

## Principles of Good Batter Design

### 1. Introduction

This Principles of Good Batter Design document outlines general design, construction, and maintenance guidelines intended to maximise both the short- and long-term success of soft landscaped batters on State Government infrastructure projects.

### 2. Background

These guidelines capture learnings from previous DIT infrastructure projects and aim to achieve well-designed and well-constructed vegetated batters that minimise ongoing maintenance requirements and maximise the longevity of batter slope formations.

Soft landscaped or vegetated batters are often incorporated into infrastructure projects to stabilise batter slopes. Vegetated batters help to visually integrate road infrastructure into the surrounding landscape and can provide good environmental outcomes (e.g. erosion control, improve visual amenity and biodiversity, increase canopy cover and habitat creation).

Experience has shown that the best results are achieved when engineers and landscape architects work closely together to consider the ramifications of all aspects of batter design early in the design process.



Successful vegetation establishment on a Southern Expressway batter.



Successful batter planting incorporating trees, low ground covers and a good drainage solution.

### 3. Design

#### ***Batter Gradients***

- The design of batter slopes should consider short- and long-term stability requirements as per RD-EW-D1 'Design of Earthworks for Roads'.
- The design of batter slopes should consider the short-term constructability requirements and the long-term maintenance requirements of the vegetation being proposed.

- Ideally, grassed batters requiring regular mowing should be 1v:6h. If this grade is not possible, they should not be steeper than 1v:4h as they become too dangerous to mow/slash, with a high risk of vehicles tipping over or slipping down batters.
- Planted batters should not be steeper than 1v:3h as they become difficult to walk on to carry out watering and weed control and are therefore less likely to be maintained.
- Steep batters should be avoided as they are often difficult to stabilise, are more prone to land slips, and are problematic for maintenance access. There have been instances where Contractors have refused to landscape and maintain batters that are too steep, citing WH&S issues for their staff.
- Incorporation of earth-shaped cut-off terraces running horizontally along the batter can help to slow stormwater runoff and retain moisture which assists plant survival.
- If batter slopes flatter than approximately 1v:2.5h cannot be achieved in the available space, an engineered solution should be considered.



Reactive subsoil, no topsoil, and lack of integrated drainage solution resulted in a batter that had ongoing stability issues.



Severe erosion caused by steep batter gradient, poor subgrade material, and lack of soil preparation.

### ***Plant Species Selection***

- Consider the vegetation establishment timeframes required to properly stabilise batters. Incorporate short-, medium- and long-term stabilisation strategies into the design.
- Design to maximise plant survival rates long term. This will require appropriate species selection and spacing of plants or seeding rates. Assume that batters, particularly those outside of metropolitan areas, will receive little or no long-term maintenance following completion of the project.
- Resolve the plant species lists early and prior to construction to ensure sufficient lead time for supply of plant or seed material. This will minimise substitutions with potentially undesirable or less successful plant species being used.



- Avoid 'banding' or strips of the same plant species or monocultures. Single species monocultures have a propensity to die out leaving whole sections open to weed invasion. Assume that batters may not get replanted in the future and should be designed with this in mind.



Northern Expressway banded batter planting towards the end of the establishment period.



Northern Expressway after the establishment period. Bands of tussock planting have died, leaving large unvegetated areas resulting in weed invasion.

- Use trees and large shrubs in the planting mix to provide both a canopy and longevity to a landscape. Tree canopies reduce erosion on batter slopes, and also self-mulch over time which can significantly reduce maintenance requirements over the long term.
- Ensure plant species have sufficient longevity and resilience from insect or pathogen attack. Short-lived species have been known to die, break off in winds and roll up or roll down batters and onto roads presenting safety issues for road users.

### ***Erosion Control and Drainage***

- Prevent overland flow from running down the batters. Collect stormwater above the batter and direct it away from the face of the batter to avoid ongoing erosion issues.
- Ensure drainage structure outlets do not release water above the toe of the batter to avoid ongoing erosion issues down the batter.



Land slip from overland flow above.



Drainage outlet located above toe of batter causing erosion.

- Ensure longitudinal open swale drains are located at a sufficient distance from the toe of batter to prevent erosion along the toe of batter.

- Seeding batters with a cover crop twelve months prior to planting allows soil to naturally settle and stabilise. Areas to be vegetated should then be sprayed out with herbicide prior to mulching, planting or seeding.
- If steeper vegetated batters are unavoidable, mulch pieces should be of irregular size and shape to minimise mulch slipping off batters. Shredded coarse organic mulch will bind together creating a stable protective layer over the soil.
- If erosion control matting is required, a thin, biodegradable product such as jute should be used as it allows moisture to penetrate the soil profile enabling better plant establishment.
- Thick matting generally requires ongoing pinning and re-levelling to maintain good contact with the soil. It takes longer to break down, prevents natural colonisation of desirable plants, and is often visually unattractive.



Successful use of thin jute matting to stabilise batter and suppress weeds.



Thick jute matting takes longer to break down and prevents colonisation by surrounding native vegetation.

### **Watering Requirements**

Consider the watering requirements of the vegetation early in the design phase. Watering via water cart can appear to be a cheap solution, however it generally requires dedicated maintenance access routes or traffic management and is labour intensive which can make it resource hungry and therefore expensive. Water carts parked on roadways may require lane closures which can generate negative community feedback and are therefore undesirable for recently completed and opened road projects.

- If hand watering is unavoidable, the installation of temporary irrigation mainlines with quick coupling hose connections spaced regularly has proven successful on previous projects and does not require a water cart.

### **Maintenance Access**

- Consider maintenance access routes early in the design so batters can be safely maintained from off the road. Safe and legible maintenance access will encourage the likelihood of batters being maintained. Batters that are difficult to access are much less likely to receive regular maintenance.

## 4. Construction and Establishment

### *Appropriate Soils*

- Topsoil should be stripped from the site and quarantined for later respreading on batters or other landscape areas to be vegetated. Topsoil should not be used for other construction activities across the site. Frequent weed control of stockpiled topsoil is very important, as is weed control prior to topsoil stripping to prevent weed seed being spread across the site.
- The materials used in the construction of the batter are critical to the success of the plantings, particularly in the upper 600mm of the soil profile where the majority of roots will grow. Rock and other fill materials not conducive to plant growth should be avoided as near-surface materials as they can prevent vegetation cover stabilising the batter.
- Soil testing should be undertaken in accordance with DIT specification PR-LS-C7 Topsoil. If soil testing indicates soils are poor, consider incorporating ameliorants to improve soil structure, increase water holding capacity and reintroduce natural microbial activity. This is particularly important if topsoils have been stockpiled for extended periods of time or have been heavily compacted.
- Contaminated soils from the project site are often re-used in batters as a cost-saving and waste-reduction method. Prior to re-using contaminated site soils in batters on site, they should be assessed to ensure that they pose no actual risk to human health or ecological receptors. Any soils that are re-used should also be carefully screened/assessed to ensure that they do not contain large inclusions (larger than 100mm), asbestos, concrete or asphalt, or other inert debris (e.g. plastics).

### *Soil Preparation*

- Avoid heavy compaction of topsoils after spreading on batters. Heavy compaction can reduce water retention and infiltration and restrict plant growth. Heavy compaction significantly adds to the cost of subsequent soil preparation and remediation.
- Deep ripping along the contours of batters is crucial to batter stability and the survival of plantings. Deep ripping 'keys' the topsoil into the subsoil and breaks up the upper 300mm of compacted batters to permit rainfall and oxygen to penetrate into the plant root zone. Deep ripping along the contours also reduces the likelihood of batter erosion. Note that deep ripping is very difficult to achieve on steep batters.
- Use batter stabilising cover crops that do not seed prolifically and introduce additional weed issues to the site. Even 'sterile' cover crops can introduce ongoing weed problems if they are not managed properly or controlled before they go to seed.





Poorly prepared batter has not been decompacted and will allow minimal moisture infiltration, resulting in a poor landscape outcome.



Batter subsoil has been deep ripped horizontally across the batter allowing moisture infiltration and minimising erosion potential.

### ***Weed Control Prior to Planting or Seeding***

- Weed control of batters prior to planting or seeding is important to minimise weed competition and reduce weed control costs during the maintenance phase. Successive seasonal weed control events twelve months prior to planting or seeding will significantly reduce the weed seed load in soils and maximise the success of planted or seeded landscapes.

### ***Timing of Planting or Seeding***

- The timing of planting or seeding is critical to vegetation success. Planting during mid to late spring and summer is undesirable due to the additional watering requirements for successful establishment.

### ***Installation of Plants***

- Providing water bowls or planting into riplines maximises plant survival by capturing rainfall and directing it to the root zone where it is required.
- The incorporation of water retention agents into the planting area prolongs water availability and has been shown to improve plant survival rates.
- Ensure plants are regularly provided with adequate water supply, especially during the establishment period. This will maximise plant survival rates.
- Ensure plants are thoroughly watered in immediately after planting to maximise plant survival rates.

## **5. Maintenance**

### ***Weed Control***

- Controlling weeds while they are small and prior to them reproducing removes weed competition and enables desirable plants to naturally outcompete undesirable plants over time. Allowing weeds to outgrow plants can result in off-target damage to desirable plants when sprayed with herbicide and removal by hand is expensive.