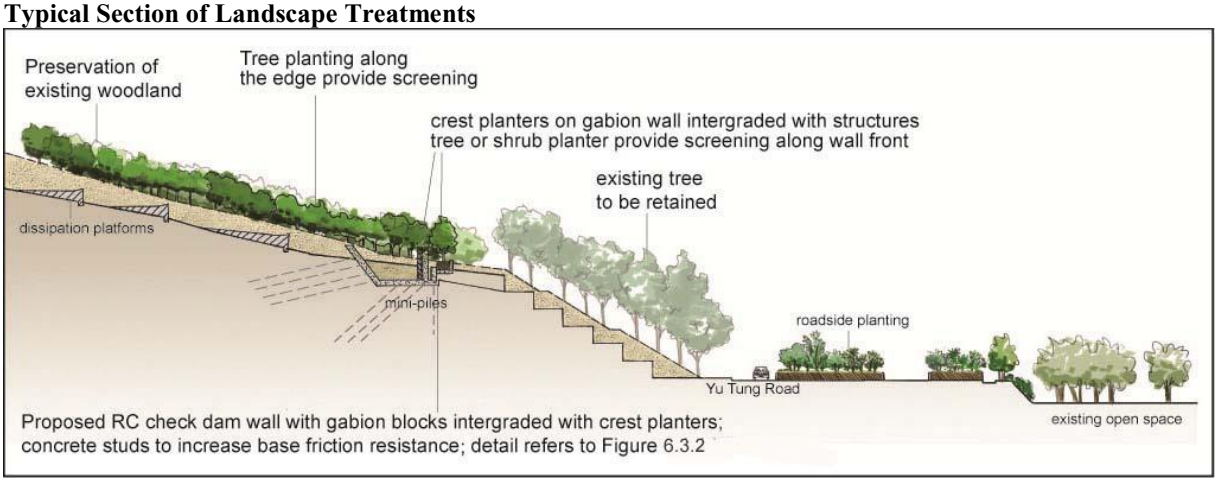
Worked Example C

Option 2 - Energy Dissipation Platforms in Rural Area

Three dispersion and energy dissipation platforms are proposed in upstream area. The platforms could help protect the stream course from possible erosion and reduce potential for debris entrainment. By slowing down the flow velocity, the debris can deposit more efficiently. A nominal impact barrier would also be provided to trap any debris reaching the end of the stream course. The excavation works required for the platform are minimal.



Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 2

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√	√√	√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√√	√√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Climber on wall surface	√√√	√√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√√	√√	√	● Cost-effective and practical
Planting on gabion wall	√√	√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√	√	√√	● Not cost-effective and practical in roadside setting views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√√	√	√	● Not practical in an rural setting
Colour treatment for exposed concrete structure	√√√	√√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√√	√	√√√	● Sustainable but not cost effective in rural context

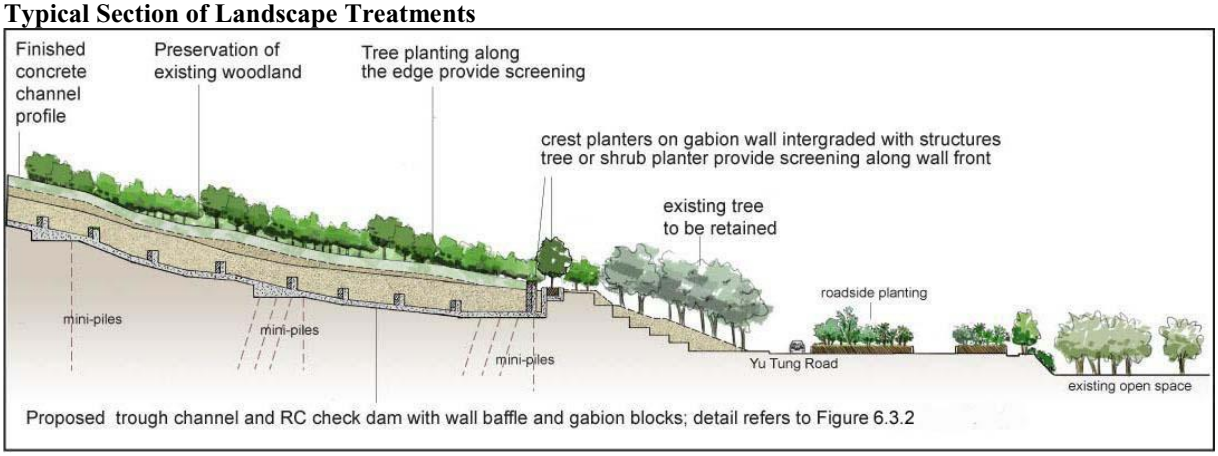
√√√ High √√ Moderate √ Low

Worked Example C

Option 3 - Trough Channel and Wall Baffle in Rural Area

This option involves the construction of a trough channel with baffle along the stream course with a check dam at the base of the stream course. The overall length of the channel will be 130 m and 6.5 m depth below existing stream course level. Substantial amount of excavation materials will be generated during the construction. Maintenance and debris removal works will be difficult to carry out as well as maintenance of proposed screening planting.

Typical Section of Landscape Treatments



Assessment of Application of Landscape Treatment and Consideration - Option 3

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Retention of existing tree	√√√	√√√	√√√	● Existing vegetation will be retained where practical to minimise visual impact to the surrounding environment
Screen planting as visual buffer	√√	√	√√	● Proposed planting to create visual buffer
Planting in crest and toe planter	√√	√	√√	● Cost-effective and practical to soften the edge of structure for visual mitigation

Landscape Treatment	Practicability	Cost-effectiveness	Sustainability	Design Consideration
Climber on wall surface	√√√	√	√√	● Cost-effective and practical to mitigate the perceived scale and bulkiness of the proposed structure
Texture and finishes on wall	√	√	√	● Not practical and cost-effective in rural setting
Planting on gabion wall	√√	√	√√	● Integration of planting with gabion structure
Shrubs/ grass crete on surface structure	√	√	√√	● Not cost-effective and practical in roadside setting views from above is limited ● On-going maintenance cost for plant (trimming and inspection)
Mural/ artwork	√√	√	√	● Not practical in an rural setting
Colour treatment for exposed concrete structure	√√	√	√	● Not required if climber is used on wall surface
Use of in situ (locally found) material	√	√	√√√	● Not practical and high cost associated with this design option

√√√ High √√ Moderate √ Low

Option Assessment:
The catchment is situated in a relatively remote rural setting. With no VSR in the vicinity, engineering considerations should be guiding force in determining the optimal solution.

Options 1 and 2 are the least visually intrusive options comparing to Option 3.
When comparing Options 1 and 2, Option 2 provides more planting opportunities given its size, but that implies more maintenance for the proposed screening planting. Species selection should aim to reduce on-going maintenance commitment. Option 1 is preferred in terms of visual simplicity and can be easily mitigated through screen planting.

Given its remoteness and lack of VSR in the vicinity, engineering preferences and ease of maintenance should be prioritized in the assessment process. Appropriate landscape treatments should be used to mitigate the structure in a practical and cost-effective way.

As discussed, Option 1 will be the preferred option from a landscaping point of view.

GEO PUBLICATIONS AND ORDERING INFORMATION
土力工程處刊物及訂購資料

A selected list of major GEO publications is given in the next page. An up-to-date full list of GEO publications can be found at the CEDD Website http://www.cedd.gov.hk on the Internet under "Publications". Abstracts for the documents can also be found at the same website. Technical Guidance Notes are published on the CEDD Website from time to time to provide updates to GEO publications prior to their next revision.

部份土力工程處的主要刊物目錄刊載於下頁。而詳盡及最新的土力工程處刊物目錄，則登載於土木工程拓展署的互聯網網頁 http://www.cedd.gov.hk 的"刊物"版面之內。刊物的摘要及更新刊物內容的工程技術指引，亦可在這個網址找到。

Copies of GEO publications (except geological maps and other publications which are free of charge) can be purchased either by:

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Information Services Department,
Room 402, 4th Floor, Murray Building,
Garden Road, Central, Hong Kong.
Fax: (852) 2598 7482

or
- Calling the Publications Sales Section of Information Services Department (ISD) at (852) 2537 1910
- Visiting the online Government Bookstore at http:// www.bookstore.gov.hk
- Downloading the order form from the ISD website at http://www.isd.gov.hk and submitting the order online or by fax to (852) 2523 7195
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Tel: (852) 2762 5380
Fax: (852) 2714 0247
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Fax: (852) 2714 0275
E-mail: thomashui @cedd.gov.hk

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MAJOR GEOTECHNICAL ENGINEERING OFFICE PUBLICATIONS
土力工程處之主要刊物

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GEOTECHNICAL MANUALS

Geotechnical Manual for Slopes, 2nd Edition (1984), 300 p. (English Version), (Reprinted, 2000).

斜坡岩土工程手冊(1998)，308頁(1984年英文版的中文譯本)。

Highway Slope Manual (2000), 114 p.

GEOGUIDES

Geoguide 1	Guide to Retaining Wall Design, 2nd Edition (1993), 258 p. (Reprinted, 2007).
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