Final Draft
September 2014

Landscape Guidelines

NZ TRANSPORT AGENCY
WAKA KOTAHI

New Zealand Government

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Safer Journeys

The NZTA is part of, and contributes to, the Safer Journeys programme.
Safer Journeys is the government's strategy to guide improvements in road safety over the period 2010–2020. The strategy's vision is a safe road system increasingly free of death and serious injury. It is a co-ordinated effort across partner agencies to improve each aspect of road safety – better behaviours, a safer road environment, safer speeds and higher vehicle standards.

For more information visit **www.transport.govt.nz/saferjourneys**

OUR PURPOSE

CREATING TRANSPORT SOLUTIONS FOR A THRIVING NEW ZEALAND

Image source: Tourism NZ

CONTENTS

FOREWORD

The NZTA is pleased to release the NZTA Landscape Guidelines (Final Draft) September 2014. The Guidelines recognise the important contribution landscape thinking, landscape planning, landscape design, implementation and management (maintenance) provides in the delivery of quality infrastructure.

These guidelines replace the NZTA Guidelines for Highway Landscaping 2006 and provide an important point of reference outlining the key considerations and critical steps to be followed when assessing, designing, constructing and maintaining state highway landscape assets.

In particular the Transport Agency recognises that highway landscapes need to reflect values, recognise the environment and landscape processes, create a sense of place for communities, and protect heritage and cultural aspects across the transport network. To date many of our landscape initiatives have resulted in increased public satisfaction with highway infrastructure, biodiversity gains and recognition through awards for design excellence and environmental sustainability.

This document reflects the Transport Agency's ongoing commitment to highway landscaping and the environmental, social, cultural and economic value landscape brings to infrastructure projects and the community.

New guidance has been included within the guidelines on how to maximise the benefits of highway landscaping in terms of value, including safety, environmental performance, social outcomes, cultural wellbeing, health, and whole of life value for money. Further to this, there are real project examples illustrating lessons learnt from roading upgrades and new sections of highway, from around New Zealand.

This document will be a source of inspiration to all teams responsible for the planning, design, implementation and maintenance of Transport Agency landscape assets, and for others in the Transport Agency whose actions affect landscape outcomes.

This document demonstrates the Transport Agency's commitment to landscape outcomes, to our concerns for the environment, and communities.

INTRODUCTION

This document demonstrates an evolving understanding and commitment to the ongoing pursuit of social and environmental outcomes, and design leadership by the Transport Agency.

Within the Transport Agency highway landscaping has evolved to become an essential component in the delivery of transport infrastructure. The Transport Agency has pursued various initiatives such as staff training, establishing a register of preferred consultants, and developing various pieces of guidance material in order to embed landscape thinking into its business. The purpose of this document is to pool these learning's to firmly establish landscape best practice within the Transport Agency.

WHAT IS THE LANDSCAPE?

Landscape is more than 'a physical tract of land' or 'a view or scene' or 'a planted garden'. For instance Landscape as defined by the New Zealand Institute of Landscape Architects (NZILA)[1] is:

'the cumulative expression of natural and cultural features, patterns and processes in a geographical area, including human perceptions and associations'[2] .

Put simply, landscape can be described as the relationship between people and place.

Highway landscapes in particular are part of our everyday landscape, they traverse the landscape connecting communities, towns and cities, to farms, forests, and industry, from inland to the coast, region to region, place to place. These everyday landscapes are also an integral part of our international and domestic tourism industry with highways providing access to New Zealand's scenic beauty, national parks and coastline.

Carefully designed highway landscapes can provide a sense of place, can facilitate way-finding for road users, facilitate pedestrian and cycle transport, and also encourage safer driver behaviour, as well as greatly enhance a journey and improve our quality of life.

1. New Zealand Institute of Landscape Architects, 2 November 2010, 'Best Practice Note 10.1: Landscape Assessment and Sustainable Management'.

2. The Geographic setting is known as 'the landscape'. Visual appearance and views are a subset of 'landscape'. The integration of structures is a subset of 'Landscape'. The works associated with the design, implementation and management of such items as rest areas, trees, mass planting, gardens, ecological restoration, storm water management planting, screening, ground preparation for planting, slope integration and topography/ landform, artworks and design features, as well as the overall layout and composition of the landscape; these elements in association with highway pavement and infrastructure is also known as 'Landscape'.

The Transport Agency projects require collaboration to deliver landscape design outcomes

AIM OF THESE GUIDELINES

The objectives and requirements set out in these guidelines aim to deliver a consistent message about the role of landscape and the landscape outcomes sought by the Transport Agency. These guidelines will assist the Transport Agency, consultants, contractors, project managers, stakeholders and the community who participate in landscape planning, landscape design, landscape implementation and landscape maintenance across the transport network in:

- delivering on the Transport Agency's environmental and social responsibility policy;
- addressing any landscape component required as part of approvals and ongoing compliance under the RMA;
- optimising value and reducing ongoing maintenance costs;
- improving the overall quality and longevity of highway landscaping;
- creating a positive landscape legacy across the highway network;
- enhance and reinforce the landscape character and community identity.

These guidelines respond to "lessons learnt" and seek to improve our landscape outcomes to ensure:

- that landscape designs are well refined, cost effective and easy to implement and maintain;
- adequate resources are provided for planting to establish and flourish e.g. sufficient topsoil;
- that landscape designs are well planned with efficient use of space within the designation to create appropriate slopes and gradients for planting;
- appropriate plant selection (including species, size and densities);
- quality soil to ensure high success rates and ecological value are developed reducing risks of weed invasion;
- safety issues are addressed to achieve: well integrated planting which facilitates public access (walkers, cyclists and highway users); access for highway operations and maintenance; and clear sight lines to signage and active lanes;
- high quality of the landscape asset following completion of the capital works program is achieved through maintenance considerations being integrated into the design.

WHO SHOULD USE THE GUIDELINES

The Transport Agency has well-developed project evaluation and asset management systems for built infrastructure such as roads, structures and earthworks. The Landscape Guidelines provide this point of reference for the landscape components of transport infrastructure.

The early integration of landscape thinking on highway projects invariably leads to better outcomes overall and improved landscape asset performance over time. Early consideration of landscape opportunities and constraints in particular can also help streamline projects through Resource Management Act (RMA) processes.

From the high level route selection process and landscape assessment, to design input on the shape and form of the earthworks, topography and planting, the interface between structures and the ground plain, the planting associated with corridor amenity and management, ecological restoration, and stormwater management, these all fall within the landscape remit.

The Transport Agency recognises that successful landscape planning, landscape design (in parallel with Urban Design[3]), landscape implementation, and landscape maintenance (for hard landscape[4] and soft landscape[5]) requires a specialist body of knowledge, and needs to be supported by a collaboration of all parties whose actions affect landscape outcomes.

The parties who should use this document include Transport Agency staff, consultant teams, project managers, contractors and highway asset management organisations, infrastructure providers, local government, local communities, and landowners.

Highway landscaping encompasses a wide range of disciplines including:

- Landscape Architecture, e.g. NZILA Registered Landscape Architects (in landscape planning, landscape and visual assessment and landscape design);
- Landscape Construction (in implementing and maintaining the landscape treatments);
- Urban Design;
- Ecology and Environmental Sciences;
- Horticulture;
- Social Sciences;
- Archaeology;
- Geotechnical, Civil and Structural Engineering;
- Noise and Air Quality Specialists;
- Stormwater/ Coastal / Environmental Engineering;
- Planning and Transport Planning (including walking, cycling and public transport);
- Property;
- Civic Art.

3. Refer to Bridging the Gap NZTA Urban Design Guidelines
4. Hard landscape (e.g. paving)
5. Soft landscape (e.g. planting)

APPLICATION OF THE GUIDELINES

The Landscape Guidelines apply in the following situations:

- the planning, design, implementation and maintenance of all proposed new sections of state highway;
- all state highway improvement work included in capital works and maintenance programmes within the NZTA designation;
- the improvement of existing sections of highway landscaping (retrofitting and/or adaptive management);
- community projects within the highway corridor (e.g. Adopt-a-highway);
- the development of the landscaping component of Corridor and Network Management Plans.

In some instances the Guidelines may also be used to assist the Transport Agency in the review of district and regional planning instruments developed under the Resource Management Act (RMA).

Bridging the Gap: NZTA Urban Design Guidelines

For the Transport Agency Landscape is a major factor in the integration of the State highway network within New Zealand's environment both urban and rural. These Guidelines should be read in conjunction with Bridging the Gap NZTA Urban Design Guidelines which are interrelated in the outcomes they seek to deliver.

THE VALUE OF LANDSCAPE: 10 PRINCIPLES FOR HIGHWAY LANDSCAPING

This document contains 10 principles which capture the key elements of landscape planning, landscape design, implementation and maintenance in transport projects. These principles reflect the Transport Agency's expectations for the integration of landscape into all phases of highway projects and the desired interdisciplinary approach to addressing landscape issues. These principles are generic in nature and are the starting point for more project-specific landscape objectives and principles. They can also form the basis for evaluating designs. The principles should not be considered in isolation but as an inter-related framework for decision-making.

ten

The 10 landscape principles are:

1. A context sensitive and place based approach
2. Facilitate green infrastructure and landscape integration
3. Understand the physical conditions
4. The right plant in the right place
5. Promote biodiversity and build in resilience
6. Champion water sensitive design
7. Deliver visual quality and a quality user experience
8. Facilitate community engagement and a collaborative approach
9. Low maintenance and whole of life value
10. Safety in design

Native revegetation planting being undertaken by landscape contractors, Nothern Gateway

THE GUIDELINES

The Guidelines are divided into four sections and two appendices.

1

SECTION 1: POLICY
This section presents the Transport Agency landscape policy framework, objectives and methods. These will assist with planning of network and corridor activities, and inform fundamental design principles and decisions in projects.

2

SECTION 2: LANDSCAPE DESIGN REQUIREMENTS AND PROCESS
This section sets out the Transport Agency's landscape design requirements and outlines how this must be addressed and integrated with other activities throughout the process of planning, designing, implementing and maintaining highway projects.

3

SECTION 3: LANDSCAPE PRINCIPLES
This section describes the 10 key principles of landscape design, implementation and management for transport projects. The purpose of this set of principles is to guide decision-making on fundamental rather than detailed aspects of transport projects.

4

SECTION 4: DESIGN OF HIGHWAYS - LANDSCAPE
This section provides landscape design guidance focused on environmental performance, social and cultural outcomes and quality of highway landscapes overall. Through planning, design, implementation and maintenance. The section covers the landscape treatments appropriate to urban, peri-urban, rural natural environment and coastal settings, including the key considerations for each setting.

This section also provides overview of design considerations for asset maintenance and Transport Agency land management aspects of highway landscaping. This includes how designers and asset managers can assist in streamlining these operations to achieve whole of life value for the Transport Agency.

The following appendices also accompany the Landscape Guidelines:

app1

APPENDIX 1: LANDSCAPE AND VISUAL ASSESSMENT GUIDELINES
This section sets out the Transport Agency's Landscape and Visual Assessment Guidelines. These guidelines promote 'best practice' for landscape and visual assessments (LVA) for Transport Agency projects. LVAs are technical reports forming part of Assessments of Environmental Effects (AEE) for applications for resource consent and Notices of Requirement for designations (NoR) required under the RMA.

app2

APPENDIX 2: NZTA P39 STANDARD SPECIFICATION FOR HIGHWAY LANDSCAPE TREATMENTS
This is a base line landscape specification for all highway landscaping. This specification shall be used on all Transport Agency projects.

STATUS OF GUIDELINES

These guidelines may be modified to suit particular circumstances so that optimal environmental, social and whole of life value outcomes result. Guidelines are only recommended best practice, therefore they require judgement when applied to particular project and circumstances.

Guidelines become legally binding when invoked in resource consent requirements and contractual documents. Any substantial departure from the Guidelines should be justified and recorded in consultation with the Transport Agency Project Manager and Transport Agency Environment and Urban Design Team.

SECTION 1: POLICY

1.0 POLICY

1.1 INTRODUCTION

As an organisation the Transport Agency is responsible for planning the land transport network, investing in land transport, building and managing the state highway network and providing for access and use of the land transport system. In undertaking these activities the Transport Agency influences the shape of the landscape within urban and rural environments throughout the network.

The Agency and its service providers need to consider how these environments are affected by transport infrastructure and how the infrastructure can contribute to the future character and function of these designations and adjoining landscapes.

A suite of policy documents underpins the landscape components for the Transport Agency. This policy aims to ensure that transport projects contribute to an effective, efficient, and safe land transport system in the public interest, while also addressing landscape related matters to ensure that transport projects contribute positively to the environments they sit within. The relevant legislation and policy documents are outlined in the following section.

1.2 LANDSCAPE POLICY

LAND TRANSPORT MANAGEMENT ACT 2003

The legal foundation for the Transport Agency's environmental and social responsibility policy and requirements is the Land Transport Management Act.

The Act established the Transport Agency and states that the objective of the Agency is to undertake its functions in a way that contributes to an effective, efficient, and safe land transport system in the public interest.

The Act contains operating principles for the Agency. Of particular relevance to Landscape the Act specifies that in meeting its objective and undertaking its functions, the Transport Agency must exhibit a sense of social and environmental responsibility.

RESOURCE MANAGEMENT ACT 1991 (RMA)

The Resource Management Act (RMA) promotes the sustainable management of natural and physical resources. The state highway network and the various environments it traverses are resources that fall under the umbrella of the RMA. The RMA has a particular focus on ensuring that the adverse environmental effects of activities are avoided, remedied or mitigated. Landscape planning and landscape design in particular have an important role in addressing the effects of highway construction and infrastructure.

The RMA is also the principal statute governing the management of landscapes. Part II of the RMA contains a number of directives regarding the protection and management of landscape as follows:

- Section 6(a): The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development;
- Section 6(b): The protection of outstanding natural features and landscapes from inappropriate subdivision, use and development;
- Section 6(c) the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna;
- Section 6(f): The protection of historic heritage from inappropriate subdivision, use and development;
- Section 7(c): The maintenance and enhancement of amenity values;
- Section 7(d) intrinsic values of ecosystems;
- Section 7(f): Maintenance and enhancement of the quality of the environment;

Section 6(e), which concerns 'the relationship of Maori and their culture and traditions with their ancestral land, water, sites, wahi tapu, and other taonga', can also overlap with landscape matters.

In addition to Section 7(d) above Section 2 defines 'intrinsic values' in relation to ecosystems as "...those aspects of ecosystems and their constituent parts which have value in their own right including:

- their biological and genetic diversity; and
- the essential characteristics that determine an ecosystem's integrity, form, functioning and resilience."

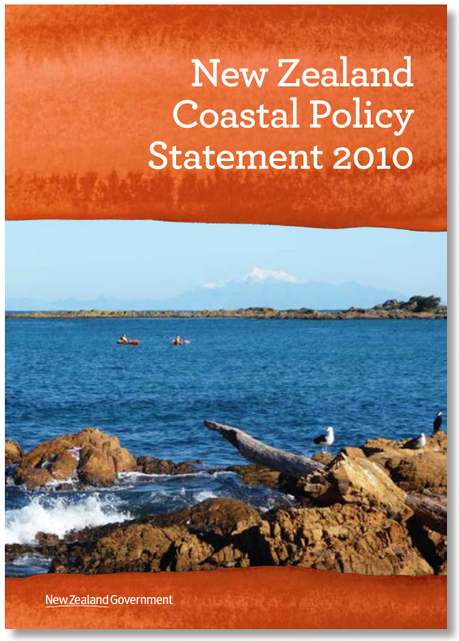
This is of particular relevance to highway landscaping as generally planting associated with highway projects requires the use of native species designed to act as a self sustaining plant community in keeping with the local ecology. This includes a mix of ecosourced plant species suited to the local soil types, and climate.

All landscape planning (including Landscape and Visual Assessments) and landscape design, implementation and management (maintenance) should be undertaken with an understanding of the RMA context of the project. The conditions of resource consent and associated requirements should also be followed through in the implementation of highway landscaping. Consent requirements in relation to landscape may continue beyond the landscape implementation phases to landscape maintenance and monitoring activities in some cases (e.g. landscaping associated with ecological or visual mitigation).

It is recommended that the relevant RMA context be discussed and clarified with the project team as part of the initial scoping for any landscape design. This is important as RMA consent matters such as ecology, archaeology, stormwater, etc. can all fall within the landscape scope to co-ordinate within the overall highway landscape framework and concepts.

Other relevant legislation of particular relevance to RMA matters and highway landscaping includes:

SH1 North of Auckland (Alpurt B2 section)



NEW ZEALAND COASTAL POLICY STATEMENT (NZCPS) 2010

The New Zealand Coastal Policy Statement (NZCPS) is a national policy statement under the Resource Management Act 1991. The purpose of the NZCPS is to state objectives and policy in order to achieve the purpose of the RMA in relation to the coastal environment of New Zealand. The NZCPS also provides guidance on national priorities for biodiversity in the coastal environment. The NCPS is of particular relevance to highway landscaping within the coastal environment as coastal environments generally require a greater level of landscape input and specialised landscape advice, given the significance of the landscape and the conditions of the coastal environment (i.e. salt laden winds, exposure, coastal soils).

HERITAGE NEW ZEALAND POUHERE TAONGA ACT 2014

The Heritage New Zealand Pouhere Taonga Act (HNZPTA) is administered by Heritage New Zealand Pouhere Taonga (HNZPT), the consenting authority for archaeological sites. As such, the HNZPT needs to be involved in establishing the basis for management of archaeological sites, within any Transport Agency designation. The HNZPTA empowers HNZPT to operate a national register of historic places, historic areas, wahi tapu and wahi tapu areas.

As well as recognising archaeological sites and the requirements under the HNZPTA landscape planning and landscape design may also choose to represent the cultural landscape as part of a highway project. The HNZPTA recognises the term cultural landscape (refer s23 (2)(k)). Cultural landscapes are the patterns and forms of heritage in a landscape. They can be thought of as a useful way to recognise the interrelationships of archaeological sites, historic places or historic areas. Cultural landscapes may possess aesthetic, archaeological, architectural, cultural, historical, scientific, social, spiritual, technological, or traditional significance or value.

With knowledge of the history and cultural heritage of an area, archaeologists and landscape architects can collaborate to identify the heritage story. This heritage can be acknowledged and celebrated as part of a cultural landscape proposal and could include:

- different types of occupation or activity over time (e.g. Maori pa, battle sites, early farming);
- interrelated uses of a place (e.g. old factories, sheds, field boundaries, connections to water bodies, distances between towns);
- local stories, or acknowledgment of individuals or groups that have relevance.

Providing for cultural landscapes in highway landscaping is a challenge, as they can be multi-layered, and their interconnections may cross over boundaries outside of Transport Agency designations. None the less cultural landscape themes can enrich highway landscaping and provide a sense of place for the local community and road users. Highways also provide an opportunity to address the cultural heritage values over large distances. This could apply to a section of highway or an associated heritage trail following a particular theme. This is a common application of this concept; for example the HNZPT's Waikato Wars Driving Tour, http://www.hamiltonwaikato.com/the-waikato-war.

For cultural landscapes best landscape practice is to at least recognise the interrelated nature of heritage places in identifying heritage values. This will help ensure that the associations between protected archaeological sites or seemingly modest places or items are provided for appropriately.

BIOSECURITY ACT 1993

The Ministry for Primary Industries (MPI) administers the Biosecurity Act. It provides a legal basis for excluding, eradicating and effectively managing pests and unwanted organisms, and its powers can be variously used by MPI, other government agencies, regional councils and pest management agencies. It is an enabling tool that provides a range of functions, powers and options for the management of risk organisms.

The control of plant and animal pests is of particular importance to highway landscaping as existing pest populations can impact on the establishment of highway planting. Equally as highway landscapes establish maintenance is required to address any re-infestation or emergent pest species. The Transport Agency has identified pest management as a priority within highway landscaping for the following reasons:

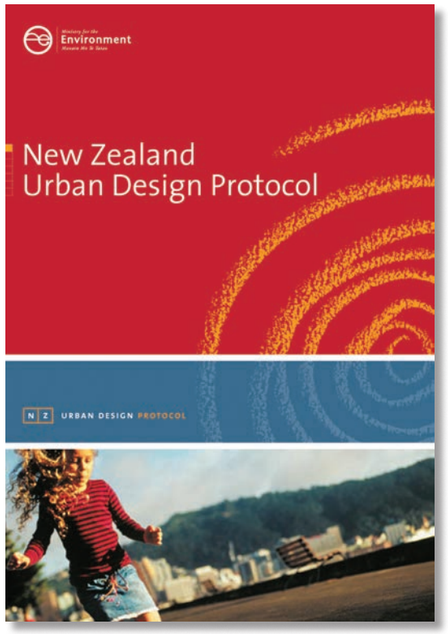
- achieves environmental and social policy objectives;
- addressing pest impacts early aids the establishment of highway landscape treatments;
- meets biosecurity and land management requirements in relation to Transport Agency State Highway Control Manual (Biosecurity) and Territorial Authorities Regional Pest Management Strategies;
- meets whole of life objectives to ensure Network Operations do not inherit landscape assets which require costly pest management and replacement of planting due to pest problems.

Territorial authorities (Regional councils) have pest management strategies which outline priorities for each region in relation to plant pests and animal pests in line with the Biosecurity Act. These pest management strategies should be reviewed as part of the scope of the landscape planning, landscape design, and landscape maintenance to ensure that the Transport Agency are addressing their biosecurity requirements within the land they administer.

NEW ZEALAND URBAN DESIGN PROTOCOL

The New Zealand Urban Design protocol is outlined within Bridging the Gap NZTA Urban Design Guidelines. Refer to section 1.4, page 4.

The urban design protocol recognises the role that landscape and the natural environment play in making urban areas great places to live and work, and the value and contribution landscape makes to identity, liveability and quality of life. The Protocol also acknowledges the role landscape plays in the context of the built environment including aspects such as landscape protection, and the protection of ecological systems and cultural heritage values.



NZTA ENVIRONMENTAL AND SOCIAL RESPONSIBILITY POLICY (2011)

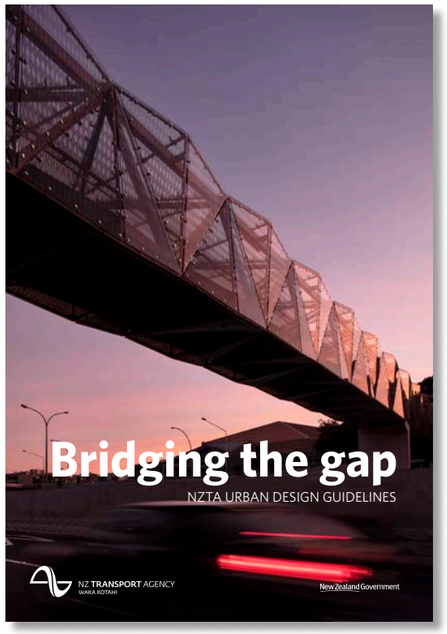
The Transport Agency is committed to acting in an environmentally and socially responsible manner. The Transport Agency's Statement of Intent (2013) (SOI) sets out principles to guide its decision making and day-to-day operations. It includes the promotion of an accessible and safe transport system that contributes positively to New Zealand's economic, social and environmental welfare; and to act in an environmentally and socially responsible manner.

In addition to the SOI the Transport Agency Environmental and Social Responsibility Policy further clarifies this commitment by the Transport Agency to act in an environmentally and socially responsible manner. Of key relevance to these guidelines is the commitment to protect and enhance the natural, cultural and built environment; and take appropriate account of the principles of the Treaty of Waitangi.

The policy commits the NZTA to a number of actions, including:

- promote the safe and efficient movement of goods and people in a manner that avoids, to the extent reasonable in the circumstances, adverse environmental and social impacts;
- continuously improve performance in the management of environmental and social impacts;
- integrate good urban design into all our activities;
- work to improve our knowledge and understanding of the extent and condition of New Zealand's environmental and cultural heritage assets;
- maintain and improve opportunities for Maori to contribute to our decision-making processes;
- actively and meaningfully engage with affected and interested persons and organisations;
- identify and comply with all relevant environmental and social legislation and regulations;
- seek whole-of-life value for money by taking into account environmental and social costs and benefits when procuring goods and services;
- provide our employees with the skills, awareness and leadership to achieve environmental and social objectives.

The full version of the Environmental and Social Responsibility Policy can be found at: www.nzta.govt.nz/resources/environmental-and-social-responsibility-manual/index.html



BRIDGING THE GAP NZTA URBAN DESIGN GUIDELINES (2013)

Bridging the gap outlines the Transport Agency's policy and guidance for Transport Agency projects as it relates the integration of land use and transport. It seeks to ensure amongst other things a transport network which fits in sensitively with the landform, built and natural environment and communities through which it passes; and that design contributes to the quality of the built environment, public spaces and the road user experience.

Bridging the gap recognises the fundamental role landscape design plays in delivering on urban design outcomes, including contribution to the character of an area, integration of the roading infrastructure with the surrounding environment, facilitating way-finding for road uses, encouraging safer driving behaviour and as a valuable ecological asset.

"Bridging the Gap" should be read in parallel with these guidelines.

http://www.nzta.govt.nz/resources/bridging-the-gap/

NZTA GIS AND ASSET MAPPING SYSTEMS

Traditionally, asset management systems have focussed on the road and structural elements of the state highway network, which have been assessed in terms of quantitative information, cost/benefit ratios and financial value. Other elements such as the importance of the Transport Agency's natural and cultural assets have historically not been included. The Transport Agency are in the process of developing systems which will capture these landscape and cultural assets, and existing features (such as important natural environments, archaeological sites, art works etc). This type of data base will provide support to assist in prioritising landscape planning, landscape design, operations and maintenance associated with all assets under the Transport Agency's management.

SAFE SYSTEMS

The government's long-term goal for road safety in New Zealand is a road system increasingly free of death and serious injury based on the international 'Safe System' approach.

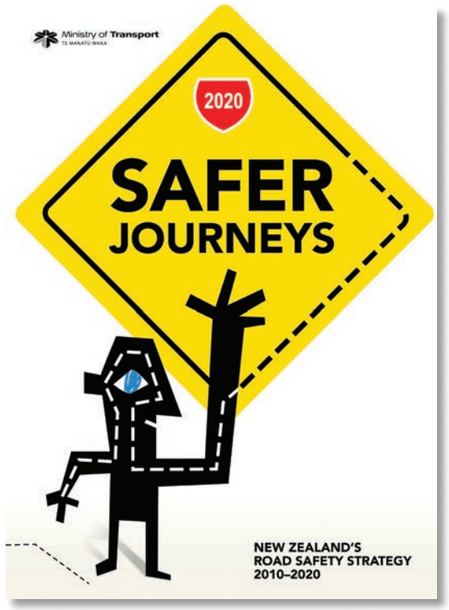
This approach involves:

- making the road transport system more accommodating of human error;
- managing the forces that injure people in a crash to a level the human body can tolerate without serious injury;
- minimising the level of unsafe road user behaviour.

The Safe System focuses on creating safe roads, safe speeds, safe vehicles and safe road use. Of particular relevance to Landscape outcomes is that Safe Systems applies to all parts of the system including roadsides to improve safety overall.

Safe systems in relation to highway landscaping includes the following matters:

- design of landscape treatments which encourage safe travel speeds and behaviours;
- planting designs that integrate sight lines and safety setbacks from structures, barriers and signage;
- frangible planting[6];
- provision for safe access and landscape maintenance as part of maintenance and operations requirements for highway landscape assets;
- provide for attractive and safe stopping places and rest areas with good visibility;
- make walking and cycling safer.



6. Frangible vegetation: Any plant with a stem less than 100mm in diameter at maturity, measured 400mm above the ground is considered to be frangible. Non-frangible vegetation may be planted closer to the highway within the 'clear zone' when there is a physical barrier restricting errant vehicles.

Image: Highway through National Park

1.3 NZTA LANDSCAPE OBJECTIVES & METHODS (2014)

The Transport Agency's commitment to landscape is through its ESR Policy. These environmental, social, cultural and economic factors translate to the following:

Objectives

LANDSCAPE OBJECTIVES:

- Transport networks, their scale and alignment, recognise the landscape, including the natural and cultural features, patterns and processes, sensory and associated socio-cultural aspects of an area.
- Landscape design that builds resilience to environmental change while promoting and contributing to human health, the life supporting form and function of soils, water quality, ecosystems, hydrology and biodiversity.
- The creation of a sense of place for communities, as well as visual quality and quality of the experience for all transport modes.
- Recognition of whole of life value and resource efficiency, in fostering a sense of stewardship and care for all Transport Agency landscape assets.

Methods

LANDSCAPE METHODS:

To achieve its landscape objectives, Transport Agency staff, consultants and contractors will:

a. integrate landscape thinking and highway landscaping into all processes to scope, plan, design, construct, implement, maintain and operate the state highway network;
b. consider landscape outcomes from the initial phase of a project, through RMA processes, to ensure that the adverse environmental, landscape and visual effects of activities are avoided, remedied or mitigated, and identify and comply with all relevant landscape (environmental and social) legislation and regulations;
c. Take into account the following physical parameters to ensure the successful delivery of landscape design outcomes:
    - adequate space for highway landscaping when establishing designation boundaries
    - soil conditions and availability of topsoil
    - slope and elevation
    - climate, including wind
    - hydrology
    - ecology
    - public access
    - highway geometrics and sightlines
    - highway maintenance and operations
    - designation wide boundary to boundary land management
d. Include NZILA registered landscape architects, as part of the multi-disciplinary team approach to the planning, design, development, implementation, monitoring and maintenance phases of all state highway projects;
e. Ensure funding for landscape; including the Landscape and Visual Assessment (LVA), landscape design (Preliminary design, Developed design and Detailed Design) and the construction, implementation and maintenance of landscape capital works; as well as the Landscape Architects review; are included as part of all state highway project budgets;
f. Establish, through its Environment and Urban Design Team, the highway landscaping documentation requirements for any state highway upgrade, new build or operation and maintenance contract. This will ensure landscape design, construction and maintenance requirements are included in all necessary documentation relating to the state highway network;
g. Actively and meaningfully engage with persons, organisations, communities, iwi and hapu as part of the landscape design process. Particularly during the planning and concept design phases of state highway projects. Maintain and improve opportunities for Maori to contribute to decision-making processes and design in relation to landscape;
h. Seek whole-of-life value for money by taking into account landscape design and landscape maintenance outcomes in projects.
i. Seek environmental and social benefits when procuring goods and services for projects, for example use local goods and services;
j. Ensure landscape treatments are permanent and lasting. Use plants with longevity and/or succession strategies to deliver long lasting vegetative cover and reduced maintenance.
k. Ensure that the 'design intent' is carried through the project and passed on once the project is complete to those who continue to manage and maintain the asset (Refer to section 4, Part 4, Asset Owner's Manual);
l. Improve knowledge and understanding of the landscape components of projects and feedback knowledge and innovation within the Transport Agency;
m. Have the leadership, skills and awareness necessary to deliver appropriate landscape design outcomes in all state highways projects. Provide all employees with the skills, awareness and leadership to achieve good landscape planning, landscape design, landscape implementation and landscape maintenance outcomes.
n. Develop a landscape, to the Transport Agency's standards, fit to handover on completion of the capital works project.

SECTION 2: LANDSCAPE DESIGN REQUIREMENTS AND PROCESS

Image: Anderson Road Roundabout, Wanaka

Image: Northern Gateway, Otaneroa Viaduct

2.0 LANDSCAPE DESIGN REQUIREMENTS

An essential feature of landscape design in New Zealand is its focus upon sustainable land management, sustainable development, native biodiversity protection and restoration and cultural heritage. Highway landscape architecture is aimed at directing and shaping landscape change in order to achieve the purpose of relevant statutes and related community goals in combination with the development of essential state highway infrastructure, which includes highway landscape assets.

An aesthetic for highway landscapes has emerged over recent decades. This aesthetic embraces concepts directly associated with ecological design practices and celebrates our unique landscape setting and cultural heritage. It represents a shift away from the orderly structure of trimmed grass, manicured exotic tree planting and exotic flower beds; to an approach that is context specific, biologically diverse, and focused on conservation, community, resource re-use, sustainability and cost efficiency. Contemporary highway landscape design seeks to re-establish and re-engage the natural cycles and processes of a site and can be broadly defined as sustaining environmental integrity and enhancing human wellbeing.

Recent research has identified the Transport Agency's customer values associated with the environment and landscape condition of the state highway corridor[7]. The research shows particular support for context-sensitive management of the highway corridor using landscape design, management styles and materials which relate to the specific landscape through which the road corridor passes. The implications of the research points towards a corridor landscape design and treatment which:

- is sensitive to the context;
- is sensitive to the local ecology (through retention and re-establishment of native vegetation and limiting grass areas to those needed);
- includes safety in design;
- provides a layered or gradual landscape transition to the view of the surrounding landscape; to avoid a sense of being confined. Also, actively manages the view from the road user perspective with improved legibility of road side conditions, signage and highway facilities;
- minimises the visual impact of operational areas, and (where applicable) screens unattractive land uses adjoining the highway;
- manages weeds species in a way that reduces their visual impact as well as their ecological impact;
- minimises the use of exotic species (other than grass);
- provides stopping areas that feature views to the surrounding landscape and, where applicable, that these stopping areas feature local heritage and history in a subtle way.

This public support for this more environmentally sensitive and multifunctional "green infrastructure" approach aligns well with Transport Agency's environmental policy framework.

7. Environmental Values of the State Highway corridor: A West Coast case study survey of stakeholders. Research undertaken by Dr Jude Wilson and Professor Simon Swaffield, Facility of Environment Society and Design, Lincoln University. The research was funded by the Transport Agency through Landcare Research Ltd, and the results are contributing to a wider programme focussed upon improved environmental asset management.

ROLE OF THE NZTA ENVIRONMENT AND URBAN DESIGN TEAM

The Transport Agency's Environment and Urban Design Team have the responsibility to support Agency staff, consultants and contractors in the planning of network and corridor activities; and to assist project managers to optimise landscape and urban design in all project stages. Their involvement in projects across the country promotes the sharing of best practice and a consistency of approaches to landscape design and related issues.

In particular, advice and assistance is provided on:

- defining landscape requirements and the scope of work for the purpose of procuring landscape architecture professional services as part of a project's tendering process;
- assessing consultants' offers of services;
- reviewing a project's landscape and urban design objectives and principles;
- reviewing the landscape and urban design aspects of a project's deliverables including Landscape and Visual Assessment (LVA), Urban and Landscape Design Framework and Landscape Plans;
- contributing to multi-disciplinary design workshops;
- recommending known successful design solutions and products.

The following section includes guidance on key points for project managers to optimise the landscape design and landscape outcomes for Transport Agency projects.

REQUIREMENTS FOR PROJECT MANAGERS

Start early

The project manager must take landscape design into consideration from the early planning stages of a project. A common misconception is that highway landscaping and landscape design need only be considered in the latter stages of the project to influence the plant selection for areas of the highway planting.

On the contrary, landscape is a discipline which spans from the strategic – where should a new road alignment be located? - To the design and detailed aspects of a highway project – how should the construction be integrated with the landscape and the stormwater management, ecological mitigation, tree protection, and landscape treatments associated with structures. Landscape therefore needs to be considered during all project phases:

- from defining objectives to inform fundamental decisions in network and corridor plans;
- to route option assessment and preliminary design;
- to RMA designation and consenting process;
- through to the development, design, implementation and maintenance of capital projects;
- to the maintenance of highway landscape assets overtime.

Landscape is to be considered early on in relation to all projects small or large.

Inter-disciplinary working

The project manager needs to build a multidisciplinary project team including landscape specialists to ensure that the landscape design work is closely integrated with that of the roading engineers, stormwater management, urban designers, acoustic specialists, ecologists, transport planners, heritage and cultural advisors and other environmental specialists. These disciplines need to work together rather than in isolated silos to achieve landscape outcomes sought by the Transport Agency.

The right skills

On a small or simple project it may be that the Transport Agency's Environment and Urban Design team can provide advice directly to the project team on what skills and expertise are required.

On larger or complex projects, specialist Landscape Architect consultants with experience in highway projects will be required as part of the project team working alongside the projects engineers and other specialists.

On such projects, NZILA Registered Landscape Architects may act as an expert witness to assess the Landscape and Visual Effects of the project and provide evidence in court at the planning phase, prepare the concept and detailed design drawings during the design, tendering and construction phase of the project, and provide expert advice, supervision and sign-off of landscape works during the implementation and maintenance stages.

NZILA Registered Landscape Architect

It is essential for the project manager to appoint suitably qualified and experienced landscape professionals for all projects. Such professionals will usually be Landscape Architects who have extended their expertise into the field of highway landscapes, who have skills and experience integrating infrastructure requirements and landscape architecture design.

The Transport Agency's Environment & Urban Design team maintains a register of NZILA Registered Landscape Architects, as well as urban design consultants with experience in transport projects. This is a useful document to identify potential consultants for a project.

Different project types and locations may require different landscape responses and expertise. The Transport Agency's Environment & Urban Design team can help project managers evaluate tender bids to ensure that these demonstrate the right set of skills for the particular project.

Adequate resources

The landscape design work needs to be appropriately resourced. Consideration shall be given to:

- the time required for attendance at briefings, team meetings, multi-disciplinary workshops, presentations and consultation events;
- the time and resources required for site visits, research, site analysis and inter-disciplinary working with roading engineers and other disciplines;
- design reviews and iterations following landscape input;
- the preparation of artist's impressions, photomontages, 3D models and drive-through simulations, as may be required to inform the design;
- the preparation of landscape design documents including Urban and Landscape Design Frameworks (ULDF), Urban and Landscape Design Master Plans (ULDMP) and input into other documents used by the Transport Agency;
- time required for risk assessments, quality control, including site inspections and the preparation of post-construction reviews.

Design continuity

Further to the above when addressing environmental design aspects and consent conditions the Landscape Architect will often collaborate with experts. An example is an ecologist who provides valuable support for Landscape Architects in regard to natural values and ecological mitigation.

Projects are developed in stages and can take many years to complete. Throughout the life of a project different design teams may be involved. Good design solutions can become diluted over time, if not altogether lost. This may reduce the quality of the built outcome or use up significant sums in re-design.

It is important to ensure continuity of landscape design across all stages of the project. Whilst the finer details of a project will understandably evolve over the life of a project, the broader principles underpinning the design should not be changed without due consideration of impact on the design outcomes, risk involved, cost implications and statutory/resource consent impacts. Contractors undertaking the detailed design and construction phases of a project should not remove components of the project which contribute to good landscape design and landscape outcomes. Items such as ecological restoration planting and bespoke landscape design features may have been agreed through consultation with the community and stakeholders and confirmed through a statutory planning process. Removal could undermine the concept and the commitment the Transport Agency has made.

Good documentation of landscape design objectives and proposals at each stage of the project will help subsequent teams continue the work of their predecessors. The preparation of an Urban and Landscape Design Framework (ULDF) is the recommended practice to capture the outcomes of the landscape design process. This document can evolve from high level principles early on in a project and be added to at each stage of the design development.

Using the same landscape and urban design personnel throughout a project is another way of ensuring design continuity.

Project phases

The Transport Agency's Environmental and Social Responsibility Standard provides direction to Transport Agency project managers and their teams on how to implement the landscape planning and landscape design requirements at each phase of a highway project. The level of landscape input will be commensurate with the scale and complexity of the project or the sensitivity of the surrounding environment. It is important that as a project progresses, the landscape objectives and concepts developed during the earlier phases are carried through to the next one to avoid duplication of work and to build on previous analysis and public engagement activities.

2.1 LANDSCAPE DESIGN PROCESS

CONTRIBUTION TO THE WIDER TEAM

Landscape design consultants are expected to:

- carry out the contextual analysis (often as part of the Landscape and Visual Assessment (LVA)) and set down the project's landscape design objectives and principles;
- contribute to the design of the project both at the broad and detailed scale in collaboration with engineers, ecologists and other team members;
- contribute to the assessment of project options;
- contribute to the Assessment of Environmental Effects (AEE) for the project, through LVA (refer to Appendix 1);
- help the project avoid or minimise adverse effects through design and if adverse effects are unavoidable, contribute to the development of appropriate mitigation measures and consent conditions;
- take part in public engagement activities and help communicate the project's landscape design principles and proposals to communities and other stakeholders;
- follow a rigorous and transparent methodology which is integrated with the wider project design process and clearly explains the rationale behind the design proposal, with a logical sequence from strategic decisions, to concept design then to detailed design;
- contribute to quality control through active involvement in the construction phase of the project including identifying risks to the success of the landscape implementation, landscape construction quality control input, post construction evaluations and reporting back at various stages of the Project process;
- assistance in the preparation of landscape related sections of the Asset Owner's Manual.

GENERAL LANDSCAPE DESIGN METHODOLOGY

The design of a highway project is developed in increasing detail from the initial strategic work, through to the development stage, and then into detailed design implementation and maintenance. It is important that landscape design is considered early in the life of a project because as a project advances through the various stages, the opportunities for significant changes to minimise adverse effects or deliver benefits will gradually reduce.

The basic components of the landscape design methodology are consistent across all stages of a project. They include the following:

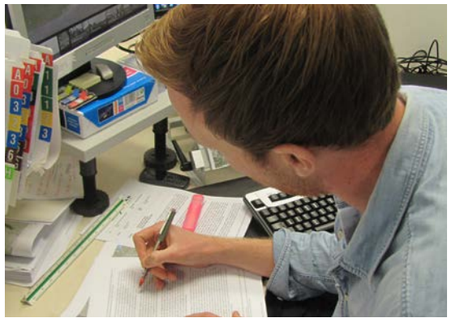
- LVA and Contextual analysis
- Landscape design objectives and principles
- Design development
- Assessment of outcomes, effects, costs, maintenance requirements, etc.
- Detailed design, implementation and management
- Review, feedback and sign-off

Design is an iterative rather than linear process so a number of feedback loops operate between these broad tasks, for example, the LVA stage will help refine the proposed design. The definition of landscape design objectives will help hone in the contextual analysis on specific aspects of the surrounding environment.

Image: Noise bund integrated with NZ native planting

Site visit scoping the alignment options and landscape context

Desktop studies, models and montages



Assessment preparation

Visualisations of proposed highway alignments and structures

Contextual Analysis, Landscape and Visual Effects Assessment

The Transport Agency Environmental and Social Responsibility Standard outlines when a Landscape and Visual Assessment (LVA) shall be undertaken. The LVA is generally a precursor at the start of the landscape design process. LVA include a contextual analysis of the site and its surrounds. The LVA outlines the spatial framework and steps necessary to integrate the highway within the landscape at the broad scale. LVA's can be undertaken at a range of scales, and for a range of purposes, from strategic route selection to the effects of a small project. A LVA is critical step, where it informs the landscape design decisions by:

- identifying the significant features, character and values of the existing landscape, and in urban areas the built environment, through which the highway will pass;
- identifying and assessing the nature, extent and significance of any landscape, environmental or visual effects caused by the highway development;
- identifying the environmental issues and concerns of interest groups and stakeholders;
- identifying how landscape contributes to the local sense of place and community (including heritage); and
- identifying opportunities and management options; then with appropriate expertise and collaboration providing the knowledge and skills needed to integrate different values, functions and activities within a particular highway landscape setting.

The understanding of the landscape planning frameworks, statutory aspects and the physical environment as well as areas to protect is the foundation of a good landscape design outcome. These layers are generally revealed through the LVA.

Landscape design objectives and principles

The landscape design objectives for the project will flow on from the contextual analysis/ LVA and reflect the values which have been identified as being important. During the early stages of a project, landscape design objectives are likely to be included as part of broader environmental and social objectives. They should be compatible with the overall project objectives and can help to refine narrowly focussed traffic outcomes to also include broader issue (e.g. biodiversity, walking and cycling connectivity etc).

Landscape design principles on a project provide the design direction for the projects landscape design outcomes and landscape management regimes, and set the framework against which detailed design implementation and maintenance can be developed and assessed.

There may be a number of different design solutions that satisfy the stated landscape design principles. The development of design principles provides the flexibility in the early stages of a project by not limiting the design to one specific solution. Design principles are also helpful in communication for planners and non-designers as they set out the key issues a particular aspect of the design is seeking to address and the intention behind the design overall.

Developed Design & Detailed Design

The developed design by the Landscape Architect should be fully integrated with the engineering design and the work of environmental specialists such as stormwater engineers, acoustic engineers and ecologists, amongst others. All the disciplines involved in the design of the project should work collaboratively to develop a balanced and cohesive design package.

During the developed design phase any consent conditions from the project planning process and offset mitigation requirements need to be captured, along with any landowner and community agreements the Transport Agency have.

The Value Engineering process must also be integrated with the landscape developed design process through the sustained awareness of value for money when making design decisions. The Landscape Architect should be involved in the decision making process as design changes need to be balanced between upfront capital costs and the whole of life value of the landscape assets. The full life cycle costs associated with landscape, including slope treatments, planting maintenance, mowing of grass areas, maintenance access considerations, risks such as vandalism, and replacement costs should all inform the design process at this point.

Detailed design is then carried out so the highway landscaping can be implemented. The qualitative and quantitative attributes of the landscape design should be included in the detailed design with instructions to inform the contractor, enabling them to achieve the design on the ground. The inclusion of an explanation of the design intent behind the landscape treatments can also assist the contractor.

All designers should be familiar with NZTA P39 Standard Specification for Highway Landscape Treatments and incorporate the requirements of this standard into the design.

The Corridor Approach

Where a network strategy leads to the upgrade or construction of significant segments of new state highway, a corridor landscape design strategy may be required. Examples of this situation are the Roads of National Significance (RoNS) projects where the design of numerous segments of new or upgraded state highway has necessitated the need for whole-of-corridor landscape design coordination.

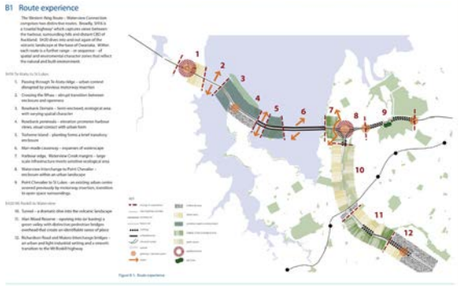
A corridor-wide landscape design approach and objectives can:

- inform the individual projects to ensure a consistent and appropriate outcome for the corridor;
- help avoid unnecessary duplication of design work on each project in the corridor, thereby reducing costs;
- assist in the strategic location and design criteria of facilities required along the corridor, for example rest areas;
- help minimise the types of different road components and provide continuity through a palette of highway furniture and landscape elements, thus reducing maintenance complexity and cost.

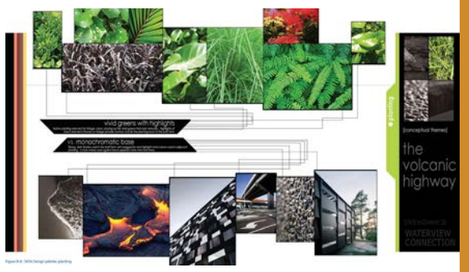
Corridor-wide landscape design strategies recognise that:

- corridors traverse diverse community, landscapes and ecological areas;
- road users will experience the various segments of a highway corridor in succession and their travel experience should be seamless and logical rather than reflecting the arbitrary boundaries of the individual projects within a corridor;
- whilst the corridor design should be unified, local circumstances may affect the form, function and character of part of a corridor and may warrant a different treatment from the rest of the corridor;
- designing each segment of a corridor separately may be costly, visually incoherent and confusing for road users.

Public workshop session

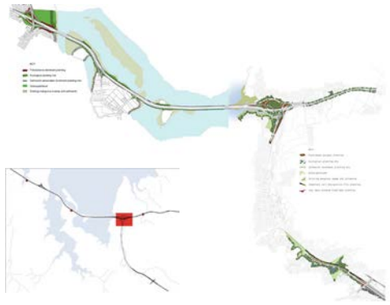


Landscape Architecture, diagrams and design concepts

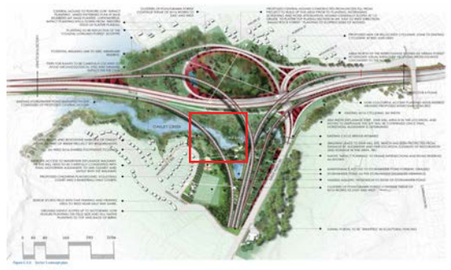


Corridor design thinking and strategies

Urban and Landscape Design Framework documents



Overall masterplan



Sector plans

Planting concept plans

Design details

Boundary to boundary scoping

The planning and design of any highway project should consider the landscape area controlled by the Transport Agency. This can include land owned by the Transport Agency, the site works area and overall designation combined. The Transport Agency seek an outcome known as 'boundary to boundary' maintenance. This is required where existing issues such as pest plant control outside the project footprint but in areas adjacent that are managed by the Transport Agency are scoped, addressed and included within new projects. This avoids retrospective works and protects new landscape assets.

Whilst the extent of highway landscape projects are generally specific to the highway construction footprint, designations often include land associated with offset mitigation and residual land owned and administered by the Transport Agency. Within the highway landscape scope, these areas also require consideration as part of the project.

Further to the above considerations, landscape treatments along boundaries need to be considered so as not to encroach on neighbouring properties. Retrospective trimming or felling of overgrown trees planted too close to boundaries is an unnecessary expense for the Transport Agency.

Design Deliverables

Drawing standards

Landscape Design drawings are reviewed by a number of people including project engineers, consultants, designers, stakeholders, local communities, and contractors. The design must be easy to read, easily visualised and most importantly easily understood for implementation purposes. The following general principles shall act as guide:

- consider the purpose of the drawing or model; think about the viewing audience and tailor the content and presentation technique accordingly;
- for public consultation and concept development, models, photomontages and colour graphics are attractive and easily understood. Note any 3 dimensional renders or photomontages should be carefully selected to show the critical elements of the project design. The image should be as realistic as possible;
- simple, clear sketches, models and drawings are generally sufficient for internal review. Photographs of precedent images to illustrate landscape treatments are highly convincing and descriptive;
- if the purpose of a drawing is to inform and guide the engineering team on landscape related issues. A quick mark up over an engineering drawing might be the best and most cost effective solution to communicate a message, and to incorporate it into the project;
- when construction drawings are required then simplicity is the key. Each drawing should stand alone. All landscape treatments, plant locations and arrangements should be legible and unambiguous. Hatching and shading variation should be highly distinctive, full names of all treatments and plant species, plant sizes/ grade, density and planting details should be included;
- construction drawings should work in black and white. Abbreviations and cross referencing should be avoided;
- accurate survey information is vital. Ideally a 3D topographic survey, verified by a registered surveyor. All survey information should be geospatially correct and within NZTM (New Zealand Transverse Mercator) projection, datum NZGD2 2000 (New Zealand Geodetic Datum 2000). A local circuit may be used, but this needs justification;
- the property boundaries, existing vegetation, existing buildings, archaeological sites etc. should all be survey accurate;
- all aerial photography shall be georeferenced and orthocorrected. In addition aerial photography shall be the most recent available;
- plant abbreviations should not be used. They can be misinterpreted and make it hard to visualise the outcome. All botanical plant names should be written in full;
- the number of plants of each species should be stated for each planting area and written down adjacent to that area on the drawings;
- plant schedules should be provided in reference to each drawing stating numbers of each species, total number of plants, sizes, and densities and any other requirements (e.g. staking);
- all drawings, whatever their purpose must include a scale, scale bar, north point, labelled key and places/landmarks/road names. In addition all drawings must feature the Transport Agency logo;
- sections, sketches, models and photomontages should be realistic in their illustration of vegetation growth. At time of establishment, at 5-10 years growth is sufficient. Drawings showing the intended effect after 20-30 years can look unrealistic;
- for references to "As-built drawings" please refer to Professional Services Guide (PSG/9) Delivery of As-built Documentation at www.nzta.govt.nz

Quality Control

The landscape architects role does not end once the capital contract has been awarded. In accordance with NZTA P39 Standard Specification for Highway Landscape Treatments the experts that make up any landscape and urban design team must be actively involved during the detailed design phase of a project, right through the construction process until the project is completed and handed over to the Transport Agency. This is vital to ensure the quality of the project is not undermined through design iterations and to ensure that the right experts are involved in the detailed design and construction phase, to guarantee that the Transport Agency receives the product they require. The Landscape Architect shall be NZILA Registered. This is to ensure they have the skills, technical and professional knowledge, understanding and integrity to practice on a Transport Agency project.

Sign off of the works

For highway landscape projects there are two distinctive types of sign off as follows:

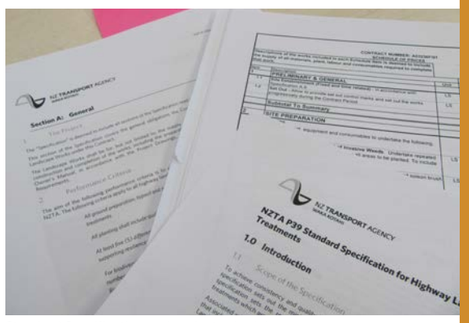
1. Urban Design and Landscape Design review sign off: The form and quality of any landscape design should be commensurate with the guiding principles set out within the projects urban and landscape design framework, and statutory requirements. As a quality control check to ensure that these agreed principles, the design intent and consent requirements have been enacted, the Transport Agency have developed a designer review template (refer NZTA P39 Standard Specification for Highway Landscape Treatments).
The template shall be completed by the designer (in the case of highway landscape works a NZILA Registered Landscape Architect) prior to practical completion of all construction works. The final completed review shall cover the key aspects of the project and be relative to the scale and complexity of the project in its detail. The designer sign off forms shall be co-signed by both the capital works contractor and the designer to determine to what degree the project has delivered on the design intent. The completed form shall be submitted to the Transport Agency's Environment and Urban Design Team for their review and records.

2. Landscape Construction sign off: Generally within the construction contract the Landscape Architect acts as either; the engineer to the contract for all landscape works, the engineer's representative or a technical advisor to the Contractor.
As a quality control check to ensure that the quality and quantity of landscape treatment specified have been enacted within the project the Transport Agency have developed the NZTA P39 Standard Specification for Highway Landscape Treatments.

At contract completion for the landscape construction works, the Landscape Architect nominated in the tender shall complete a producer statement. The statement shall confirm that the contract works have been undertaken in accordance with the plans and landscape specification. The Transport Agency may accept the producer statement as evidence the landscape works comply with the landscape design and the requirements included in the NZTA P39 Standard Specification for Highway Landscape Treatments. In addition the landscape architect may be requested by the main contractor to provide advice and/ or material to be included in the Asset Owner's Manual following the landscape construction works.

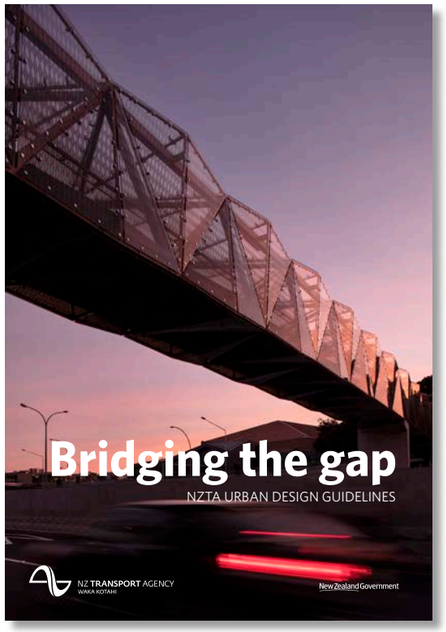
Concept refinement and developed design (Te Rapa Section)

Detailed planting plans and detailed design



Standard Specification and project schedules

Sign off during on site landscape construction phases



2.2 LANDSCAPE DESIGN TOOLS

This section outlines the various documents which are produced to support new or altered State Highway projects. The requirements to produce specific documents will depend on the scale and complexity of the project as well as its stage of development. Below is a brief description of the documents. Additional guidance is contained within the appendices to this document and within Bridging the Gap: NZTA Urban Design guidelines.

URBAN AND LANDSCAPE DESIGN FRAMEWORK (ULDF)

[refer to Bridging the Gap: Appendix 2]

An ULDF shall be developed on urban projects or large or complex projects in the consenting phase once a preferred route has been chosen. The purpose of an ULDF is to ensure that the urban and landscape design concepts of the project are appropriately defined, developed and implemented. The ULDF describes and explains the various design elements of a project and ensures that the design proposals from various disciplines within the project are integrated. Appendix 2 of Bridging the Gap outlines the Transport Agency requirements for an ULDF in detail.

URBAN AND LANDSCAPE DESIGN MASTER PLAN (ULDMP)

[refer to Bridging the Gap: Appendix 2]

The purpose of an ULDMP is to provide detailed plans for the urban and landscape design elements of the project on which the construction drawings will be based. The ULDMP will evolve from the ULDF to include details, materials and plant specifications and maintenance requirements. The ULDMP will be in general accordance with the design principles and proposals contained in the ULDF. Appendix 2 of Bridging the Gap outlines the Transport Agency requirements for ULDMP in detail.

LANDSCAPE PLANS AND PLANTING SCHEDULES

Not all projects will require an ULDF as part of their development for example the realignment of an intersection. Landscape concept plans and a planting schedule may be all that is required to address the landscape aspects of such projects.

ASSESSMENT OF LANDSCAPE AND VISUAL EFFECTS

Refer to Appendix 1: Landscape & Visual Assessment Guidelines

The purpose of this assessment is to identify and assess the landscape and visual effects of the project. Landscape and Visual Assessments (LVA)[8] are technical reports forming part of Assessments of Environmental Effects (AEE) that are required by the RMA process within applications for resource consents as well as Notices of Requirement for designations (NoR).

8. This guideline is consistent with the general approach and principles contained in the 'Best Practice Note 10.1: Landscape Assessment and Sustainable Management', 2 November 2010, published by the New Zealand Institute of Landscape Architects (NZILA).

Landscape and Visual Effects can be defined in the context of a statutory provision, as per the following example:

RMA PROVISION	EXAMPLES OF LANDSCAPE ISSUES[9]
s6(a) Natural Character of Coastal Environment, Wetlands, and Lakes and Rivers	Effects on natural character (biophysical and perceptual) of rivers and streams
S6(b) Outstanding Natural Features and Landscapes	Effects on the qualities of an outstanding natural feature or landscape
s7(c) amenity values	Effects on landscape character Effects on streetscape Effects on recreational experience in a park Effects on landscape context of an historical site Effects on views Effects on visual amenity from private property Temporary visual effects during construction
S7(f) quality of the environment	Effects on landforms Effects on vegetation [10]

The examples listed above are typical, but there are a range of potential landscape issues and a key task is to identify those relevant to the particular context and project.

Effects include potential as well as actual effects. A potential effect might be avoided (or reduced) by design measures, which should be described in the 'Design and Mitigation Measures' section of the LVA.

Effects include positive as well as adverse effects.[11] While assessments typically focus on adverse effects, positive effects are also a relevant consideration[12] and should be described in the LVA[13]. RMA sections 7(c) and 7(f) require that particular regard should be had to the maintenance and enhancement of amenity values and the quality of the environment respectively.

Effects include temporary as well as permanent effects (for example landscape and amenity effects are typically amplified during construction).

Effects also include cumulative effects which will arise over time or in combination with other effects.

A LVA includes an overall appraisal on the effects in relation to each landscape issue including:

- A summary of the nature and magnitude of landscape effects;
- An appraisal of the likely effectiveness of the mitigation measures (whether the effects will be 'adequately mitigated'); and
- A professional opinion on whether the effects will be 'acceptable' or 'not acceptable' in landscape terms.

(Source: NZTA Landscape and Visual Assessment Guidelines)

The LVA should have a level of detail that corresponds to the scale and significance of the effects the activity may have on the environment (following the principle set out in RMA s88). LVAs for a project with minor effects should be brief, whereas highway or motorway projects with potentially significant effects require a more comprehensive assessment.

Refer to Appendix 1: Landscape & Visual Assessment Guidelines

9. This list is not exhaustive.

10. Sometimes there is overlap between different issues. Rather than repeat matters it is best to simply refer to other parts of the LVA.

11. RMA section 3.

12. For instance, RMA s104 and s171 relating to applications for resource consents and notices of requirement respectively. Note that positive effects are not relevant to decisions on notification.

13. Positive effects should be described in an impartial way. Avoid becoming an advocate.

DESIGNATION CONDITIONS FOR LANDSCAPE

Generic conditions are available in Appendix 4 of Bridging the Gap.

On all projects being consented through the RMA, highway landscape considerations shall be put forward by the Transport Agency. Councils, communities and stakeholders place a lot of emphasis on the landscape conditions and urban design conditions that form an important part of the Notice of Requirement (NoR). Early commitment to landscape plans and/or an ULDF in draft conditions has reduced the scope of additional conditions and minimised re-litigation of urban and landscape design issues in later stages of the project development. It is important that the Transport Agency has a clear and consistent position on highway landscape conditions to avoid unmanageable conditions or unintended implications from them.

NZTA P39 STANDARD SPECIFICATION FOR HIGHWAY LANDSCAPE TREATMENTS

[refer to Appendix 2]

The Transport Agency Standard Specification for Highway Landscape Treatments sets out the minimum standards for all highway projects in order to achieve consistency and quality in the delivery of highway landscaping. The specification sets the required performance standards for quality and workmanship, which are required in all highway landscape projects.

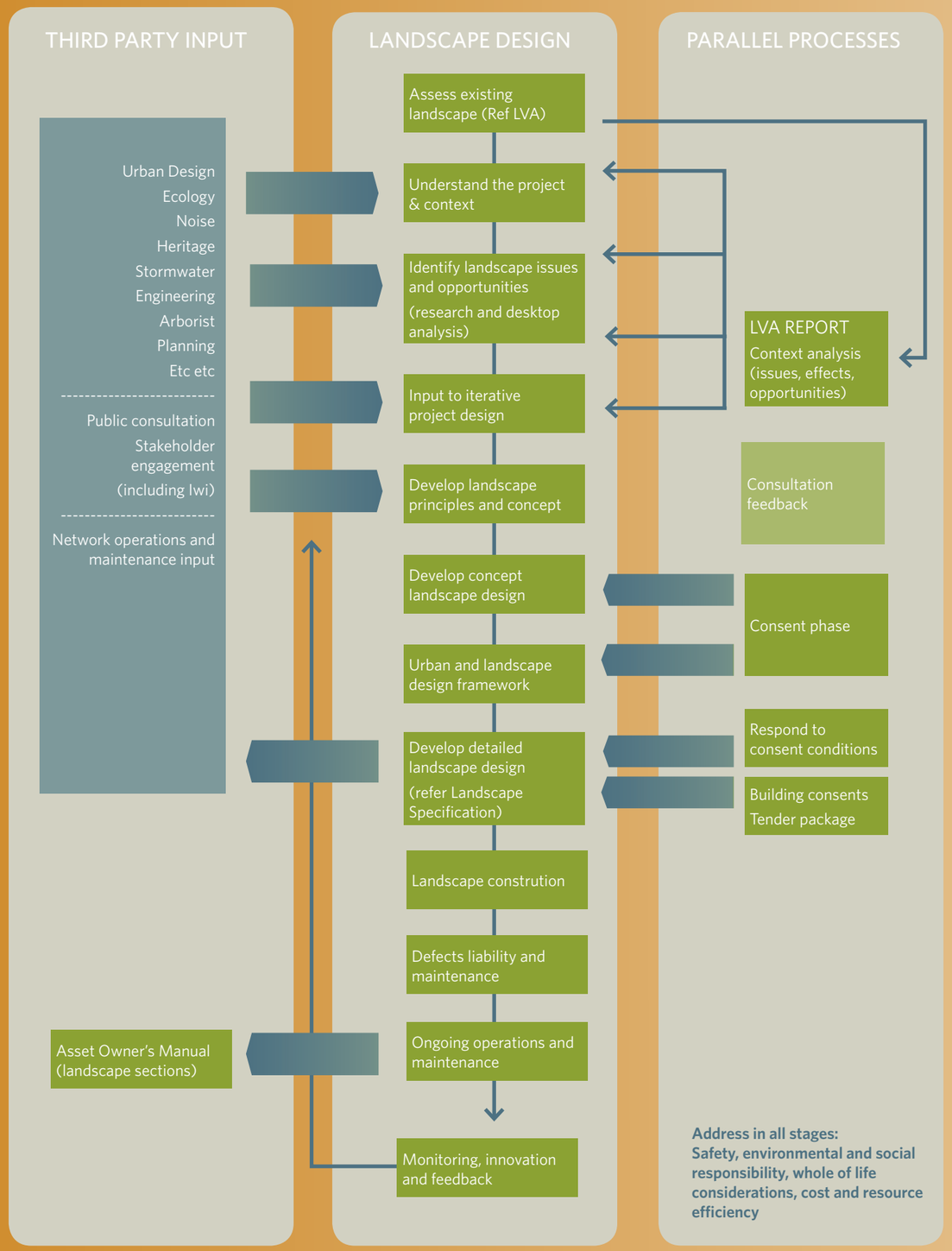
Each highway project that is developed will include a suite of landscape plans and a schedule of works which will be accompanied by the specifications.

Generally both the NZTA Standard Specification for Highway Landscape Treatments and the site specific plans and schedules will form part of the construction contract and pricing package for all capital projects. The specification will also form part of the Transport Agency's principles and requirements as an instruction to outline the Agency's expectations on capital projects.

A summary of NZTA P39 Standard Specification for Highway Landscape Treatments is provided in Appendix 2. A full version of the specification is accessible on the NZTA website. If further detail is required, contact the Transport Agency's Environment and Urban Design Team.

2.3 LANDSCAPE DESIGN PROCESS DIAGRAM

The following landscape design process has been developed to guide designers where the Landscape Design process is shown in the centre. The inputs of the Third Parties shown to the left with timing of inputs and feedback arrowed. The Parallel Processes on the right show how the landscape and visual assessment, once completed, feeds back into the Design Process, and how the Design Process and Consenting Process align.



SECTION 3: LANDSCAPE DESIGN PRINCIPLES

Image: Walkway along the St Mary's Bay cliff line, part of the Victoria Park Tunnel Project in Auckland

3.0 LANDSCAPE DESIGN PRINCIPLES

3.1 INTRODUCTION

This section outlines ten principles which capture the key elements of landscape design for highway projects. These principles reflect the Transport Agency's expectations for the integration of highway landscaping through all project phases. The principles below are applicable to all highway projects from the large and complex to the small and simple.

The principles are to be used as a point of reference at the outset of any project; when scoping the design and route selection options as the landscape design develops through the ULDF[14] and ULDMP[15]; or in the concept design and developed design phases for smaller projects. These principles should be reflected upon and adapted to form context and project specific design objectives and principles.

The following principles should not be considered in isolation but be pursued in parallel as they are closely inter-related. A project which dismisses one or more principle entirely is unlikely to lead to satisfactory landscape outcomes for the Transport Agency.

ten

THE 10 LANDSCAPE PRINCIPLES ARE:

1. A context sensitive and place based approach
2. Facilitate green infrastructure and landscape integration
3. Understand the physical conditions
4. The right plant in the right place
5. Promote biodiversity and build in resilience
6. Champion low impact design (LID)
7. Deliver a quality user experience
8. Low maintenance and whole of life value
9. Safety in design
10. Facilitate community engagement and a collaborative approach

14. Urban and Landscape Design Framework

15. Urban and Landscape Design Master Plan

1

3.2 PRINCIPLES

A CONTEXT SENSITIVE AND PLACE BASED APPROACH

Transport Agency roadside areas have many natural, environmental, historic and cultural values that contribute to the sense of place. These factors need to be considered in the design of landscape treatments to deliver a place-based approach.

Factors to be considered could include:

- remnant native forests and existing mature trees which are significant visual features and provide valuable ecosystem services;
- Records on the local ecology, which may include things such as habitat and movement corridors for native fauna;
- Places of significance to Maori; including waahi tapu (sacred places). Waahi tapu sites can be natural features, such as trees, springs, rivers or mountains which were associated with historical or cultural activities or events. They can also be locations which are known to have been associated with events but where there are no physical remains of the activity or event;
- Historic builidings, structures and archaeological sites significant to Maori or European heritage (refer NZTA Guide to Assessing Historic Heritage Effects of State Highway Projects);
- The experiential aspects of a place including features such as views to landscape features within the wider landscape.

When designing a new section of highway or retrofitting an existing highway the design should:

- Identify cultural heritage values early in the process and avoid or minimise the impact on sites;
- Recognise and incorporate Maori and European cultural heritage;
- Protect and incorporate important views or vistas;
- Seek to locate the road to avoid existing native forest remnants and mature trees.

A context sensitive approach requires consideration of the above factors to deliver a place based approach.

2

FACILITATE GREEN INFRASTRUCTURE AND LANDSCAPE INTEGRATION

Highway landscaping should perform a number of beneficial functions in association with roading infrastructure. These functions shall benefit the environment, the community as well as the projects requirements.

Green infrastructure outcomes can include the following:

- infrastructure outcomes
- ecological outcomes
- water quality and storm water management outcomes
- climate change adaptation outcomes
- enhanced native biodiversity outcomes
- enhanced connectivity, recreation and public open space outcomes
- human health and wellbeing outcomes
- education and environmental stewardship outcomes

The basis of 'green infrastructure' is an approach to planning, design and management which considers the widest range of functions an asset can perform simultaneously. The green infrastructure approach seeks to manage and address the many, often conflicting, pressures of highway infrastructure integration with multifunctional landscape outcomes.

The approach aims to deliver environmental, social and economic benefits simultaneously through the highway landscape design, and then looks at how those benefits can be linked to the wider context. In this way 'green infrastructure' can provide the catalyst for wider beneficial aspects beyond the highway designation.

To develop 'green infrastructure', the hard and soft landscape materials should perform multiple functions wherever possible and sustainability will underpin all aspects of the project. For example in roading construction use of recycled materials; integration with the surrounding landscape with a natural cut slope; protection and enhancement of vegetation and ecosystems.

Further to this the inclusion of art and cultural heritage elements; use of locally sourced materials; making provision for cyclists, pedestrians and alternative transport modes; LID stormwater treatment, life cycle cost analysis and management systems which consider the environment and whole of life aspects.

Further examples of 'green infrastructure' include urban forests, wildlife refuges and green corridors, and Low Impact Design (LID) or water sensitive design initiatives including stream daylighting.

Highway earthworks, slope integration and feathering, cut batters and fill sites are an important consideration as part of the 'green infrastructure' approach. Earthworks can be visually jarring and create areas which are hard to access and maintain if not co-ordinated with the landscape designer, to develop an integrated outcome.

3

UNDERSTAND THE PHYSICAL CONDITIONS AND CONSTRAINTS

Landscape designs are a relatively inexpensive element of our state highway and wherever situated, roads and their settings are enhanced by the presence of vegetation. Plants need water, soil, sunlight and space to grow, these necessities determine the success or otherwise of highway landscaping. The physical conditions of the project site need to be understood so that these basic requirements can be incorporated into the design. Topsoil compaction, inadequate rooting depth and mixing of topsoil and subsoil will reduce plant success and plant resilience to drought or water logging.

Aspects of the physical environment which are important for plants include:

- climate, including temperature, wind exposure and drought tolerance
- topography, slope and aspect
- soil drainage and rooting depth needs
- proximity and exposure to the coast

New physical conditions created by the highway project need to be understood in the landscape design. Highways create modified soils, ambient heat from hard surfaces, wind tunnels or tunnelling, rain shadow and disrupted hydrology effects. Structures and road surfaces cause micro-climatic effects and restrict space for plant growth directly; they also impact on ancillary requirements such as safe access for highway operations and maintenance. Other physical conditions to be understood include the presence of important ecological habitat, or the presence of pest plants and animal pests which, if left unmanaged, could seriously impact upon the viability of any highway planting.

Plant selection will need to recognise these physical conditions and constraints in the preparation of the plant palette and landscape design.

4

THE RIGHT PLANT IN THE RIGHT PLACE

The effects of plant size and form at maturity, seasonal changes, textures and colours all need to be considered in the design. Plant growth rates and the length of time required for planting to reach the desired visual screening, aesthetic effect or canopy coverage should also influence plant selection. Selecting the right plant for the right place requires knowledge of the environmental, functional, aesthetic, and safety aspects of highway landscaping. In addition plants should be selected for the long term, consider what the right plant in the right place would look like in 5, 10, 20, 50 years etc.

The following select criteria shall apply when preparing the planting layout:

- environmental suitability; that is suitability to the new physical conditions, hardiness, tolerance to climate conditions, lifespan/ longevity, ecological attributes, maintenance, or as a cultural resource;
- the resource needs of the plants;
- functional suitability; that is erosion control, visual screening, climate control, maintenance requirements;
- resilience; for example the species mix and its ability to withstand the highway climate, variable weather conditions over time and planned maintenance (especially spray and mow regime);
- safety suitability; that is the planting needs to meet the requirements for sightlines and setbacks, frangibility, Crime Prevention Through Environmental Design (CPTED), the provision of cues to drivers on change of speed environment and direction of travel;
- selecting the most appropriate planting methodology. Generally on highway projects this includes the planting of nursery grade plant stock, but could also include assisting natural regeneration, direct seeding, or establishing a nurse crop;
- aesthetic suitability; that is colour, texture, seasonal change, size, form and composition;
- maintenance considerations.

Planting scale and form at maturity should be considered in the landscape design. As a minimum:

- consider the canopy and root ball spread in relation to highway infrastructure;
- seek medium and fast growing species to achieve screening, short lived species may provide a nurse crop in association with long-lived species;
- co-ordinate planting to avoid utilities and services (above and below ground);
- avoid vegetation patterns that create strobing (flickering of light and shadow);
- consider both beneficial and negative shade effects of large trees within the highway designation and at the designation boundary, also manage solar access to the road surface especially in ice prone areas;
- set planting back to ensure all parts of the plants are clear of live traffic lanes, cycle paths or pedestrian areas;
- consider passive surveillance and CPTED principles in the location of planting, and the value plants can add in the reduction of graffiti;
- provide for any clear zones or deflection behind safety barriers;
- space plants and plant species to achieve canopy coverage;
- take advantage of ecosystem services that plants provide; noise attenuation (perceived), shelter, shading, screening, dust attenuation, stormwater detention and retention.

LANDSCAPE DESIGN INFORMED BY MATAURANGA MAORI

MATAURANGA MAORI

Another aspect of a place based approach is the implementation of Maori values and principles in the process of developing methodologies for effective design. Matauranga Maori refers to the framework of knowledge that Maori communities, iwi, hapu and whanau have retained since the advent of Polynesian arrival to Aotearoa New Zealand. This knowledge is place-based, and founded in empirical observation and interaction with the environment and the natural world in which Maori have existed for generations.

Matauranga Maori can inform landscape design practice to allow Maori aspirations to be fulfilled while complementing and improving Transport Agency's highway landscaping outcomes.

The following steps will help to ensure the successful implementation of Matauranga Maori, including kaitiakitanga (stewardship), in the design of new and existing projects within New Zealand's state highway network:

1. Ensure outcomes informed by Matauranga Maori are context specific and drawn from local sources of knowledge and interpretation. Early engagement with local mandated iwi representatives at the inception phase of the project is important.
2. Formation of an Iwi working group/key stakeholders that can advise on the implementation of Matauranga Maori based design solutions; for aspects including environmental management, landscape design, artworks, construction methods, cultural heritage management (wahi tapu/wahi taonga).
3. Adequately assess Maori expectations pertaining to kaitiakitanga (stewardship) such as monitoring requirements, plant species selection, cultural harvest, mahinga kai, bio-diversity, ecological enhancements and protection of mauri (life force).
4. Ensure the group is well resourced to contribute and provide inputs into the design and implementation phases of the project.
5. Design responses should be tailored to addressing specific issues within specific areas. Local iwi, hapu or whanau will provide the guidance on how this can be achieved.

5

PROMOTE BIODIVERSITY AND BUILD IN RESILIENCE

In addition to its amenity and highway integration purposes, highway landscaping is required to support ecological processes, augment existing habitats, reinstate wildlife corridors and connections, filter stormwater runoff and improve air quality. Benefits can also be gained from recycling and reusing materials such as topsoil, salvaging intact plants, mulching on-site where possible, or utilising available material as habitat fwweatures.

> *"The greater the biodiversity, the greater the ability to adapt to change. Reduced biodiversity leaves an ecosystem unhealthy and vulnerable."*
>
> *Scaefer et al 2004*

The New Zealand Biodiversity Strategy aims to halt the decline of New Zealand's biodiversity — our unique plants and animals and the places they live. Since New Zealand was first settled its unique native biodiversity has been impacted by the destruction of habitat, harvest by humans, and successive waves of pests, weeds and diseases. Highway landscaping can play a part in "turning the tide" on the decline of our biodiversity, especially in intensive pastoral areas, and cities.

Highway landscape treatments in natural areas; such as scenic reserves and national parks can maintain and restore a range of natural habitats, ecosystems and viable populations of native species. Conversely, if conservation values are not considered through the landscape treatments, detrimental effects may arise through the importation of, for example, pest plants.

Landscape designs should include the input of an ecologist and consider the ecological patterns and process of an area. Designs informed by ecological studies are more likely to benefit our native fauna and flora. Specific ecological opportunities include:

- protection and enhancement of important habitat;
- plant and animal pest control;
- salvage and reuse of plants;
- ecological connectivity including fish passage, which may allow access to new suitable areas, such as stormwater wetlands;
- riparian enhancement including stream fencing and revegetation;
- creation of complementary habitat using salvaged materials such as rocks and woody debris, or creating geological features;
- flowering plants for pollinators (e.g. bees), and a variety of nectar and fruit sources for native fauna;
- eco-sourcing plant material by collecting seed from remnant vegetation as close as possible to the location of planting, and from a similar ecotone (environment of similar climate and elevation);
- dense edges and buffers reduce edge effects of adjacent remaining vegetation and reduce opportunities for weed establishment;
- re-vegetation with pioneer vegetation species to protect exposed soils, and allow for natural forest succession processes;
- restoration of multiple vegetation 'tiers' from root zones and litter layers, through herbaceous plants, shrubs, canopy, and emergent trees to form diverse habitat niches; complementary flowering and fruiting species may be appropriately included to extend food supply for native invertebrate fauna across the seasons;
- diversity might be further enhanced by providing a range of conditions to support diversity, for example, from wet to dry, from fertile to exposed. Given the modifications caused by highway projects the designer can make the most of these opportunities.

6

CHAMPION LOW IMPACT DESIGN (LID)

Low Impact Design[16] (LID) is a preferred approach to sustainable stormwater management in relation to landscape design outcomes. It is an inter-disciplinary design approach to stormwater management often seeking partnering opportunities as part of the design in recognition of the wider watershed/ catchment. LID complements successful landscaping. LID solutions often align with landscape, urban design or ecology objectives in creating integrated stormwater management solutions and examples of best environmental practices.

LID first seeks to protect and enhance natural water systems, and mimic natural hydrological processes to achieve environmental and social outcomes. Outcomes may include improved water quality, erosion protection and riparian enhancement, increased native biodiversity. Further opportunities may arise such as utilising stormwater as a resource for passive irrigation, improving plant growth.

LID is inherently a context-specific approach which combines conventional stormwater management structures and devices with designed natural systems.

The common LID devices are:

- Swales (wet or dry)
- Raingardens
- Tree pits
- Detention basins (wetland or dry)

The designed system capitalises on the ecosystem services provided by soils, natural structures and planting to achieve filtration, infiltration, transpiration and the associated physical, chemical and biological processes which remove contaminants. The aim is to achieve the best practicable stormwater management response, while recognising the associated benefits of an integrated and designed highway landscape.

The aim of LID is to locate and integrate stormwater management systems within the overall landscape design to achieve multiple outcomes. This can be championed by:

- promoting inter-disciplinary planning and design for stormwater management;
- protecting and enhancing the values and functions of natural waterways and ecosystems, i.e. avoid impinging on natural systems;
- addressing stormwater effects as close to source as possible (e.g. swales and no curb and channelling);
- mimic natural systems and processes in stormwater management to create a sense of place and amenityavoid piping direct to receiving water.

Stormwater Treatment Standard for State Highway Infrastructure

The Transport Agency's "Stormwater Treatment Standard for State Highway Infrastructure" provides guidance on the implementation of project specific water quality and quantity management objectives. The Transport Agency's approach to stormwater quantity and quality control is "To provide best practice for both stormwater quantity and quality control that, in the absence of local requirements or where local requirements are limited, demonstrates environmental responsibility."

16. Also known as Water Sensitive Design (WSD), for example Auckland Council have adopted the term WSD in place of LID terminology

7

VISUAL QUALITY AND THE DELIVERY OF A QUALITY USER EXPERIENCE

Landscape contributes both to the character and legibility of the local environment and to the road users' experience. In addition New Zealand has scenic routes with a landscape and context that is of high value to national and international tourism.

Adequate space within highway designations for landscape treatments to establish, flourish and be easily maintained is important in achieving quality outcomes.

Designated green buffers, for example, can separate the footpath from the carriageway providing a more comfortable and safer pedestrian environment. Stopping places for drivers to break and rest along a journey are also part of a safe quality experience and require adequate space, separation, and facilities.

Visual quality is an important aspect of highway landscapes. The perception of a place can be heavily influenced by the quality of the on-road environment and its integration or contrast with the surrounding context.

The landscape design component of any state highway project shall be responsive to the viewing audience and recognise the different experiences of both the moving highway user, cyclists and pedestrians and the static local community. To achieve this highway landscapes need to provide high visual quality and amenity. Visual quality can aid navigation and legibility and benefit driver behaviour if designed correctly. It can create pride of place and unify an area, for example an entrance to an urban area. Visual quality generally translates to landscapes that are:

- uncluttered and cohesive;
- well implemented and integrated with the highway urban design;
- appropriate to the local context and character;
- well maintained and tidy.

Amenity landscapes address the sensory, perceptual and experiential aspects of the highway network. This can include the protection and framing of significant views.

Vegetation influences landscape through size, scale and form of planting, its floral display or seasonal colour and variation. Specimen trees can be distinctive landscape markers or features; an example of this is a tree lined avenue, or clusters of trees in an open landscape.

Public art, signage, lighting, heritage interpretation and structures (see also urban design) all play a role in creating amenity and a quality user experience (refer to Bridging the Gap).

8

LOW MAINTENANCE AND WHOLE OF LIFE VALUE

Low maintenance and whole of life value for money in the management of Transport Agency administered land and the highway landscape assets is a fundamental component of the landscape design. Landscape assets unlike most motorway infrastructure should appreciate in value (not depreciate). To ensure this is the case landscape designs need to be integrated with the operations and maintenance aspects of the transport network. Designs that integrate operation and maintenance thinking are generally more cost effective, successful and endure in the long term. Speaking with the local Transport Agency operations and maintenance personnel at the start of the landscape design process is the best way to capture the landscape asset maintenance perspective. These conversations will help identify opportunities and constraints, highlight what has been successful within the network to date and the types of landscape treatments to avoid, from a whole of life value perspective.

The following issues should be addressed as part of these conversations:

- co-ordination of corridor boundary treatments and surplus land divestment (upon completion) of works. For example agricultural land can be divested back into production or native ecological areas returned to DOC management;
- co-ordination of landscape boundaries and fencing treatments (including the fencing of covenant areas to the covenant standard); allowing access points;
- minimise the potential for weed establishment/re-establishment, this has a twofold effect in protecting the landscape investment and reducing maintenance and impacts on adjacent native areas (e.g. wildling pines on highway to Arthur's Pass, or agapanthus on the Auckland/Northland/West Coast highways);
- design for safe maintenance access for both soft and hard landscape areas, and structures (e.g. bridge inspections). Ensure safe deceleration and acceleration from these access points and allow space to maintain areas safely without the need for traffic control;
- where possible co-ordinate landscape maintenance access with adjacent pathways where possible, e.g. walking and cycle paths;
- design to reduce the need for mowing grass, where possible. Mowing is costly in the long term especially if traffic control is required to access grass areas;
- design which includes quality ground preparation, soil and growing conditions for plants suited to the conditions is important so that plants establish. The goal is to achieve long term canopy coverage to reduce the maintenance requirements;
- select the most appropriate planting method to deliver long term outcomes; avoid short lived plant species unless they are specifically part of the nursery planting, which will be superseded by longer lived climax species. Design to reduce reliance on chemical control by considering landscape treatments to minimise the need for weed spraying;
- design to ensure that all landscape assets are implemented as per NZTA P39 Standard Specification for Highway Landscape Treatments; with sufficient time allowed in the defects liability and maintenance period to ensure that the landscape assets are establishing well prior to hand-over;
- recognise whole of life value, which may also include life cycle costs, when procuring goods and services.

9

SAFETY IN DESIGN

The landscape design component of all state highways projects shall promote the long term goals of road safety and the 'Safe System' approach.

- design which encourage safe travel speeds and behaviours;
- planting design that integrates sight lines and safety setbacks from structures, barriers and signage;
- frangible planting;
- inclusion of provision for safe access for landscape maintenance as part of highway maintenance and operational requirements;
- provision for attractive and safe stopping places and rest areas with good visibility;
- safe walking and cycling opportunities.

Research on 'Human Factors in Road Design' prepared by the World Road Association, shows that spatial and perceptual factors can be used to validate planning and design processes around safety. For designers and engineers this interaction between the road design and the surrounding highway landscape environment is a critical aspect of safety in design.

Landscape design plays an important role in relation to human factors where it can provide physical cues for drivers to perceive the roading environment and changes ahead.

Safe systems highway landscaping includes:

- designation and planting boundary fence design should be considered in terms of vehicle safety where the fence or barrier is adjacent to the highway;
- consider surfacing of clear zones and their need to be traversable, material should not encroach onto the highway. Avoid gravel or similar materials that can be tracked, blown and/ or washed onto the highway creating a hazard;
- surveillance over public areas is considered; crime prevention through environmental design (CPTED).[17]

17. Definition: CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN (CPTED) is a crime prevention philosophy based on proper design and effective use of the built environment. The use of CPTED is intended to reduce crime and fear of crime by reducing criminal opportunity and fostering positive social interaction among legitimate users of space. The Ministry of Justice Guidelines for "Crime Prevention through Environmental Design" (CPTED) sets out seven qualities for well-designed, safer places. The principles are as follows (MoJ 2005):
1. Access: Safe movement and connections - landscape to consider sightlines, and pedestrian choices to avoid criminal activity.
2. Surveillance and sightlines: See and be seen - landscape with appropriate planting heights and densities to retain sightlines and allow for passive surveillance.
3. Layout: Clear and logical orientation - landscape to work within the legible patterns of the development.
4. Activity mix: Eyes on the street - landscape to encourage passive recreation and public spaces to maintain surveillance.
5. Sense of ownership: Showing a space is cared for – Landscape overall to maximize the visual quality, amenity of public spaces.
6. Quality environments: Well-designed, managed and maintained environments to provide a well-kept appearance with reduced ongoing maintenance requirements.
7. Physical protection: Use active security measures - Landscape to encourage active use of appropriate areas and limit access to sensitive environments or private areas.
CPTED principles should be considered in relation to the location of landscape and its relationship with pedestrian and cycle routes. Landscape that is well maintained can deter crime through the appearance of an invested and vigilant community.
Reference Ministry of Justice www.justice.govt.nz/

Community workshop

10

FACILITATE COMMUNITY ENGAGEMENT AND A COLLABORATIVE APPROACH

In highway projects, there is no single author. Designers cannot work in isolation; they need to collaborate with technical experts, contractors, the highway maintenance operators, as well as community members and key stakeholders. Each brings expertise and knowledge to what can be a complex site, construction, or legislative process.

Designers should familiarise themselves with the project, project team expertise and legislative requirements. In addition being aware of community input and stakeholders is essential. In even the smallest projects there may be key stakeholders to engage with. Engaging a cross-section of stakeholders as part of the design process will elicit ideas, opinions and local input to a project.

The Agency requires Designers to demonstrate how they are fulfilling the following engagement principles through their public or community engagement process. These principles form the foundation of good engagement practice, and allow flexibility rather than a 'one size fits all' approach to public engagement with the Transport Agency. Engagement with the public can cover the following spectrum:

- informing, to assist understanding, technical constraints and alternatives, opportunities and or solutions; via information days, websites, and project fact sheets;
- consulting, to obtain feedback on analysis, alternative options and or design decisions; via focus groups, surveys, and public meetings;
- involvement, through working directly with the public to address concerns and ensure their aspirations are consistently considered; via workshops;
- collaboration, through partnering with the public in the development of alternatives and identification of a preferred solution; via citizen advisory committees, participatory decision making workshops;
- empowering, through placing the final decision making in the hands of the public; via citizen juries, ballots, and delegated decision.

Establishing the level of engagement for each project and stakeholder, and public input from the outset can avoid disappointment or frustration for all parties. Designers should be aware of the various ways the Transport Agency engages with the public so that the design process can align with the public participation process where required. Co-ordination of public feedback also needs to be checked technically against the highway landscape requirements and outcomes sought.

SECTION 4: HIGHWAY LANDSCAPE DESIGN

Image: Mt Taranaki Source: Tourism NZ

PART 1: HIGHWAY ENVIRONMENTS

Consult the genius of the place...

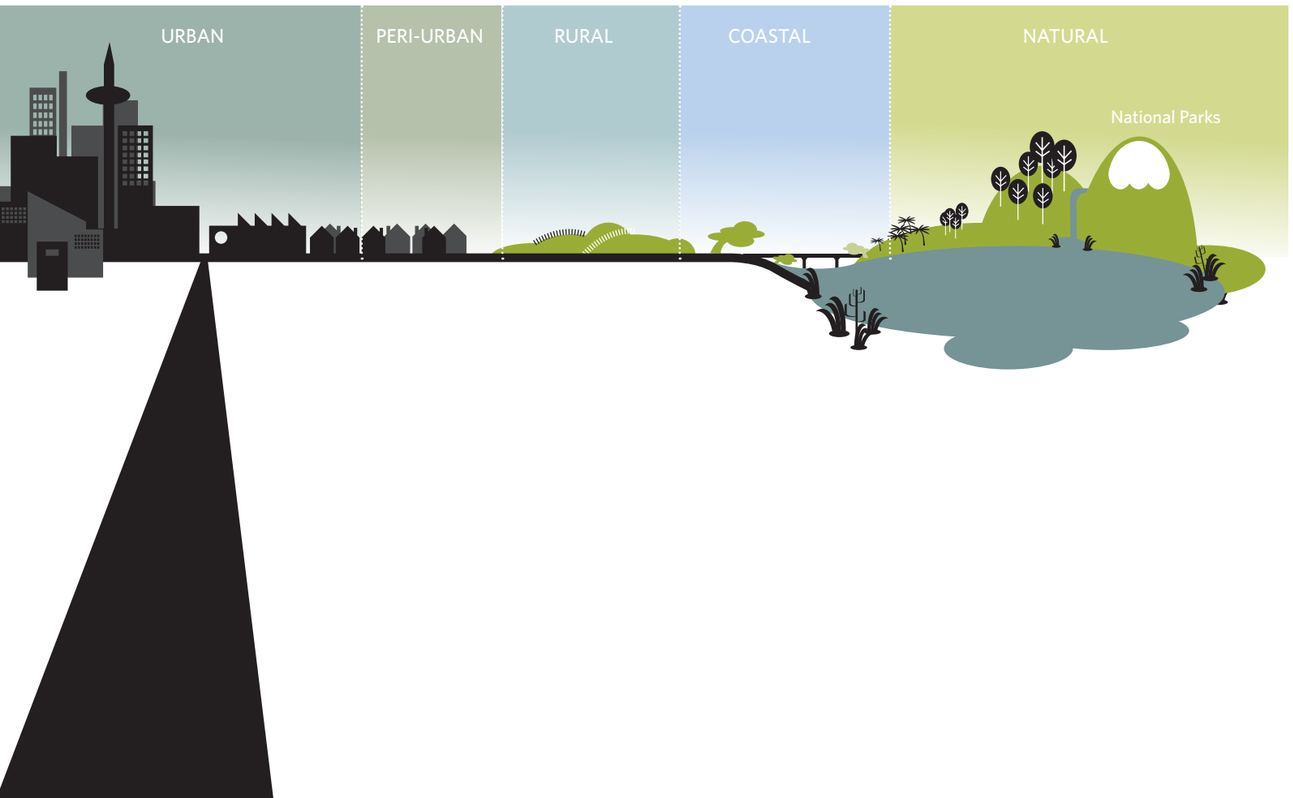
This verse by Alexander Pope laid the foundation for one of the most widely agreed principles of landscape architecture. The principle that landscape design should always be adapted to the context in which they are located.

4.0 HIGHWAY ENVIRONMENTS

Highway landscape design should recognise the highway environment and project context: the social/cultural setting, environmental setting and road class environment.

The section below provides guidance on the following typical highway landscape environments:

4.1 Urban
4.2 Peri-urban
4.3 Rural
4.4 Coastal
4.5 Natural (including through National Parks)



4.1 URBAN ENVIRONMENTS

Urban environments include major urban areas and satellite or independent urban communities (Statistics New Zealand)[18].

Due to population density in urban areas and the close interaction between transport users and the roading network, a high level of finish and maintenance is expected of landscapes in urban environments.

There are a range of transport route types that traverse our urban environments contributing to the urban fabric:

- high volume traffic areas including central city motorways and the wider motorway network;
- urban arterials which connect suburban areas;
- rapid transit routes (such as busways);
- cycleway and pedestrian routes which are generally part of the wider pedestrian and cycle network);
- highway routes which pass through main street environments and busy centres with commercial and community services;
- highway routes which pass commercial and public realm and open space areas within highway designations;
- highway routes which pass through residential areas.

Typical considerations for landscape design within urban environments are set out below.

URBAN LANDSCAPING AS A CONTRIBUTOR TO A SAFE VIBRANT TOWN OR CITY

Urban highway landscapes are part of the everyday landscape for urban communities, commuters, cyclists and pedestrians. Many towns and cities are first experienced by visitors through journeys along the highway network.

Landscape treatments therefore play an important role in helping to create a sense of place, as well as contributing to liveability and vitality, social and cultural expression and physical benefits such as urban greening, ecological networks and amenity along urban highways.

When designing landscape treatments the arrangement of landscape planting adjacent to highway structures; noise walls, barriers, bridges, interchanges etc. should achieve setback requirements and recognise sight lines. Scoping these technical requirements is important to ensure that the landscape assets do not impact on the safety performance of the highway or any structures, whilst also helping to create a sense of place.

THE SURROUNDING CONTEXT & CORRIDOR

Urban highway landscape design should recognise and respond to the surrounding context; it needs to be recognised that highway landscapes are a part of the whole town or city, and urban ecology.

The landscape design processes should recognise "that towns and cities are part of a constantly evolving relationship between people, land, culture and the wider environment"[19]. In this context highway landscape treatments are not simply a vegetated buffer to the neighbouring land, but an opportunity to enhance the urban environment. The highway landscape can create a vibrant interaction with the public realm whilst also screening and buffering the corridor through the landscape design.

18. Details of these urban areas are available from Statistics New Zealand (www.stats.govt.nz) and the Transport Agency's Spatial Viewer www.virtualhighway.org.nz

19. New Zealand Design Protocol http://www.mfe.govt.nz/publications/urban/design-protocol-mar05/html/index.html


Variable edge context to the corridor within urban environments


Street trees providing urban character


Integration of structures and urban design elements


Gateway palisade and carved pou structures at the southern entrance to Rotorua.


Integration of public spaces and accessibility

Urban corridors shape the way people experience our cities (Wellington NZ)

Urban cycle and pedestrian way (Auckland NZ)

Urban environments are generally highly modified, soil quality and ground conditions need to be checked to ensure they are suitable for planting

Micro climate conditions, including heat island effects can impact on planting areas. Consider alternatives where the heat of surfaces would otherwise create an inhospitable environment for planting

Within urban environments NZTA customers can experience the landscape from multiple speeds, so quality landscape is essential

Context for highway landscape design should also include recognition of the adjoining highway sections and their respective landscape treatments up and down the corridor. While the immediate context to the project is important to the planning, design and management of highway landscapes, just as important is a sense of continuity across the wider network. Maintenance and operational aspects in particular can be aligned between new projects and adjoining network sections. Issues already existing within the network can be addressed early in the design of new sections thereby avoiding long term costs for the Transport Agency and delivering whole of life value for money.

REVIEW URBAN GROUND CONDITIONS

Urban sites can yield pre-existing site constraints at a specific location or even designation wide, these conditions can affect the success of landscape treatments. Early identification of risks to the establishment of any planting treatments can assist project teams with planning remediation methods or scoping design alternatives early.

Constraints could include: poor soil conditions and drainage as a result of historic landuse and urbanisation; contaminated soils; constraints around existing utilities and services (above and/or below ground); rubbish from historic activities or adjoining properties; fly tipping; and plant or animal pest infestations.

URBAN MICROCLIMATES

Microclimate effects caused by urban areas can adversely influence landscape treatments if not considered in the design. Surrounding buildings, structures and impervious surfaces can create a harsh environment for planting. Heat island effects, rain shadow, sun shade, overland stormwater flows and wind concentrations can adversely impact certain plant species. These factors can generally be mitigated through the design; along with the use of hardy plant species capable of surviving and withstanding the urban microclimatic conditions of the project.

MAXIMISE ENVIRONMENTAL BENEFITS & BEST PRACTICE LANDSCAPE MANAGEMENT

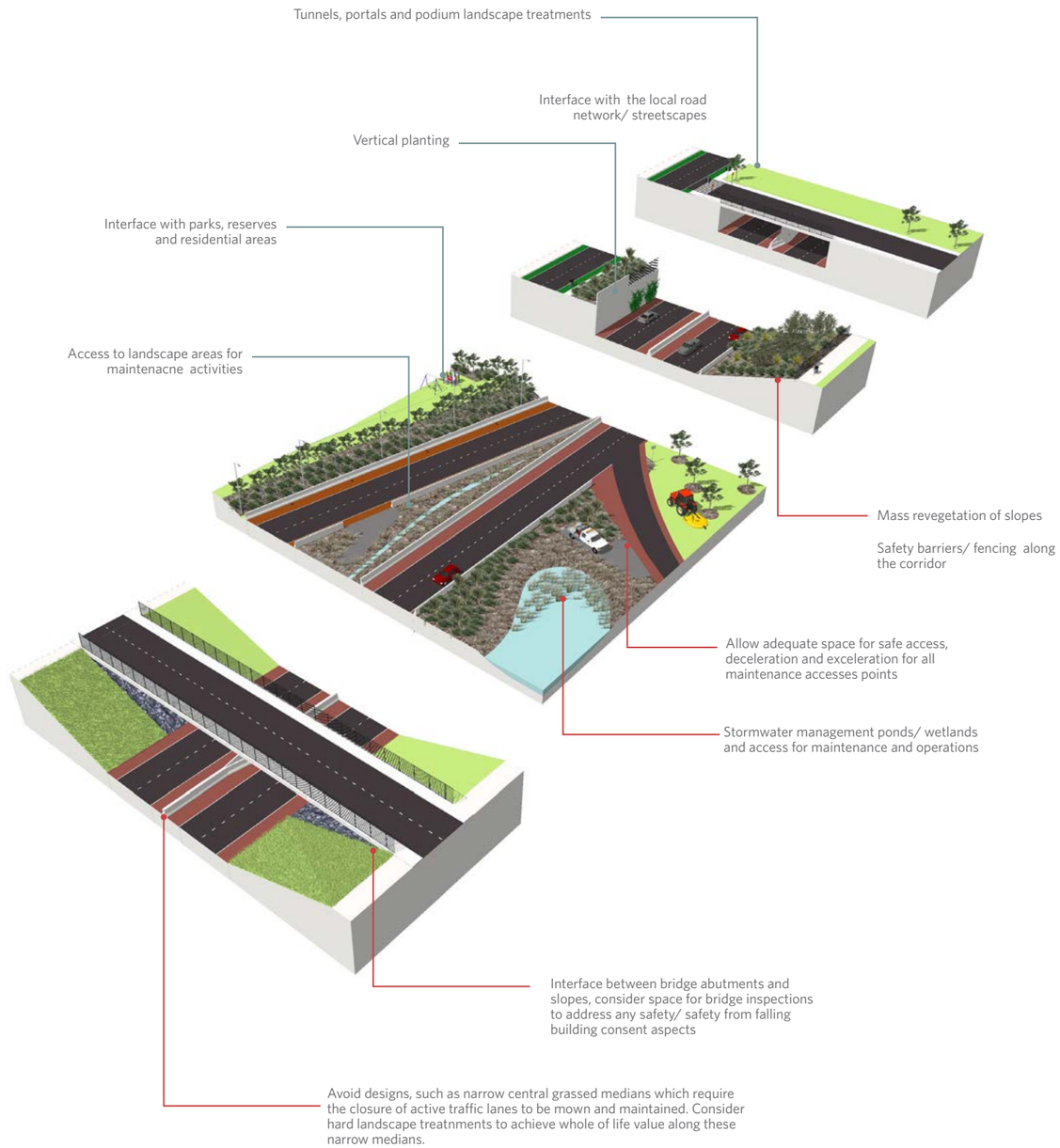
The relationship of living organisms with each other and their surroundings in the context of our urban environments should be considered part of highway landscape design. There is growing recognition of the importance of highway landscapes providing ecological benefits. Biodiversity in cities is thought to be important for both the provision of ecosystem services[20], as well as wildlife conservation and human health and well-being.

Landscape design should also acknowledge any adjoining initiatives or restoration projects. The highway landscape requirements could have a dual role in increasing environmental benefits to an adjacent initiative and meeting the Transport Agency requirements.

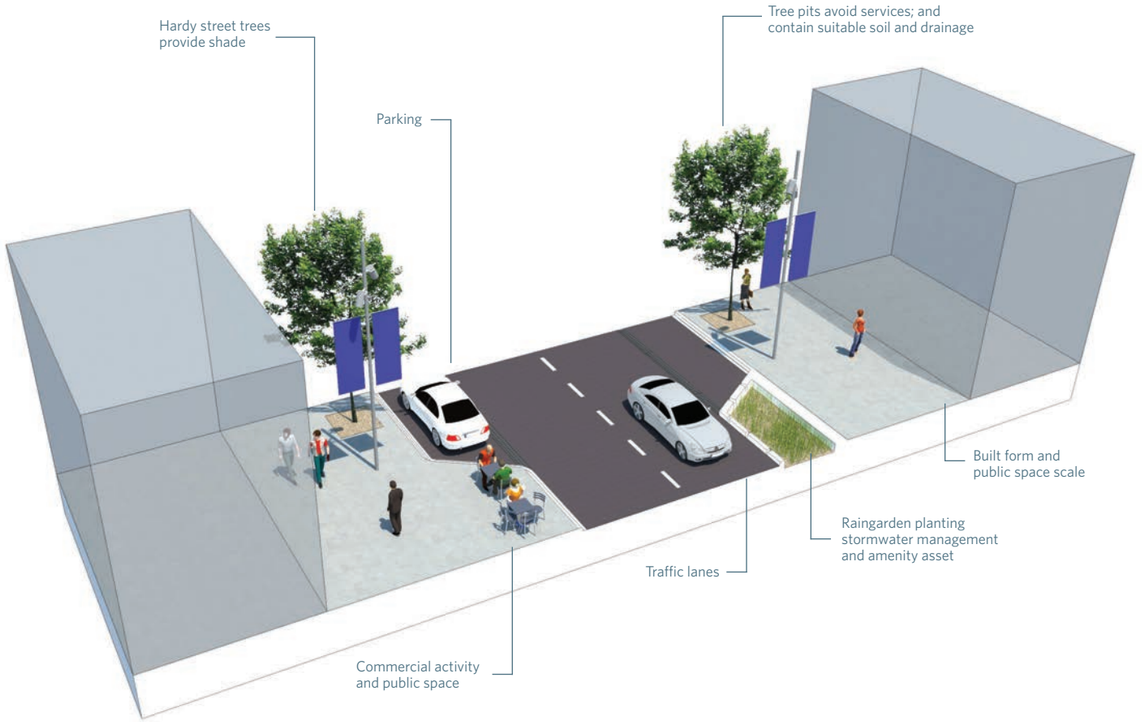
While avoiding the transport and dispersal of pest species generally falls under the environmental management aspects of highway projects, the issue also needs to be considered for landscape design and landscape maintenance biosecurity. Animal pest and plant pest management may be required to ensure that landscape planting treatments are successful. As well as minimising the spread of pests, the need for pest control through ongoing control, spraying or mowing is required. Specialist advice is often required for pest control operations in urban environments given the proximity to the public, households and highly populated areas.

20. Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life. They maintain biodiversity and the production of ecosystem goods such as seafood, forage, timber, biomass fuels, natural fibre and many pharmaceuticals, industrial products and their precursors. GC Daily, S Alexander, PR Ehrlich, et al. Ecosystem services: benefits supplied to human societies by natural ecosystems. Ecol 1997, 2:2
Ecosystem services are the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services that directly affect people and supporting services needed to maintain the other services. Source: Millennium Ecosystem Assessment http://www.millenniumassessment.org/en/Products.Synthesis.aspx

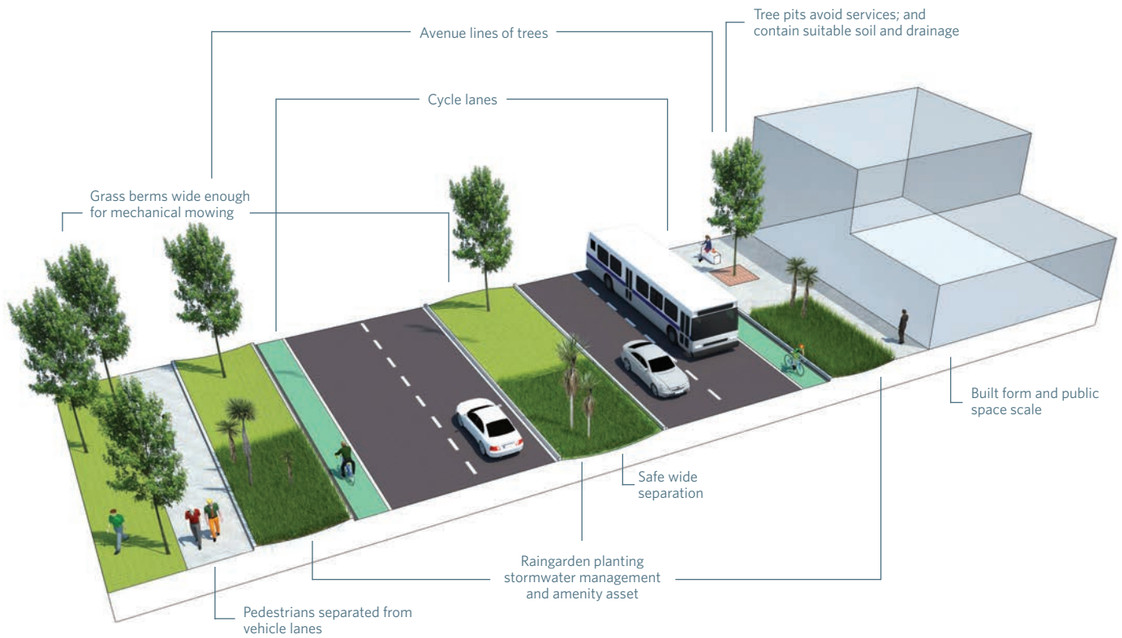
URBAN ENVIRONMENT: TYPICAL URBAN MOTORWAY SITUATION



URBAN ENVIRONMENT: TYPICAL MAIN STREET SITUATION



URBAN ENVIRONMENT: TYPICAL URBAN ARTERIAL SITUATION



Even constrained sites can provide opportunities for landscape design and public art works at the interface with the public realm

The interface between the highway and adjoining public space is critical in urban environments. Structures can integrate with art and cultural heritage to provide something functional and artful

The landscape component of highway projects can make a positive contribution to communities within urban environments

Traffic control operations required for landscape maintenance on the Auckland Motorway network, can require costly operations. Consider access for maintenance early in the design process to achieve whole of life value for the Transport Agency

UTILISE SPACE TO GOOD EFFECT

Space constraints can be a limiting factor within urban highway designations. In these situations landscape design outcomes which are interwoven with the spatial constraints and other requirements such as stormwater management assets, are an excellent way to utilise limited area and also achieve multiple project outcomes. In these instances, a high level of co-ordination is required between the Landscape Architect and engineering design team to ensure the requirements work together in the design.

SAFETY THROUGH DESIGN

Landscape design in urban environments should contribute to safety in a number of ways:

- apply safe sight distances recognising sight lines, physical separation between active highway lanes and the view for drivers, cyclists and pedestrians;
- provide visual cues, such as through planting and a narrowing of the carriageway alerting drivers to a change in speed environment;
- the use of frangible vegetation across clear zones and within the deflection zone of barriers to avoid obstacles for errant vehicles;
- provision of landscape features which relieve monotony on long journeys, but which are not distracting; avoid vegetation patterns which can create flickering of light and shadow for the driver; screen headlight glare through planting;
- avoid vegetation which could create solid shade and potential for slippery damp or icy areas on the road;
- allow for good road signage visibility;
- provision of safe access for landscape maintenance - landscape maintenance access requirements should be addressed early in the design phase to ensure safe access and to minimise costs to the Transport Agency associated with traffic management (e.g. static or rolling lane closures) in the long term. Look for opportunities to co-ordinate maintenance access with off road pathways where possible, e.g. walking and cycle paths, underpasses;
- the provision for safe access to all landscape areas includes the location and integration of any safety from fall barriers, stairs, gates and other access features associated with access routes. Again these requirements should be addressed early in the design phase in co-ordination with the engineering design team to ensure safe access can be achieved. Thereby avoiding Transport Agency investing in retrospective additions to projects to achieve safety outcomes.

4.2 PERI-URBAN ENVIRONMENTS

Peri-urban environments form the transition between urban areas and the rural hinterland. These areas may indicate a change in landscape character, change in speed environment, change in land use, and often a corresponding change in the design detailing, type of landscape treatments, and corresponding landscape maintenance regime.

Peri-urban environments often include 'gateways' or 'thresholds' as visual cues to drivers of the change in speed environment ahead.

If not considered properly peri-urban edges can be disjointed and incongruous and provide an altogether unceremonious entry or exit to an urban area or rural environment along highways.

Typical considerations for landscape design and maintenance within peri-urban environments are set out below.

UNDERSTAND THE CHANGE IN LANDSCAPE CHARACTER

For peri-urban environments consideration of the change from urban to rural, and rural to urban environments can be reflected in the landscape treatments and act as a visual cue for road users to aid legibility and safety through changes in speed environments and landscape.

GATEWAYS AND THRESHOLDS

Generally peri-urban gateways and speed thresholds align with a change in speed environment. Landscaping can assist the legibility of this change through visual cues e.g. planting and a narrowing of the carriageway. Landscape treatments that provide environmental cues to alert drivers to the change in speed environment and setting are encouraged by the Transport Agency. Landscape design opportunities can include:

- utilising scale (e.g. canopy trees, boulevards and avenues);
- utilising density of planting, seasonality and composition to focus driver attention;
- building on natural boundaries and views (topography, waterways, natural vegetation);
- changing the road width and berms (consider the treatment of the road berm as it transitions from an open rural setting to a more urban setting);
- landmark features/ artworks and the integration of signage.

Where possible gateway or speed threshold should be located to facilitate an arrival and departure sequence. Natural boundaries or changes in the highway environment may provide the best land opportunities, these include:

- natural boundaries (such as rivers, wetlands, a valley, hill top or change in topography);
- thresholds created by highway elements (such as an intersections, roundabouts, bridges, tunnels etc).

Cadastral or local jurisdiction boundaries that are less visible in the landscape are less desirable as visual cues.

THE ROLE OF SPEED THRESHOLDS

Low impact

High impact

A well designed threshold provides a visual cue alerting drivers to change in speed environment ahead

Image: Mt Tongariro Source: NZTA

REDUCE ADJACENT IMPACTS

Peri-urban areas may be subject to planning and landuse changes. If the changes in landuse adjacent to the highway are consented and embedded into Local or Regional Authority documents then the highway landscape may need to reflect these changes in terms of the overall landscape design.

The Transport Agency sees future proofing of the highway landscape assets as essential both to achieve a comprehensive landscape design but also to protect access to highway landscape assets for maintenance purposes. Other items which require consideration when futureproofing the landscape design include the location of utilities, access easements, and cadastral boundaries/ ownership.

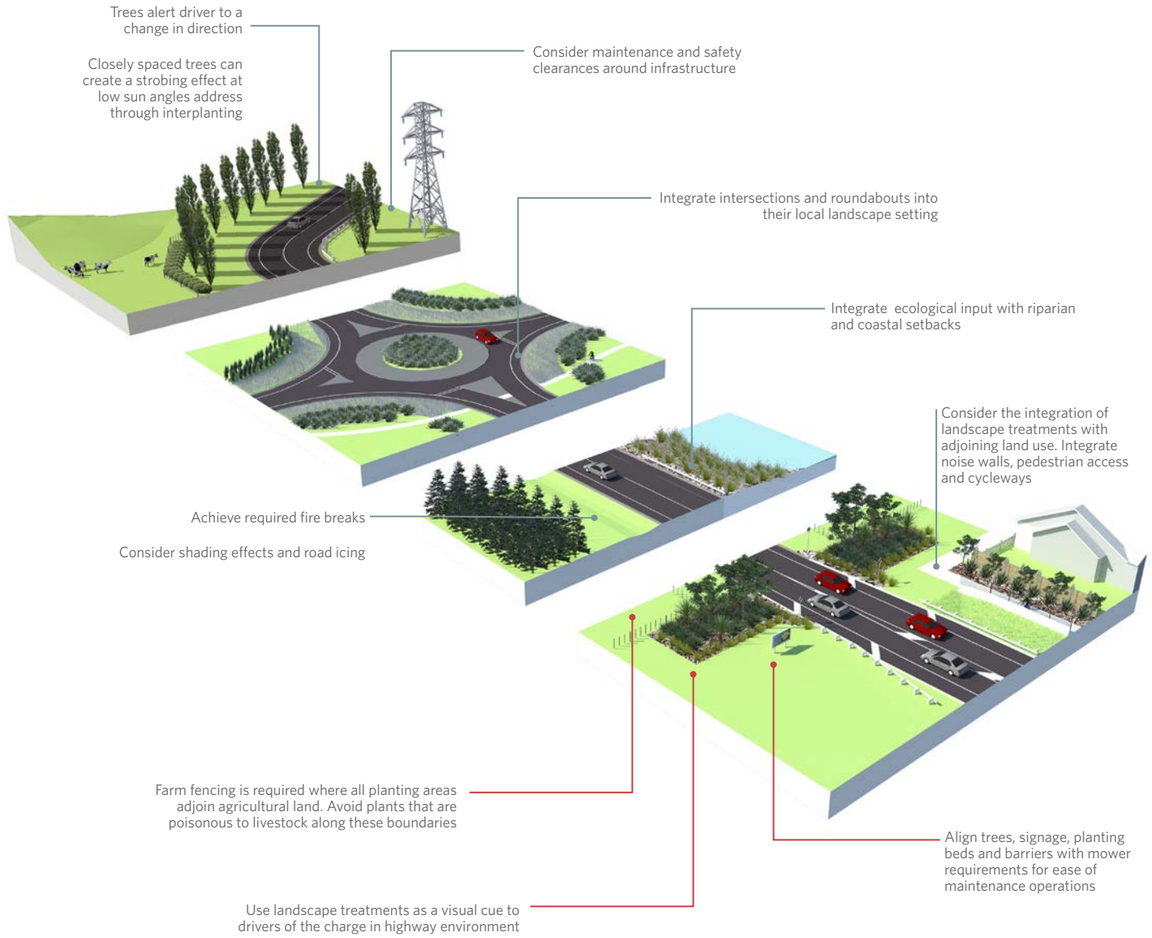
These aspects of a highway project have historically been left out of a landscape remit. However, this type of integrated landuse and land management thinking is increasingly important for the Transport Agency in achieving whole of life value for the Transport Agency's landscape investment.

The Waikato Expressway - Te Rapa Section has been integrated with surrounding landscape and future planned landuses along the boundary

IDENTIFY OPPORTUNITIES FOR ECOLOGICAL AND CONSERVATION MEASURES

As with urban environments, peri-urban environments provide opportunities for ecological enhancement utilising the highway corridor as part of the wider ecological network and connectivity. This can be either as an ecological corridor or in providing stepping stones for native species to access surrounding habitat.

PERI-URBAN ENVIRONMENTS



Typical rural highway view across the grass verge to the fenced rural pasture, and a vista to the wider landscape

Closely spaced trees such as those pictured can cause a strobing effect in low sun angle conditions. Here however the belt of trees provides a visual cue alerting the driver to the approaching change in direction

Within forestry areas a fire break is required. Trees setback from the highway can also provide solar access in frost prone areas where road icing is hazardous

Cleddau Valley, on the way to Milford Sound - high visual amenity/ scenic highway (Source: Tourism NZ)

4.3 RURAL ENVIRONMENTS

For the purposes of these guidelines, areas that are neither urban nor peri-urban are classified as rural. Rural roads are characterised by their surrounding landuses, for example agricultural and forestry abutting the road. The posted speed limit is generally more than 70 km/hr in rural areas.

Rural environments can also feature remnant native forest fragments and habitat such as wetlands, streams etc. Away from intensive urban development highways corridors within rural areas often contain:

- areas of significance to Maori, and European heritage;
- remnant vegetation, including native vegetation;
- habitat and movement corridors for native fauna;
- productive land, high quality soils and prime agricultural land.

Typical considerations for landscape design and maintenance within rural environments are set out below.

RECOGNISING THE BORROWED LANDSCAPE

Rural landscapes have spatial characteristics which are often appropriate to reflect within highway landscape treatments. Open space, large-scale tree and shrub planting should all be laid out in recognition of the natural character and local ecology.

Framed views to significant landscape features (e.g. wetlands, rivers, lakes, mountains, volcanic cones, remnant forest etc) should be identified and integrated within the design. These wider landscape features or key views can provide landmark features which enhance the journey and assist in legibility.

In certain locations the agricultural traditions associated with the landscape may be reflected to celebrate the unique agricultural heritage of an area.

HABITAT AND BIODIVERSITY OPPORTUNITIES

Highway landscapes can be designed as viable ecological corridors and 'stepping stones' between remnant native forest, native forest fragments and other native habitat. By considering the wider landscape and the proximity of any habitat areas to the highway landscape; ecological opportunities can be integrated within the highway landscape design.

Any ecological consent requirements related to habitat types or native species (fauna or flora) need to be integrated with the highway landscape design. Designers should collaborate with the project ecologist to ensure that the consent requirements can be achieved and sustained over time, as part of the highway landscape treatments.

Plant pest and animal pest management is crucial for the control of exotic species, good management leads to the minimisation of areas needing ongoing control, spraying or mowing.

RURAL LAND INTEGRATION

Productive landscapes are an important part of our rural environment and rural economy. The landscape design should consider opportunities for land revocation back into productive use where surplus land is within a highway designation. The advantages to the Transport Agency in addressing surplus land as part of the landscape design includes:

1. optimising the area which the Transport Agency is required to manage and maintain;
2. streamlining investment in highway boundary treatments and stock proof fencing.

Any land revocation should retain access routes to the Transport Agency highway landscape assets.

Revocation of land should not override the need for space required for the landscape design to integrate the highway. Consideration should be given to structures, earthworks, the construction footprint etc into the surrounding landscape and landform. Stock proof fencing should be included along all planting and grass areas bordering agricultural land. Where grazing of stock abuts the highway network, consider safe and accessible gate locations for highway maintenance access.

THE RURAL LANDSCAPE VERNACULAR

Within rural environments the shape of any earthworks should relate and transition to the surrounding landforms and topography. In some instances earthwork cut face batters can reveal the local geology. In these instances it may be desirable to leave these formations exposed (subject to landscape and geotechnical input).

In rural landscapes minimise the need for benching cut face batters as it can be visually jarring and creates areas that are hard to maintain. Cut and fill batters should be feathered into the natural landform and geometric profiles avoided unless it is a deliberate design feature.

Earthworks and slope stabilisation should, where appropriate, rely on vegetation for reinforcement and visual integration.

PLANTING RURAL LANDSCAPES

Planting should relate to the natural character, patterns and plant communities of the area. While there is a preference for utilising native species there may be a desire to continue the character of the adjoining dominant rural land use and exotic trees and vegetation patterns or cultural patterns in the design (e.g. shelterbelts and woodlots). However, planting that is overly patterned and out of context with the rural landscape should be avoided.

Using a palette of species common to the area with a mix of species is preferred. Mass monocultures of species is not desirable due to low resilience and low diversity. Species of a similar form, growth habit and shape can be grouped together as an alternative to achieve consistent look but with diversity. Designs that utilise diverse mixes of species can act as a fail-safe measure against single species intolerance and mass die back.

Set vegetation back to achieve required clear zones; fire break (within high risk areas) and solar access where ice is a concern. Within forestry areas consider the NZ Fire Service Guide to flammability for some common New Zealand native tree and shrub species[21].

PUBLIC ACCESSIBILITY NORTH AND SOUTH

Rural highways should integrate any walkway and cycleway routes adjacent to the highway where applicable. These may include national routes such as the Te Araroa Walkway. Incorporate over bridges or underpasses or other alternative routes for crossing highways as part of any pedestrian or cycle route.

Landscape design can help retain landscape features and integrate these within the highway design (e.g. local rock formations and plant communities unique to an areas)

Biosecurity issues, for example Kauri dieback need to be considered when landscape works take place near Kauri forests

For vegetation management projects within native forest areas, consider placing any felled material back into the forest to decompose and provide habitat features

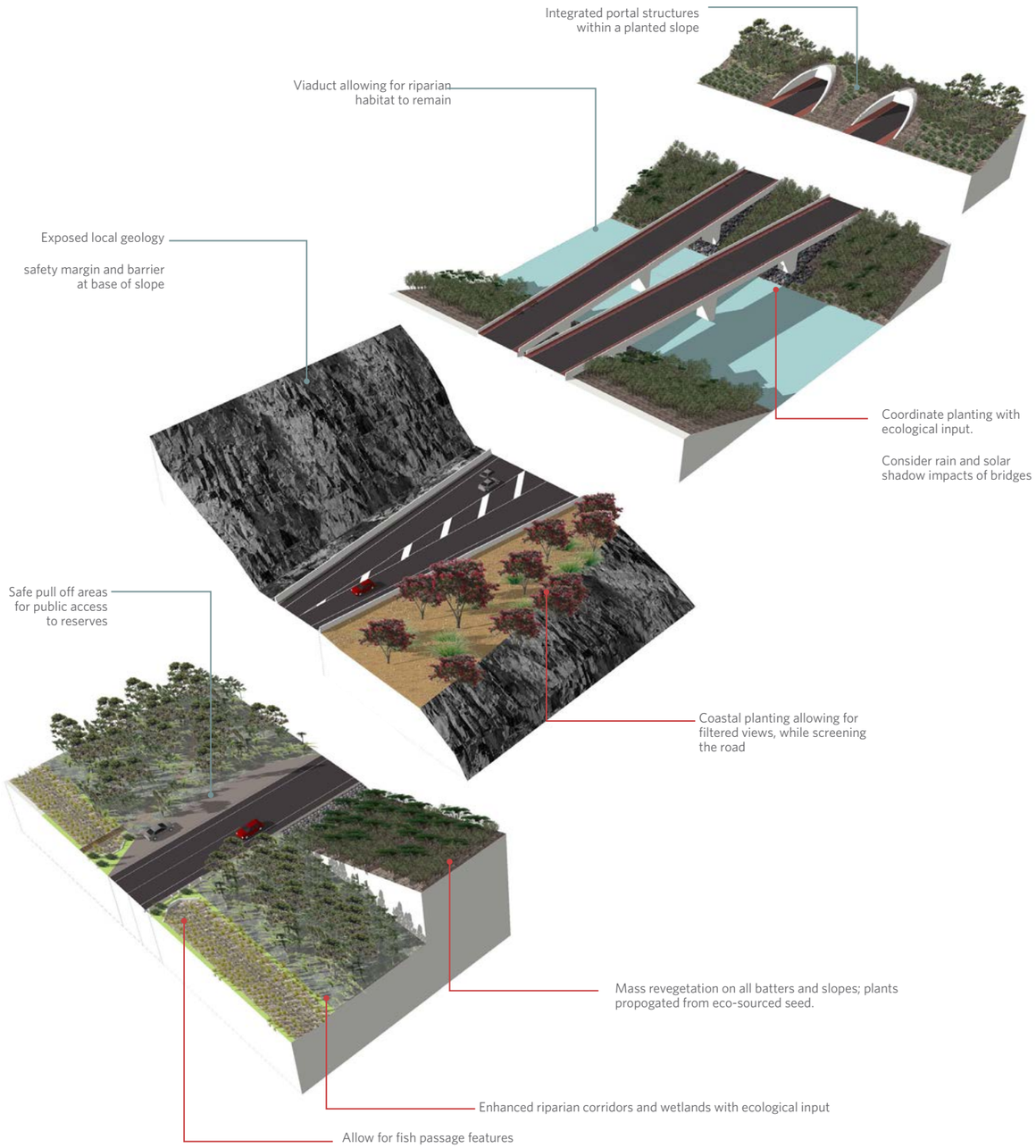
21. http://www.fire.org.nz/Research/Published-Reports/Documents/89fa12a030b48531cf396dcdba52c6e2.pdf

4.4 COASTAL ENVIRONMENTS

Coastal environments include the coastline along the foreshore and harbours, streams, rivers and lake margins, provided for in section 6 of the RMA, and the NZ Coastal Policy Statement 2010 (NZCPS). Coastal environments are particularly challenging as they are often sensitive to the effects of highway development.

Typical considerations for landscape design and maintenance within coastal environments are set out below.

COASTAL/NATURAL ENVIRONMENTS



COMPLY WITH COASTAL POLICY OBJECTIVES

When considering the landscape treatment of highways through or along coastal areas, the following matters should be considered:

- the recommendations and design objectives outlined in the landscape and visual assessment;
- the protection of natural and physical resources of importance, such as high quality coastal water, fresh water and associated high natural character landscape and amenity values;
- the effects of natural hazards such as flooding, coastal erosion and tsunami, as well as factors associated with climate change and sea level rise;
- opportunities to maintain and enhance public access to and along the coast;
- the coast has particular importance to iwi and hapu as tangata whenua, with a particular interest in maintaining their kaitiaki role.

GREEN ENGINEERING AND SOFT LANDSCAPE SOLUTIONS

Green Engineering[22] Principles should be part of the design process. The Principles of Green Engineering are:

1. Engineering processes and the selection of materials are undertaken holistically. This integrated thinking ensures engineering and environmental outcomes are integrated.
2. Conserve and improve natural ecosystems while protecting human health and well-being.
3. Use life-cycle thinking in all engineering activities.
4. Ensure that all material and energy inputs and outputs are as inherently safe and benign as possible.
5. Minimize depletion of natural resources.
6. Strive to prevent waste.
7. Develop and apply engineering solutions, while being cognisant of local geography, aspirations, and cultures.
8. Create engineering solutions beyond current or dominant technologies; improve, innovate, and invent (technologies) to achieve sustainability.
9. Actively engage communities and stakeholders in development of engineering solutions.

Using green engineering and soft landscape earthworks and slope stabilisation should, wherever possible, be integrated with vegetation for reinforcement and visual integration. Solutions need to be robust and resilient to coastal conditions. Every attempt should be made to merge the highway and associated earthworks stabilisation with the surrounding environment in sensitive coastal locations.

Landscape input together with any engineering solution and/or structures proposed will be part of an integrated solution.

LANDSCAPE REFLECTIVE OF A DYNAMIC ENVIRONMENT

The natural character and scenic qualities of the coast should prevail. Where landscaping is required it will be for either functional requirements (restoration planting, erosion control, slope stabilisation, directing views, and screening) or visual amenity requirements. Generally only naturalistic layouts and native plants (tolerant of coastal conditions) should be included. These should be detailed to match existing vegetation patterns. Urban coastal environments may be different, for example urban waterfronts may have additional urban design objectives which influence the landscape design.

PROTECTION OF THE EXISTING ENVIRONMENT

Requirements of resident native fauna should be taken into consideration (e.g. NZ dotterel need a clear view around them to breed). Such ecological input and habitat considerations should be investigated and recommended by an ecologist, then integrated as part of the landscape design.

Existing vegetation and coastal plant communities should be protected. Native plants should be sourced from the same ecological district, and if not then the ecological region, to preserve local genetic variation and be best suited to the site conditions.

A transition from the road edge to the coastal mangrove forest. Note sympathetic use of materials and habitat features

South Island - high visual amenity scenic highway (source: Tourism NZ)

Iconic Pohutukawa tree in flower. New Zealand's coastal landscape are generally sensitive to highway development

Vegetation buffer between beach and highway

22. reference: http://www.epa.gov/oppt/greenengineering/pubs/basic_info.html#whats_ge

In natural environments highway landscape should be tailored to the local situation. Minimising their footprint and impacts by simply managing the regenerating native bush. Here the bush edge is periodically controlled along the roadside batters.

Eco-viaduct (Northern Gateway) aimed to minimise the footprint of the highway and maintain an ecological link for fern bird.

A high level of native plant restoration is required within natural environments. Eco-sourced seedlings are utilised to maintain the local genetics.

Riparian planting can also be linked with habitat features to extend stream habitat. Note fish baffles within the culvert structure.

4.5 SIGNIFICANT NATURAL ENVIRONMENTS (INCLUDING HIGHWAYS THROUGH NATIONAL PARKS)

Significant Natural Environments include scenic routes, and highways through, adjoining or linking to land in Department of Conservation custodianship such as National Parks, Reserves and Conservation Areas, Recommended Areas of Protection and/or Council-designated sensitive natural areas. Such areas are particularly sensitive to the effects of highway developments and require special consideration.

Typical considerations for landscape design and maintenance within natural environments are set out below.

PROTECTION OF INTRINSIC VALUES

The main landscape considerations for natural environments are:

- roadside earthworks should relate to the surrounding landform;
- earthworks and slope retention should, wherever possible, rely on vegetation for reinforcement and visual integration. Attempts should be made to merge the highway with the surroundings and limit the footprint of the highway. Solutions are dependent on the situation, and may involve substantial or minimal intervention;
- the natural scenic qualities of the surroundings should prevail guiding design decisions adjacent to the highway. Where landscaping meets functional requirements such as restoration planting, erosion control, directing views, and screening or visual amenity requirements; naturalistic layouts and associations of native plants should be established and these should be blended in as much as possible with existing vegetation;
- seed for native plants should be sourced from at least the same ecological district, and if not then the region, to preserve local genetic variation and be best suited to the site conditions;
- local aggregates should be utilised in hard landscape treatments, where possible.

RECOGNISE LANDSCAPE CONSTRUCTION & LANDSCAPE MANAGEMENT PROTOCOLS

The state highway system links and passes through many of New Zealand's National Parks. The Transport Agency and the Department of Conservation (DOC) have developed protocols and procedures for works on state highways that pass through or adjoin National Parks and conservation areas.

Landscape within New Zealand's National Parks, reserves, or conservation areas (collectively, public conservation lands) or land managed by DOC shall meet the following criteria:

- work must be carried out in consultation and agreement with the administering bodies of National Parks and reserves;
- a landscape and visual assessment will be required as part of a statement of environmental effects. The significance of landscape values that apply to surrounding landscape on a local, regional or national scale should be established early. Special attention must be given to the effect of the highway on the landscape and also to the highway's visual integration and appearance;
- landscape design should complement the local landscape and other National Park values and should not adversely affect flora, fauna, or the ecology of the area;
- a very high standard of vegetative restoration will be required and the retention of vegetation will be a priority. Particular attention must be paid to reducing the footprint and extent of earthworks to preserve as much existing native vegetation as possible. Native revegetation should also act as a buffer to any remnant vegetation, against wind, and weed impacts (edge effects) from the adjacent road;
- the significance of ecological values that apply on a local, regional or national scale should be established early. Any restoration planting that may be necessary must be done using native species found in the area, preferably raised from seed taken from the immediate reserve or National Park involved. The composition and complexity of the surrounding vegetation and ecosystem components; the integrity and sensitivity of existing vegetation and other National Park values should be maintained and not adversely affected. Pre-disturbance assessment work of potential vegetation to salvage and re-use in restoration planting is recommended;
- management plans for National Parks contain provisions for planting, access, restoration, and control operations. These should be consulted during the development of both the highway and the landscape design projects and during the development of management plans;
- landscape implementation and maintenance must be undertaken with written approval from DOC to undertake any vegetation control. Any vegetation control must be in accordance with DOC's requirements;
- if chemical control is agreed to by DOC: mixing and storage of chemicals is not permitted and spray tanks shall not be emptied or sluiced out, or any other equipment cleaned anywhere within the boundaries of the National Park, reserve, or conservation area;
- all spillages and/or damage caused by the operation shall be reported to DOC immediately, and, if required by DOC, all damage shall be rectified by the Contractor;
- pest and weed management is crucial for the control of exotic species, good management leads to the minimisation of areas needing ongoing control, spraying or mowing.

CELEBRATE CULTURAL VALUES

Often areas highly valued as natural environments also have a strong link with iwi and hapu as Kaitiaki (the term used for the Maori concept of guardianship). Environmental stewardship should be considered within the landscape design. Opportunities for Tangata whenua involvement in the design, implementation and management process for landscaping with natural environments should be explored at the outset of the project.

A good example of buffering remnant native forest edges minimises edge effects and the intrusion of weed species to the interior of the forest remnant.

Highway projects can require enhancing habitat for New Zealand Fauna, for example native bat habitat considerations are part of the Waikato Expressway.

Minimum road footprint within the conservation area at Lewis Pass.

PART 2: LANDSCAPE DESIGN CONSIDERATIONS

In this section of the guidelines, the range of issues to be considered when developing the design of the highway landscapes is discussed. This discussion is followed in Part 3: Landscape Treatments; with more detailed considerations as the design moves toward the construction phase. Then in Part 4: Highway Landscape Management and Maintenance Considerations; longterm maintenance and management, as part of the design process, are discussed.

Safety considerations require to be integrated throughout the design of highway landscaping, safety issues are considered first. This is followed by sections of the extent of highway treatments, the interface of landscape treatments and highway structures and intersections; heritage considerations and further considerations.

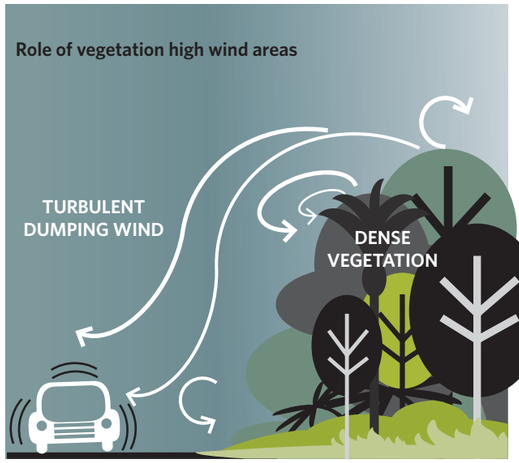
4.6 ROAD SAFETY REQUIREMENTS FOR LANDSCAPE

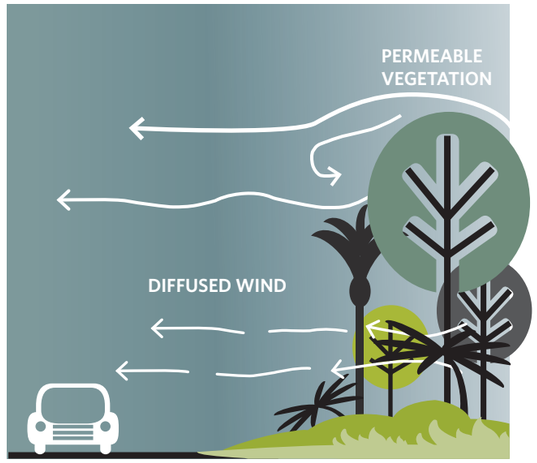
The 'Safe System' approach in relation to highway landscaping includes the integration of safety through all aspects of the projects planning, design, implementation and management.

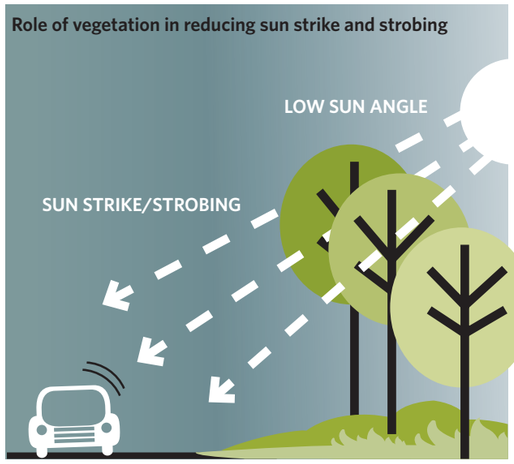
Safety requirements for sight lines, clear zones/recovery zones, and vegetation restrictions (such as fire breaks) are an essential component of any landscape design, and landscape treatment.

The layout of planting can also achieve a modicum of safety measure in response to climate factors, including:

Wind: Provide for wind breaks in windy areas. Wind breaks should be porous to defuse wind and reduce wind speeds and gusts of wind (which may be channelled by local topography) rather than dense which results in wind rolling over the belt of trees like a wave and dumping onto the road.







Ice: Restrict tall vegetation on the northern side of the road through areas prone to frost this allows for passive solar access and ice thaw.

Sun strike/ strobing: Avoid closely spaced trees with no understorey which can create a strobe effect on drivers' vision through rapid changes from contrasting sunlight and shadow. This can be a distracting and potentially dangerous effect for motorists.

Clear zones: Clear zones have a function in establishing and maintaining clear margins alongside highways. They are an effective way of reducing the severity of accidents. The main function of clear zones is to provide a safe run-off or clear recovery zone free from hazards for vehicle turn off. The Transport Agency's safe systems approach to the design and management of state highways has generally superseded the requirements for clear zones as barriers are provided along the shoulder and central median separating opposing traffic lanes in high speed environments. Setbacks from barriers should be established in consultation with the engineer. Barrier deflection distances may vary depending on the barrier type proposed. It is important to establish the deflection distances early so that the landscape architect can incorporate these setbacks into the design. Clear zones and buffers are important for the maintenance of sight lines where they provide intervisibility between pedestrians, cyclists and vehicles.

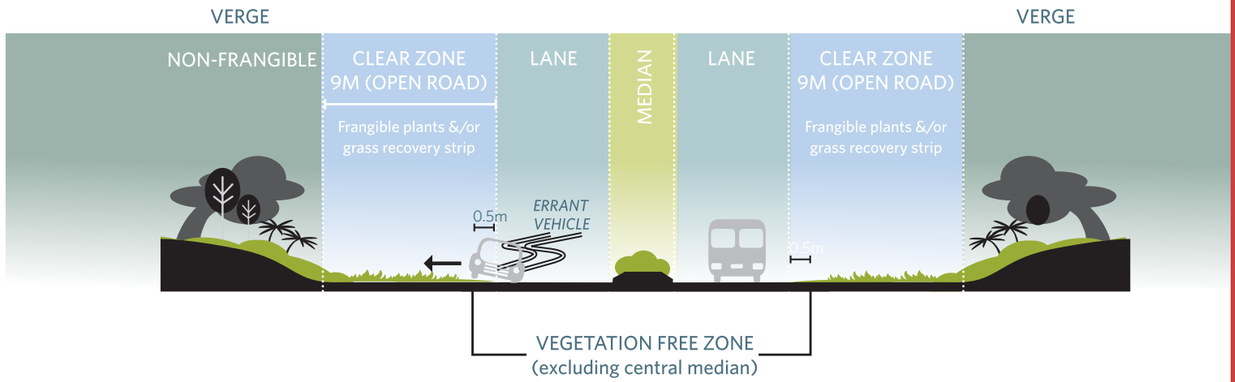
Clear zone requirements: Clear zones must be kept free of solid obstacles and **non-frangible vegetation** (including trees, NZ flax is also considered non-frangible). Where **frangible** vegetation is planted close together to form obvious clumps then it is considered **non-frangible** as it creates an overturning hazard for errant vehicles.

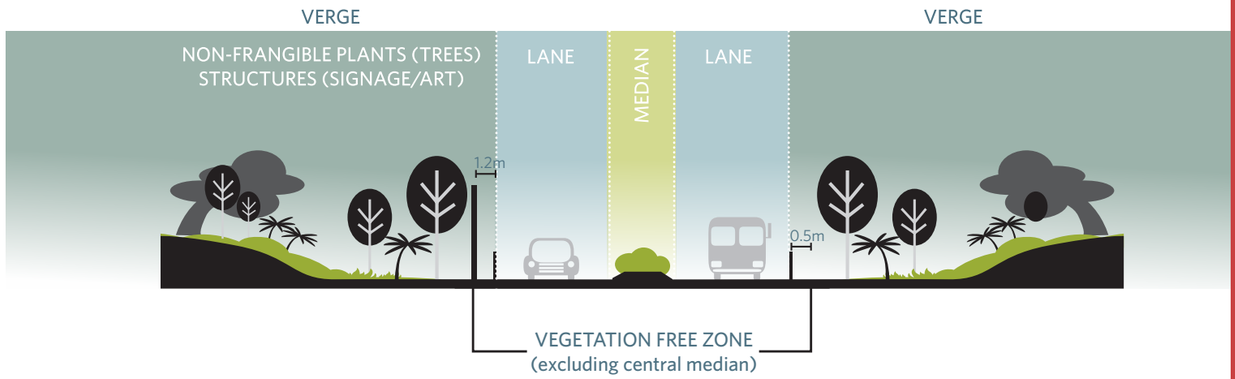
Within the clear zone only **frangible vegetation** should be planted. Any plant with a stem equal to or greater than 100mm in diameter at maturity, measured at 400mm above the ground, is considered to be non-frangible.

Non-frangible vegetation and structures such as large trees, flax, and artworks may be located closer to the highway where it is shielded by a road safety barrier.

Sight lines: Clear zones are required where sight lines must be maintained for continuous visibility along the highway for the motorist:

- at intersections, including access roads and driveways
- next to signs, barriers and roadside markers
- at pedestrian crossings and for passive surveillance
- at rail crossings
- at passing areas
- at the termination of medians
- on corners (subject to engineering design and safety audit)





SIGHT DISTANCE VISION REQUIREMENTS

Designers should check with the project Traffic Engineers to ensure all clear zone, sight lines and headlight glare screening is integrated within the landscape design

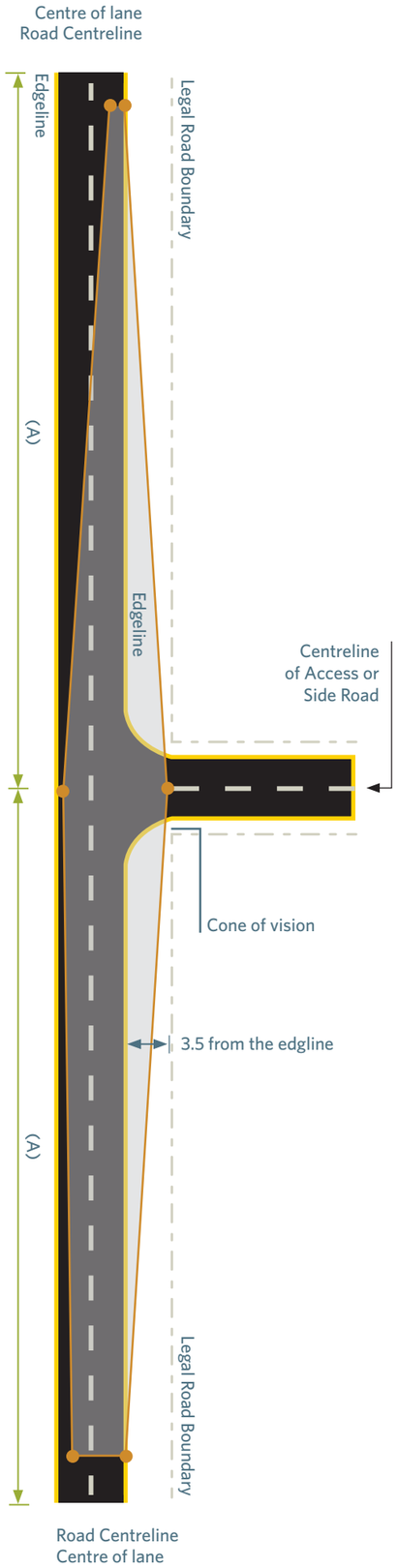
Vegetation Control at Intersections

NOTE 1 Sight distances shall be measured to and from a height of 1.05 metres above the road surface and 1.05 metres above the surface level of the side road or access.

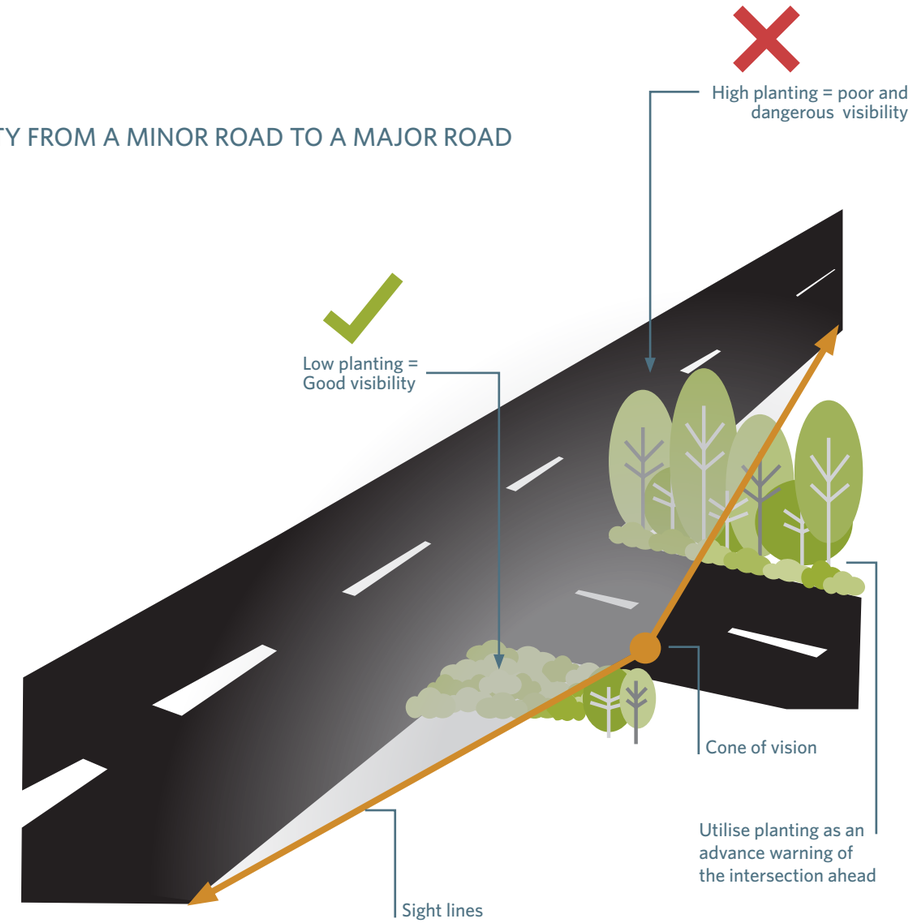
NOTE 2 Vegetation control to maintain a minimum sight distance at intersections and other designated areas must be according to the following table:

HIGHWAY ENVIRONMENT	MINIMUM SIGHT DISTANCE (A)	TYPE OF VEGETATION CONTROL
rural	250m or as specified	3
urban (50 km/hr)	100m or as specified	1
urban (60 km/hr)	120m or as specified	1
urban (70 km/hr)	150m or as specified	1

Source: NZTA Somac - 2010, NZTA 1234: Vegetation Control Example



VISIBILITY FROM A MINOR ROAD TO A MAJOR ROAD



CLEAR ZONES

Detailed requirements for clear zones are provided in the State Highway Geometric Design Manual. However, as a rule of thumb, on a straight section of state highway with a design speed over 70km/hr a clear zone of at least 9 metres from the edge of the traffic lane is sought. In areas such as the outside of horizontal curves, at congestion points, or where evasive manoeuvres may occur, a clear zone of greater than 9m may be required.

In forestry areas or where there is fire-prone vegetation, a vegetation free zone of 20 metres minimum, including the highway, can be used as a firebreak.

The clear zone may be reduced in special circumstances such as National Parks, scenic reserves and other high value ecology and amenity areas. Justification is required by the Landscape Architect in association with a traffic safety audit.

Generally trees should not overhang the roadside barrier or carriageway. However in special circumstances such as National Parks, scenic reserves and other high value ecology or amenity areas it may be allowed. Justification would be required by the Landscape Architect in association with a traffic safety audit.

Planting along the verge can focus drivers view to the road ahead (source: Tourism NZ)

Consider pedestrian and cycle sight lines

Consider seasonal colour within planting, signalling a change in speed zone

Example of cut and fill batters, and structures that integrate well with the topography, Upper Harbour Highway

SIGHT DISTANCES

Forward vision and visual containment: Landscape treatment can reduce distraction for road users from nearby land activities including light glare, focussing the road user on the highway ahead, or screening opposing traffic and filtering views to the wider context.

Plants should be of sufficient size and density in order to achieve this satisfactorily. Use the area of effective cone of vision (on page 76) to decide where the framing and screening of views will be most effective.

Planting can be used to emphasise road curvature and change in vertical alignment, giving road users early warning of changes in direction. This is particularly useful where changes are unexpected or difficult to ascertain such as when they coincide with crests in the road. Within the landscape design planting can be utilised as an environmental cue to alert road users of direction changes.

Particular attention should be given to planting and earthworks on the inside of curves, within interchange loops, inside medians, ends of ramps and on cut slopes; to ensure forward visibility for drivers is maintained.

Visibility from a minor road to a major road: It is critical that sight distances are maintained for motorists accessing the highway from a side road.

Pedestrian sight lines: It is recommended that landscape drawings be used to demonstrate that Approach Stopping Distance (ASD) and pedestrian clear sight lines are met, particularly at off ramps when vegetation is fully grown.

HEADLIGHT GLARE

Screening of headlight glare, sun strike and strobing reduction: Landscape design can reduce the effects of sun strike, also sun glare from around curves or from low sun angles. Strobing and sun strike can be minimised through appropriate planting and plant layout.

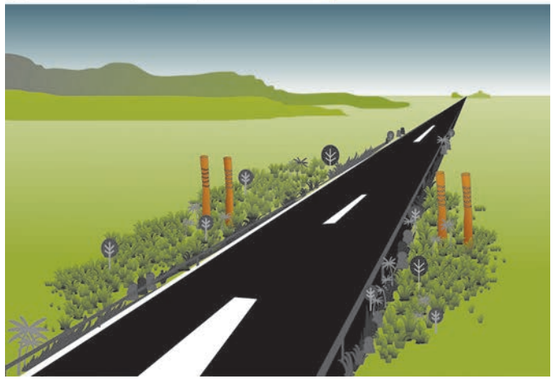
The location of planting can also be useful for screening headlight glare from local residents who live close to highways and from road ends visible from the highway. Median planting can be used as a means of reducing headlight glare from oncoming traffic; especially around bends. The following aspects should act as a guide:

- the height of screening of headlight beams above the road ranges from 500mm for cars up to 1300mm for trucks and buses;
- the most effective method for reducing glare, utilising planting, is through a mixture of groundcovers and shrubs, with a dense compact form, that will reach the desired height. Avoid closely spaced trees that create the strobing effect for road users. Planting should not be located where it impairs inter-visibility or sight lines between drivers, cyclists or pedestrians.

Road Lighting: Where road lighting is part of a highway project effective lighting is important and planting needs to be co-ordinated to ensure the effectiveness of lighting is not compromised.

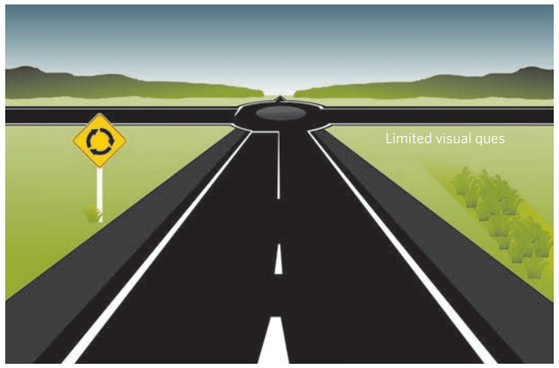
Image: National Park

LANDSCAPE AND SPEED AWARENESS

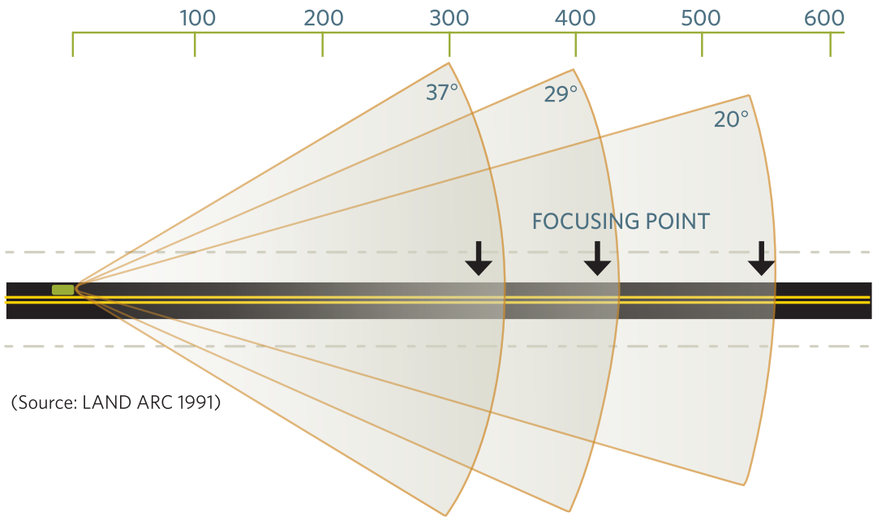


Good contrast and points of reference influence driver speed awareness

LANDSCAPE AND ADVANCED WARNINGS



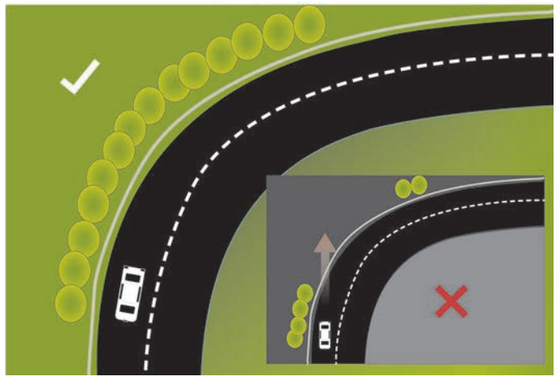
Utilise planting and landscape treatments to attract drivers attention to the approaching intersection ahead providing visual cues and advanced warning



(Source: LAND ARC 1991)

Relationship between focusing distances, angle of vision & distance of foreground detail at the speeds of 64, 80 and 100kph.
To be used to assist in design to screen/frame views.

LANDSCAPE AND OPTICAL FRAMING OF CURVES



Eye catching planting provides a visual cue for the corner ahead to the change in direction

SPEED AWARENESS

Speed awareness, visual stimulation, and views to wider landscapes: New Zealand's state highway network is the primary means through which most people, both national and international visitors, experience New Zealand's rich and diverse scenery.

Views to wider landscapes: The visual quality and integration of highway landscapes is achieved through the balance between vegetation, earthworks and well placed and designed infrastructure. Thought should be given to creating continuity to the landscape of the network, with change responding to the landscape of each area.

Roadsides should provide a simple, non-distracting foreground to highlight views of the road ahead and distant views. At highway speeds on open roads distant views are more important than near views. Panoramic views take longer to assimilate, generally, a minimum 15 seconds should be allowed.

Speed awareness: The speed of travel is an important factor, as little as one second may be enough for a fleeting view, but a minimum 5 seconds is required to appreciate a view or landscape feature. The landscape should be revealed in a series of views to provide contrast and a sense of anticipation.

Generalised example of speed, time and distance travelled.

SPEED	DISTANCE 5 SEC	DISTANCE 15 SEC
50 km/hr	69m	207m
80 km/hr	112m	336m
100 km/hr	138m	416m

Continuous lineal open space or continuous parallel roadside planting can be monotonous over long journeys.

VISUAL INTEREST

Visual stimulation: Further to the existing landscape the addition of landscape design elements which express the local environment are important. By creating regular areas of interest throughout the network landscape design can alleviate driver boredom and help maintain driver concentration.

Options for creating visual interest through vegetation include:

- clearing existing vegetation and creating view corridors with a mixture of fleeting and panoramic views;
- enhancing views and vistas by framing and orienting views with vegetation;
- varying planting composition e.g. clustering plants that have seasonal contrast e.g. Pohutukawa and harakeke/flax flowering (red in summer);
- Landscape design features can also become milestones to assist drivers in determining their progress on a journey. There should be a point of interest or view at regular intervals to assist in avoiding driver weariness.

Boundary to boundary landscape management should include all land administered by the NZTA

Example of a shoulder transition to a rock line drain which separates planting and mulched areas from the highway and provides an easy to maintain edge

Example of a sealed shoulder transition to a grass verge

Grass areas set within continuous edge barrier (centre of image) are hard to access and costly to maintain requiring traffic control. This situation is undesirable from a maintenance perspective and should be avoided

4.7 EXTENT OF LANDSCAPE TREATMENT

Generally the extent of landscape treatment on highway projects are defined by the highway corridor boundaries, either the extent of the designation or boundary to boundary. The extent of the designation is commensurate with the projects scale, the land that the Transport Agency controls can vary within the different highway environments. The extent of highway landscaping is specific to any given project, but generally includes the following:

Boundary to boundary land which includes all non-pavement areas outside the carriageway (this is generally the vegetation free zone) and includes berms, medians and traffic islands, stormwater management areas, etc.

Redundant sections of highway which are retired as a result of construction of a new road. These retired road sections and cuttings in particular should be reintegrated back into the landscape.

Special landscape areas such as areas outside the immediate construction area requiring landscape treatment; perhaps as part of a resource consent, an off-set mitigation requirement or land owner agreement with the Transport Agency.

Berms are all side slopes including flat or gently sloping berms, batters and embankments; as well as artificial mounding created as a result of earthworks; located between the road shoulder and the edge of the designation or project boundary. Generally the majority of highway landscape treatment occurs within the highway berm behind the barrier. Where there are cycle and pedestrian paths berms can form a barrier between these and the active traffic lanes.

Medians help emphasise the visual and physical separation of opposing traffic lanes and may be depressed, flush or raised. Provided conditions are rigorously stipulated and low maintenance hardy planting implemented, or a hard landscape treatment is specified, medians will be successful. There are very few examples of narrow medians (less than 2m width) which are well-vegetated and attractive. Issues include:

- the radiant heat from adjoining road surfaces affects the planting;
- construction practices have resulted in a heavily compacted median and construction material has been disposed of within the landscape median;
- limited space and a narrow width, results in an inadequate soil profile, and poor drainage;
- along edges and around barrier posts are sprayed leading to low success rates of any planting;
- there is inadequate maintenance access to these highly visible areas that require high maintenance;
- grassed medians can result in costly traffic control and maintenance operations;
- planting collecting rubbish in the middle of the carriageway is a visual amenity and maintenance issue.

Wider medians are preferable. Medians greater than 2m wide provide enough space for soil, planting and maintenance access. The following matters should be considered:

- planting in medians where the ground has been well prepared can provide high levels of visual amenity and low maintenance;
- vegetation within the median can reduce the effect of oncoming headlight glare;
- plants specified should be resistant to sprays used in road edges maintenance (e.g. avoid native grasses);
- many medians have road safety barriers installed adjacent to the carriageway and any vegetation should not interfere with the performance of the barrier;
- only frangible plants such as small shrubs and ground cover should be used within a median where there is not safety barriers on both sides;
- depressed medians which serve a stormwater function can be planted with wetland species. Plant species selections need consideration in relation to maintenance and spray resistant plant species should be selected;
- plantings can reduce on-going maintenance costs and planting is generally preferred over a grassed median which will require mowing.

Traffic Islands are common elements within the highway corridor, especially in urban areas. Traffic islands include:

- roundabouts
- traffic islands at intersections
- speed thresholds at entries to towns and urban areas
- Pedestrian and cycle refuges

Where practicable, medians and roundabouts associated with intersections should be planted or paved in preference to grass. This reduces the need for expensive, frequent and potentially dangerous maintenance. Clear zones and berms associated with these elements need to be traversable and material used across clear zones and berms should not track, wash or be able to be blown encroaching on the highway.

Planting within traffic islands should not block sight lines and there should be frangible planting at the approach and departure:

- helping drivers 'read the road' by marking an intersection and distinguishing between different sections of road;
- providing visual cues to assist drivers reduce speed at the entry to towns and other urban areas;
- increasing the visual quality of the highway and helping to integrate the highway with local roads and surrounding uses and environments;
- reducing on-going costs and potentially dangerous or disruptive maintenance associated with regular mowing of grassed areas at highway interchanges and intersections.

Sight lines and visibility are vital at intersections and must be maintained by the use of either low planting or taller shrubs and trees with clear lower limbs (refer State Highway Geometric Design Guidelines).

Where practicable, medians and roundabouts associated with intersections should be planted or paved in preference to grass. This reduces the need for expensive, and potentially dangerous, frequent maintenance of these areas.

Roundabout, Brighams Creek

Frangible plants across a verge which doubles as a swale

Planting can conflict with utility providers, if not planned carefully

Low impact design stream daylighting

Integrated stormwater management with vegetated swales, note the discontinuous kerbing

Typical grass swale, if the area is to be mown consider tractor mowing operations and movements in the placement of structures, signage, trees and services

Typical stormwater treatment pond well integrated with highway landscape planting, Onewa Interchange

Stormwater management areas Water is a limited resource that is essential to all life. Within highway projects there are both practical and safety reasons for getting rid of stormwater as quickly as possible. Stormwater runoff (quantity and quality) from roads is of concern to the Transport Agency for three main reasons:

- poor stormwater management from the road surface can adversely affect road pavement integrity;
- impervious road surfaces increase the rate of runoff which requires the Transport Agency to address stormwater within the designation to protect downstream catchments, property and stormwater systems;
- stormwater from roads containing contaminants and spills from vehicles can adversely affect aquatic ecosystems and cause erosion of riparian areas.

In recent years integrated stormwater management has been elevated to a vital outcome for all highway projects. Stormwater management can be integrated within the highway landscape design. Considerations include finding ways to harvest water on site, using it for passive irrigation, creating water features and providing habitat. There is a vision for highway landscapes to act as natural systems in hydrological terms, this means to store, clean, filter, and then distribute available fresh water back to the receiving environment. There are operations and maintenance requirements for easy to manage stormwater assets. Deciduous trees should be avoided close to cesspits where leaves can cause blockages.

Swales Grassed or vegetated swales are an alternative to conventional engineered solutions for stormwater management within the highway corridor. They can be integrated into the overall landscaping and serve a variety of functions in achieving biodiversity, visual quality and stormwater runoff objectives:

- swales can slow the rate of stormwater runoff, encourage infiltration and improve the quality of runoff entering waterways;
- vegetated swales can improve biodiversity by enhancing aquatic and wetland habitats and attract invertebrate and avian fauna, especially if combined with detention ponds and wetland planting;
- swales can improve visual quality of the highway landscape by introducing forms that integrate with natural environmental settings.

When using swales in highway landscaping the following matters should be considered:

- seek input from the traffic engineer input in relation to errant vehicles and suitable slope gradients; this will assist developing both the swale profile and the plant palette. Swales can be designed to have sandy substrates with high bearing loads that are resistant to deformation/rutting;
- whether to use a grassed or vegetated swale. Vegetated swales are preferable, but may not always be appropriate due to clear zone factors such as in narrow designations where space is constricted between the swale and the road shoulder;
- the natural alignment of watercourses should be retained wherever possible;
- varying the width and grade of swales to create organic forms that integrate with natural environmental settings;
- integrating swales with detention basins and stormwater ponds as part of a more comprehensive stormwater management system;
- integrating swales both visually and physically with landscape developments on neighbouring reserve land or open space.

Refer to The Stormwater Treatment Standard for State Highway Infrastructure (May 2010) and background reports. www.nzta.govt.nz.

Protect and restore existing water systems Avoid disturbance near streams and wetlands, and in floodplains. Plant native vegetation to buffer and shade (for water temperature benefits for fish and water creatures) the natural systems. Utilise soft engineering techniques to restore the functions of waterways.

Manage and clean water within highway landscape areas In association with stormwater engineering the landscape design of ponds, wetlands and swales within highway landscape areas has environmental benefits. The landscape treatments, including plants, soil media and mulches are part of the treatment where they capture, slow, and treat stormwater. Road runoff can be specifically designed to flow to water treatment areas which can be made a feature.

An important factor is safe access to the area for maintenance and it needs to be integrated early in the landscape design process.

Stormwater features can improve visual quality Integrated and multifunctional stormwater management areas can improve both water quality and aesthetics whilst creating an attractive natural drainage system. Stormwater management integrated with the overall landscape design can provide interest, space to represent the local ecology, and opportunities for education about green infrastructure development.

Ecological benefits Many naturally wet environments are under threat. Native vegetation adapted to these conditions can be supported within highway stormwater management areas and provide habitat and refuge for native species. Biodiversity is optimised in a wetland through physical heterogeneity. This is a function of diverse environmental gradients from aquatic to terrestrial, and from edge to interior habitats. Drought and inundation tolerant species are often important stormwater assets, where water levels vary and areas can be dry or standing in water. Saline tolerant species are important at coastal locations.

Adjacent to stormwater treatment pond with a well integrated access, co-ordinated with the landscape treatments, Onewa Road

Planting under bridges is problematic as it can require irrigation to combat rain shadow effects. A ready supply of water is required, especially during dry periods

Planting can integrate bridge abutments. However urban and landscape design outcomes need to be considered to achieve an integrated solution

Bridges create a rain and sun shadow which is not conducive for planting

Tunnel portals integrated with native revegetation

Tunnel portals integrated with native revegetation

4.8 HIGHWAY STRUCTURES AND INTERSECTIONS

The interface between landscape treatments and highway structures, and intersections requires special consideration.

BRIDGES

Planting can be used to complement, screen or soften, or visually anchor a bridge or viaduct (including individual aspects of the structure such as barriers, piers and abutments) and can help integrate the structure with the wider landscape design and with the highway landscape design overall. The landscape design treatment should be considered in conjunction with the bridge design in an integrated manner.

Generally planting along bridge structures should consist of dense durable shrubs. Trees should be setback from all structures to avoid damage. Plant grades should be commensurate with the outcomes sought (e.g. screening may require a combination of 1 litre mass planting with larger grades 5 litre and larger inter-planted along the wall or barrier). Safe access and sight lines for bridge inspection should be considered as part of the landscape design.

Specific landscape treatment considerations in relation to bridges and their integration with the landscape design include:

- the immediate interface between landscape treatments and the bridge footings, bridge piers and bridge abutments; this is required to ensure landscape requirements can be achieved (e.g. allowance for adequate soil depth and no soil compaction to allow for planting);
- generally hard landscape treatments are required under the base of bridges due to sun and rain shadow effects created by the superstructure above. Planting cannot survive in these locations so a permanent hardscape solution is required (e.g. feature rock rip rap). All hardscape material shall be considered as part of the overall landscape design and treatments for the corridor and not as an isolated area;
- for very tall bridges (such as viaducts) the sun and rain shadow effects can be limited to the upper sides of the slope nearest the superstructure. Options for irrigation in these areas are costly and hard to maintain, if a permanent supply of water is not available. Landscape may still establish well where the viaduct is at its highest point above the ground. Areas of sun and rain shadow should be identified early in the landscape design process;
- due to the publicly accessible nature of bridge piers and abutments barriers are required. Often this causes continuous 'land lock' landscape areas making them impossible to maintain without costly traffic control. These areas should be identified early on in the landscape design so safe access can be incorporated, or alternate landscape treatment proposed (e.g. hard landscape treatments);
- planting areas adjacent to bridges needs to allow for bridge inspections as well as landscape maintenance access. Any railings or barriers required in association with access for these operations should be integrated within the landscape design and planting.

TUNNELS AND UNDERPASSES

All landscape treatments associated with tunnel portals and underpass entry and exits shall be integrated as part of the engineering design, landscape design and urban design. Specific landscape treatment considerations include:

- CPTED considerations and landscape treatment that will assist with reducing the sense of confinement;
- landscape treatments that integrate the portal of the tunnel or underpass with the immediate portal area as well as the wider context and surrounding landscape;
- plant species, soil and mulch suited to the area adjacent these structures;
- setbacks for vegetation, mulch and any plant material (e.g. leaf litter);
- allowance for maintenance access and operations.

Refer to Bridging the Gap, NZTA Urban Design Guidelines, Part 2. In relation to underpasses.

WALLS/ NOISE BARRIERS

Landscape treatments such as greenwalls or walls designed to support climbing plants or mounding and planting can be used to complement, screen or soften a wall or noise barrier and can help integrate the structure with the wider landscape design.

Generally planting up or down the structures or along either side or both sides of structures should consist of dense durable species given the radiant heat and microclimate effects structures can create. Plant grades should be commensurate with the outcomes sought (e.g. screen planting with 1 litre grade mass planting, and larger grades 5 litre trees inter-planted along the wall or barrier). Planting can also provide an attractive interface with nearby properties, public spaces, footpaths and cycleways and can also be used to promote biodiversity and discourage graffiti.

Any planting surrounding a wall/noise barrier should ensure there is enough light and space for plant growth, nutrition and water retention in the soil. It is also important that the wall/noise barrier and landscape design allows access for routine maintenance. The positioning of walls/ noise barriers in relation to other landscape areas needs careful consideration, access should be provided if a noise wall cuts off a landscape area within the corridor. The following criteria should be considered when selecting species to plant adjacent to a wall/ noise barrier:

- hardiness – ability to withstand frosts and potential shading;
- life span - a minimum 20 years should be targeted;
- fast growing – screening and graffiti mitigation can be achieved faster;
- low maintenance - species that do not require watering and are natural weed suppressants;
- meet the Transport Agency safety policies – for example meets clear zone requirements; and
- ability to self seed and develop new plants; these can be used to reduce the need for cyclic planting.

Refer to Bridging the Gap: NZTA Urban Design Policy and Practice published as a companion document to these Landscape Guidelines and Transport Agency State Highway Noise Barrier Design Guide

HIGHWAY SIGNS AND GANTRIES

It is recommended that a duplicate set of landscape drawings showing the location of all signs and gantries be prepared. The purpose of the plans is to demonstrate that there are, when the landscaping is fully grown, clear sight lines between the driver and signs (to ensure reaction times and safe stopping distances are met). These plans may also include streetlight poles or other structures that may partially obscure signage. The process may lead to signs being repositioned (in consultation with the project team), to allow for essential landscape maintenance access.

Surface material utilised to address the shad effect of the bridge. Hard landscape solution featuring locally sourced rip rap rocks used to integrate this slope area which would otherwise be hard to planted and costly to irrigate

Urban design element (bridge) and landscape materials should work together

Urban design element (barrier) and landscape materials should work together

Urban design elements (noise wall) and landscape should work together

Highway planting selected to green and soften structures.

Use of appropriate structure and local materials to retain the slope

Bridge designed to fit the Landscape and minimise it's footprint.
Image : Michael McSweeney, Wilderness Lodge Arthur's Pass

Interchange under construction. Note planting coverage established to assist with erosion control

INTERSECTIONS (URBAN, RURAL)

Intersections include all types of road intersections, roundabouts and interchanges. It is important to tailor the landscape design to the context and produce a minimal maintenance solution for these areas.

There can be a temptation for overly detailed landscape treatments at intersections. While some situations may warrant a distinctive effect this needs to be balanced with not creating a distraction and too much complexity must be avoided. Landscape treatments in these areas should be simple, robust, and cognisant of sight lines, safe stopping distances, visibility of pedestrians and cyclists, and maintenance access requirements. It should avoid 'gardenesque' planting of small bedding plants and flowers.

Sight lines and visibility are vital at all intersections, and must be maintained by either use of low planting or taller shrubs and trees with clear lower limbs behind a barrier (refer State Highway Geometric Design Guidelines).

Planting can be used as an effective means of indicating an intersection ahead.

Major intersections can serve as a milestone along the journey (e.g. within rural environments). Intersections can act as a feature associated with the local town centres, heritage or landscape setting. Culturally and locally important plant species can be utilised to highlight these aspects. Large junctions including interchanges should be well integrated into their surroundings with extensive planting

Where practicable intersections should be planted, paved or grassed to reduce the need for expensive, and potentially dangerous, frequent maintenance at intersections.

CLEARANCE OF SERVICES

When services need to be located in the designation, their placement should be co-ordinated with the landscape design to avoid potential conflicts. In addition setbacks and clearances from transmission lines, CCTV sight lines and inspection viewpoints for highway structures should be preserved. Clustering services in non-vegetated areas can maximise landscape treatments and also minimise the need to disturb landscape when accessing services. Conversely service covers and boxes can also be located within planted areas to integrate them in high profile areas out of view. All service covers should have a wide maintenance margin to ease maintenance, unless they adjoin a public access point or reserve where they should be as inconspicuous as possible).

For safety reasons and to reduce maintenance, the following general clearances from services for plants with stems greater than 100mm (e.g. generally trees and shrubs) are recommended:

- lamp posts – 10 metres;
- power poles – 10 metres;
- underground services – 4 metres. Most modern plastic pipes resist roots, but when service maintenance is required root damage to the tree can result;
- drainage sump – 6 metres;
- overhead power lines – avoid planting trees or any large shrubs underneath or close by that will require trimming;
- Preservation of sight lines for CCTV (site specific).

Landscape design should address the requirements of service providers/ utility companies and the setbacks and clearances may require. Wherever possible the location of new services should be designed in collaboration with the landscape architect's design input.

All services shall be located on site prior to any landscape work commencing.

4.9 HERITAGE AND CULTURAL WELL-BEING

In New Zealand every site has a history of use and change. Understanding the layers of history — that is, how the landscape became the way it is now — reveals critical information that helps determine what can or should be protected, acknowledged, reinforced or revealed through highway landscape design and landscape treatments.

Heritage is acknowledged in section 6E & 6F of the Resource Management Act. Pre 1900 archaeological sites are automatically protected under the Heritage New Zealand Pouhere Taonga Act.

Engagement with iwi and hapu as well as the review of Iwi/Hapu Management Plans can influence the landscape design and landscape treatments on Highway projects. Generally these Management Plans have a section on Cultural Landscapes including the values, objectives, policies and guidelines for landscape. These should be reviewed as early as possible in the design process. Opportunities such as aligning highway planting to enable cultural harvest may emerge.

Local community groups and individuals are an excellent source of information on the heritage of an area.

Also consider the following sources of information:

- New Zealand Archaeological Association (NZAA) GIS layers
- Sites and places scheduled and / or managed by local authorities and / or Government agencies (HNZPT, DOC)
- Post 1900 Archaeological sites that are gazetted
- Archaeological reports
- Iwi/ Cultural management plans/ Waahi tapu areas
- Conservation plans
- Te Aranga Maori Cultural Landscape Strategy (http://www.tearanga.maori.nz/cms/resources/TeArangaStrategy28Apr08_lr.pdf)
- Guide to assessing cultural heritage effects for state highway asset improvement projects, Transport Agency 2012

Blessing by local kaumatua, Northern Gateway

4.10 FURTHER CONSIDERATIONS

CPTED – CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

Refer to Bridging the Gap, NZTA Urban Design Guidelines, Part 2, 4.11 Crime Prevention.

CPTED reviews shall be undertaken on all design projects where public access and personal safety are to be recognised. Preventing graffiti by avoiding creating areas for offenders to stand and tag is a key design/CPTED issue. Other CPTED matters such as personal safety also need to be addressed.
IPTUD (Injury Prevention through Urban Design) considerations are considered part of the CPTED review. IPTUD issues could include for example bollard holders and bollards that are hard for cyclists and pedestrians to see.

CYCLEWAYS AND WALKWAYS

Refer to Bridging the Gap, NZTA Urban Design Guidelines, Part 2 – Supporting Walking and Cycling.

The primary issues associated with walkways, cycle paths and lanes relate to perceived safety and amenity for cyclists and pedestrians due to the proximity to the high speed or high traffic volume. The degree of separation from moving vehicles, amenity and attractiveness of the setting and the reduction of obstructions all fall under the landscape treatments.

Vista to the wider landscape experienced from a stopping place

STOPPING PLACES AND REST AREAS

Refer to Bridging the Gap, NZTA Urban Design Guidelines, Part 3, 4.21 Stopping Places.

Stopping places are strategically located within the highway network, as set out in the NZTA's Highway Stopping Places Strategy. The primary purpose of a highway stopping place is for people to park safely, get out of their car, relax and be refreshed before continuing their journey.

Stopping places should be located, designed and maintained to a high quality to encourage road users to stop and rest in a small park like setting. Stopping places include designed rest areas, but are also adapted to form part of a service centres, parking bay, information bays, heavy vehicle areas, toll pay areas and commercial service centres.

Key considerations include signage and safe easy access. Landscape treatment around rest areas should achieve a range of design outcomes, including:

- perception of noise reduction from traffic, buildings and car parking which can be managed through planting;
- gaps with vegetation below 500mm height and above 3m height should be left in the vegetation along the road boundary as this provides a sense of safety for users by allowing the passive surveillance of rest areas by passing motorists. CPTED issues should be addressed within the design;
- setbacks can be used to maintain sight lines and visibility, particularly at the point of entry and exit from a stopping place;
- safety can be enhanced by planting soft frangible plants next to the highway, to create buffer zones between the highway and rest areas and slow vehicles entering the rest area
- using locally-sourced native plant species can emphasise the indigenous character of an area while reinforcing the ecological value of stopping area planting;
- retention and enhancement of views can add to the aesthetic pleasure of the stopping area;
- planting can provide shelter, shade and visual enhancement. The use of colourful and/or textured planting can add to the pleasurable experience and a parkland atmosphere.
- maintenance costs can be reduced by careful plant selection and design;
- the opportunity for art or interpretation of the cultural and natural heritage can be provided to create a point of interest;
- street furniture integrated with the landscape setting and local themes (see material selection).

Earthworks may be used to enhance rest areas through:

- visual and physical separation from the highway;
- the deflection of road noise from the highway;
- the manipulation of vehicular traffic and reduced tracking over grassed areas;
- the direction of drainage flows by way of swales that can be incorporated into appropriate planting, especially on wet sites.

Rest areas/ stopping places

Stopping places should have visibility as well as physical separation from the highway, and be designed as small parks

Stopping places can feature art and interpretation about the local environment, cultural landscape and heritage

RESOURCE EFFICIENCY

Given the scale of the state highway network; whole of life value for money for landscape treatments is essential. When developing highway landscape designs the costs of landscape treatments (materials, their implementation and ongoing maintenance) must be a key factor. Providing whole of life value in landscape design decisions requires the designer to think through all steps in the highway project and asset management to maximise value.

Best practice landscape design within state highway corridors can contribute to maximising value by:

- streamlining the landscape aspects of the RMA approvals process;
- making best use of landscape investment, in terms of initial design and future life cycle management;
- reducing the resources required for long-term management of vegetation and plant pests
- protecting the integrity of road pavements and drainage structures through integrated solutions and the selection of appropriate species;
- designing and establishing landscape that does not conflict with the operation of the state highway and infrastructure within the corridor;
- ensuring a more consistent landscape product.

Some good options for ensuring whole of life value is ingrained within the landscape design include:

- liaison with network operations and maintenance organisations for their input and advice on design and how the existing landscape asset is performing;
- utilising whole of life cost evaluation in decision making (capital cost, plus operations and maintenance) to determine the best whole of life value option(s);
- consistency of landscape components across the surrounding network to help stream line operations and maintenance activities;
- include allowance for the integration of any future utility services.

Public consultation workshop session

STAKEHOLDER CONSULTATION

Landscape design can benefit from local knowledge and input to ensure that the final landscape treatment incorporates local values, promotes local features and history and represents the reasonable aspirations of local communities.

Once a design has been prepared, it can be provided to stakeholders and interested members of the community for their comments and recommendation.

All community consultation should be undertaken in accordance with Transport Agency consultation guidelines and protocols and facilitated by experts. All consultation will need to be aligned with the highway project plan, and wider project issues.

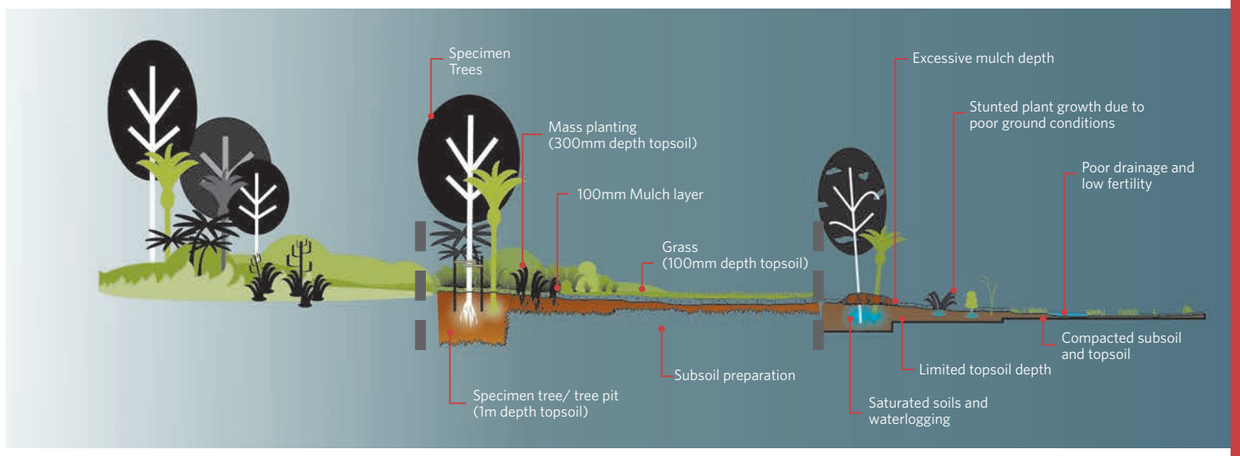
Ceremonies can also be an opportunity to associate the opening of the new road with highway landscape (e.g tree planting)

PART 3: LANDSCAPE TREATMENTS

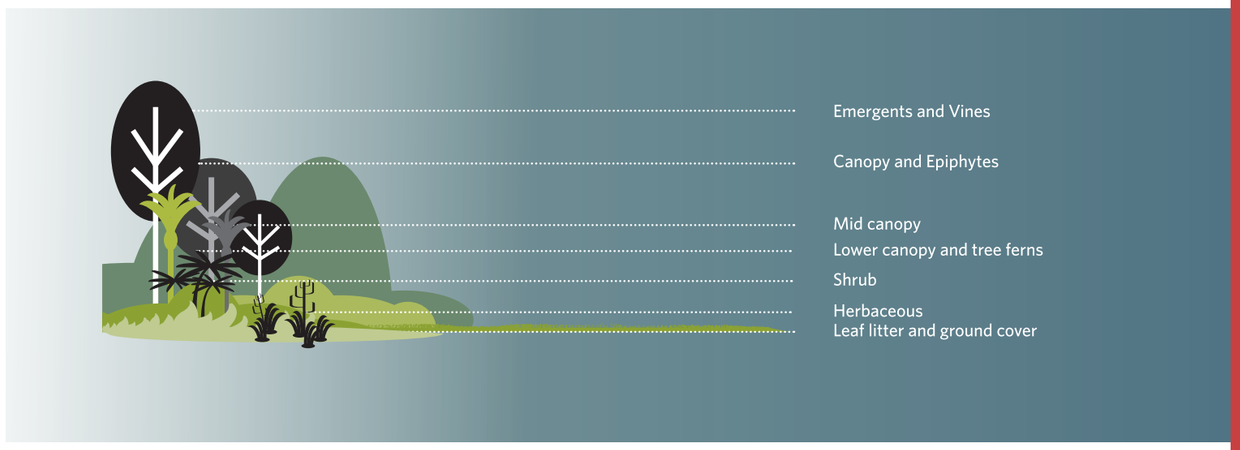
4.11 INTRODUCTION

In this section detail considerations which need to be taken into account as the design moves toward and into the construction phase are discussed. Attention is drawn to issues which can result from poor preparation, poorly grown plant materials, etc. It is necessary to follow best practice as set out in the NZTA P39 Standard Specification for Highway Landscape Treatments (Appendix 2).

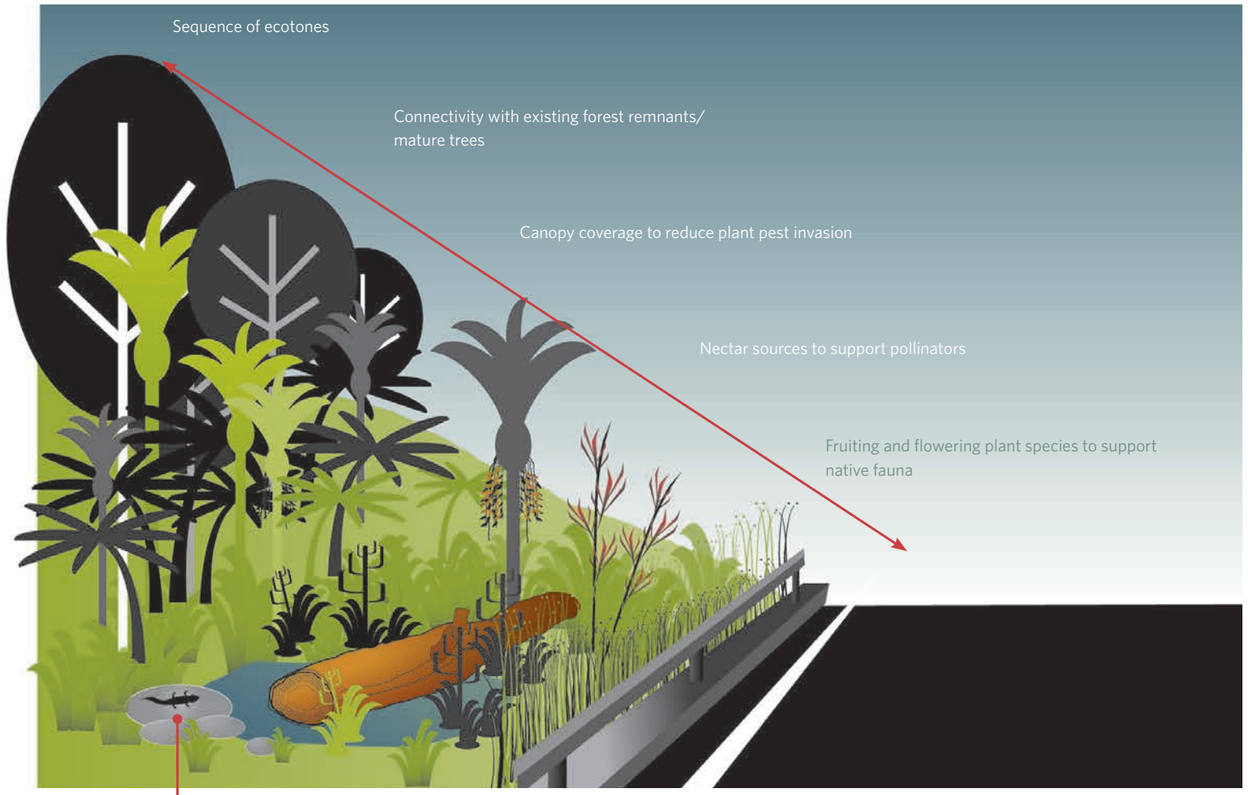
There is a direct link between successful highway landscape treatments and the ground preparation, topsoil and site hydrology. The diagram below illustrates a generalised scenario including ground preparation, rooting depths and topsoil depth for grassing, mass planting and specimen trees, and the issues associated with poor practice.



LONGTERM SELF-SUSTAINING PLANTING GROWS TO SHOW ALL THE ATTRIBUTES OF NATURAL NATIVE FOREST



LONGTERM SELF-SUSTAINING PLANTING CAN PROVIDE BIODIVERSITY ENHANCEMENT



Habitat features, utilising existing on site resources such as rocks and fallen logs.

Bees are crucial to New Zealand's primary sector, with a role far beyond honey production. New Zealand's dependence on horticulture and agriculture means we may be more dependent on pollination from the honey bee than any other country on earth. Source: www.nba.org.nz

Consider planting species which provide nectar for bees; species include Cabbage tree, Harakeke/flax, Kanuka, Karo, Kohuhu, Koromiko, Manuka, Kumarahou, Pohutukawa, Rewarewa, Wharangi (this is not a definitive list)

Rare NZ Native plants. Auckland Motorway Alliance aim for 1% of all planting to feature rare plant species unique to the area. Clianthus, commonly known as Kakabeak featured

The NZTA was recognised by the Plant Conservation Network (nzpcn.org.nz) with a Special Award for efforts in 'Restoring native plant life to road corridors' at their 2012 awards held in Christchurch. The NZTA are committed to using native plants in the state highway corridor, which not only promotes native biodiversity but decreases long term maintenance costs in selecting plants that can survive in the local conditions. The Plant Conservation Network is New Zealand's only non-governmental organisation devoted solely to protecting indigenous flora and was set up as an incorporated society in 2003 to work towards implementing the Biodiversity Strategy and the Global Plant Conservation Strategy.

Any areas of cut and fill should be a focus of the landscape design to ensure that rehabilitation is integrated with the wider highway landscape (Nukumea fill site)

Topsoil management is also vital to the success of the final landscape outcomes for stormwater management devices

Heavily compacted soils lack the structure required to support health plant growth. Compaction by machinery and mixing of unsuitable material. Topsoil stockpiles should be managed to avoid mixing of materials and vegetation (weeds) removed prior to respreading

Earth works in progress

4.12 TOP SOIL

Understanding the soil properties of a site is important to the landscape design. The combination of the sites soil together with the hydrology and the right plants can achieve the desired outcome.

Topsoil is the top layer of soil characterised by the presence of organic matter, it is generally dark-brown and can be 100 to 400mm deep. Other valuable soil materials which may be naturally prevalent on a site include peat deposits and freely-draining subsoils (usually bright red-brown in colour with very few mottles). Subsoil is generally a lighter colour than topsoil.

Good quality topsoil is essential for highway landscapes to flourish. An important initial step is to ensure that the contractor's team understands the difference between topsoil and subsoil on a site, by colour.

Why good topsoil is essential: Healthy soils provide the following functions to support plant growth in highway landscapes:

- oxygen present in aerated and well drained soils provides for plant root growth and soil life e.g. earthworms;
- healthy soils store, supply and cycle nutrients. Continued nutrient cycling requires supply and the breakdown of larger organic matter through the biological activity of worms, insects and fungi;
- structural support, especially for larger plants and trees, which require deep rooting depths;
- healthy soils infiltrate water, runoff is minimised, and more moisture will be available for plant growth.

Top soil requirements: The provision of adequate soil volume for plant growth is essential for successful landscape implementation; NZTA P39 Standard Specification for Highway Landscape Treatments requires a minimum of 100mm for lawn areas, 300mm for planted areas and 1,000mm for tree pits to allow for the specimen trees rooting depth.

Soil testing: Research from overseas suggests when stabilising sites that a soil test should be undertaken to understand what is going to be most suitable landscape treatment to get the vegetation cover sought. In addition topsoil shall be tested to ensure it meets the required standards for use within landscape areas. Samples shall be sent for analysis by the contractor, whether existing site topsoil or imported topsoil. (Refer to Appendix 2 landscape specification section for details).

Management of topsoil and conditions where topsoil is to be placed: Further to supplying the correct depths of topsoil and testing to ensure that topsoil meets the required standards; an issue for many highway landscapes is soils are often highly modified compared to natural ecosystems

Most soils can be degraded by mixing and compaction, and take many years to recover naturally if compacted. The most appropriate means to preserve soil structure on a site is to limit disturbance through erosion control and restrictions to the extent of earthworks. Where practicable natural ground topsoil should not be traversed by vehicles.

Where areas of soil and vegetation are subject to earthworks the key practices to enhance soil function are:

Avoiding/ minimising topsoil disturbance

- restrict the earthworks footprint to the minimum construction footprint practicable. This includes the works area and associated haul roads, lay down areas and yards, fencing/sediment fence or tape boundaries;
- areas of topsoil which are revegetated should not be trafficked across unless conditions are dry and vehicles are light;
- prevent and control erosion, especially of topsoil, by minimizing the extent and duration of bare soils;
- retain wetlands and stormwater storage areas, and prevent ponding in earth worked areas;
- divert water overland flows away from bare soils i.e. use cut-off drains.

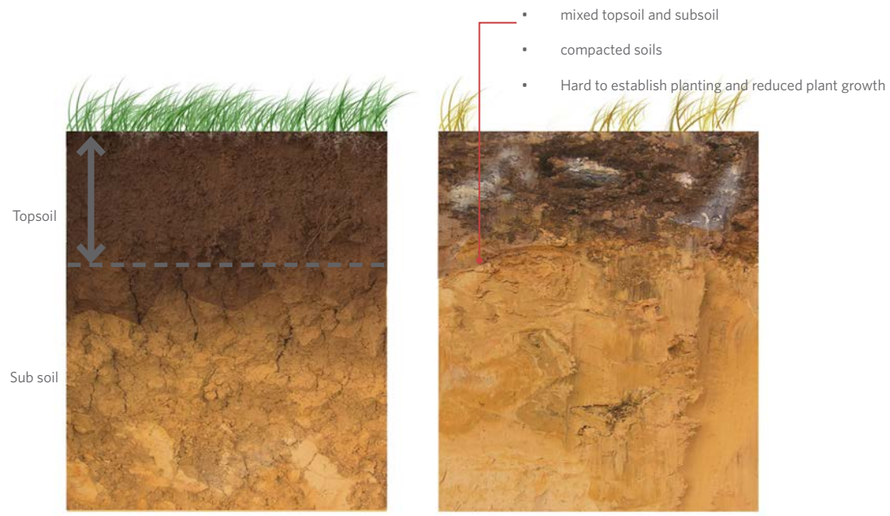
Sequencing works to protect soils

- ensure equipment is cleaned before getting to a site to reduce the risk of spreading weed species and soil pathogens from other sites;
- evaluate compaction and grading requirements i.e. use the lightest equipment necessary to get the job done and achieve final grades with as few passes as possible;
- protect root systems of existing large trees by suspending or supporting pavement or roads over soil and root zones. Install grates and protection around treetrunks where applicable.

Retaining fertility

- mulch can be utilised to retain soil moisture. Mulches (bark and woodchip) can also strip nitrogen as they decompose, which in turn can result in weeds infesting the area. The type, source and depth of mulch should be carefully assessed prior to spreading.

EFFECTS OF COMPACTION IN HIGHWAY LANDSCAPES



Example:
Typical ultic soil profile

Example:
Ultic soils after poor soil management/ compaction

Quality landscape outcomes start with quality ground preparation and topsoil

An eathworked slope compacted during formation. The soils struggle to support plant growth, resulting in an unsightly slope batter

Topsoil & Soil Stripping: Use backacters or face-shovels to remove topsoil, not earth-scrapers, particularly for soil vulnerable to degradation or where soils are highly variable. Stockpiling soils can lead to compaction and mixing with other material. Compaction and settlement can reduce the volume of soils. Maintain soil structure (large clods) and avoid re-handling topsoil (do not bulldoze into piles that are then removed to stockpiles).

Where necessary the quality of stripped topsoil can be optimised in the following ways:

- ensure machine operators can differentiate between topsoil and subsoil by colour;
- excavate only during daylight hours and when soil moisture conditions ensure wheel ruts are <50 mm depth. Do not excavate during rain;
- remove the entire topsoil depth at one time and restrict traffic over subsoil layers to preserve soil structure and minimise compaction. Where access by machinery is essential, utilise low ground-bearing vehicles to reduce compaction of subsoil especially in areas intended for replanting. Do not handle or traffic when 'wet;'
- if woody vegetation is removed, consider mulching or chipping vegetation and adding to topsoil. The chips will help reduce compaction, especially in longer term stockpiles. Be aware that the mulch will strip nitrogen from the soil as it decomposes. A slow release fertiliser or nitrogen-containing compost may need to be added to the soil when re-spread to assist plant growth;
- kill herbaceous vegetation 2 to 6 weeks before stripping and identify areas of potentially high-maintenance weeds (e.g. kikuyu grass) to separate and manage appropriately.

Large branches, tree stumps and rocks that could damage cultivation equipment should be separately stockpiled, preferably after topsoil has been stripped to reduce topsoil compaction.

Identifying the best site soils: Where soil is to be stripped from a site a pre-disturbance survey will identify soil resources available for a project. It will also reveal potentially poor soil which could become a liability and which should not be used.

- higher value topsoil should be made available for use in areas where planting will be highly visible;
- suitable topsoil will be identified and only suitable topsoil used;
- suitable soil material for specific uses may also be identified; uses such as stormwater treatment in raingardens or wetlands.

Lush planting achieveing canopy closure supported by quality topsoil and mulch

Stripping and placing soil: When stripping topsoil, the following strategies should be adopted for placement of topsoil:

- ensure soil testing has been undertaken and topsoil is fit for the purposes of landscape;
- subject to the stripping methodology, use low ground-pressure machinery or selected lightweight tracked or balloon tyred equipment operating along approved haul routes (if specific routes are required);
- remove all debris and contaminated material;
- ameliorate subsoils prior to placement of topsoil to achieve friable conditions below final topsoil grade. The purpose is to provide a roughness, through scarifying (refer to NZTA P39 Standard Specification for Highway Landscape Treatments), so that the root zone depth of the planting can penetrate the sub subsoils;
- spread soils when they are slightly moist but not wet to yield the greatest structural stability;
- cover planting areas with a full depth of topsoil as soon as possible and when moisture conditions are favourable. Where soils are well-drained and dry to moist, topsoil can be applied in two layers with an initial 50 to 75mm depth of topsoil worked into the subsoil to encourage even drainage and rooting into the subsoil. If soils are imperfectly drained or fine-textured, the risk of re compaction can be reduced by applying a full-depth of topsoil in a single pass on roughened subsoil;
- check the final contoured surface for ruts, rilling, or dishes where surface water may flow and concentrate;
- hydroseed, mulch, or seed the re-spread topsoil immediately to protect the surface from sealing or eroding.

Compacted soils become boggy in winter and dry and cracked in summer. These changes in ground conditions impact plant growth

Soil Stockpile Management: On the majority of sites topsoil is not able to be stripped and placed immediately in its final location. Where a topsoil stockpile is required, the following practices will help maintain the quality of soils for later use across landscape areas:

- designate areas for stockpiling;
- prepare stockpile areas by ensuring surface water is intercepted and diverted around the stockpile. Construct sediment control features to capture and treat runoff from stockpiles if required. Ensure the base is relatively even and sloped or well drained to minimise anaerobic conditions developing at the base of the stockpile. Under-drainage may be beneficial;
- transport material to construct stockpiles by dump trucks. Avoid over-compaction; reshape stockpiles using backacters not bulldozers. Topsoil stockpiles should not be trafficked by any machinery;
- topsoil stockpiles should be no higher than 1.5 to 2.5m, but it is better to salvage topsoil in higher stockpiles than dump it;
- place straw mulch or hydro spray mulch over the stockpile to form a crust where the stockpile will remain for more than 3 to 6 months or over winter;
- prevent weeds seeding into stockpiles before use;
- where anaerobic soils have developed at the base of stockpiles, there will typically be elevated iron and reduced pH (as low as 4 to 5). These soils will require amelioration before placement in landscape areas.

Refer to the Transport Agency Erosion and Sediment Control standard for state highway infrastructure www.nzta.govt.nz

Degraded Soil Enhancement: Most earth-worked soils will be physically or chemically degraded to some extent, especially if they have been stockpiled. Degraded soils take time to improve. This can have ramifications for the timing of landscape works, which in turn can impact on any projects programme, consent requirements for landscape sign-off and completion of landscape works.

However, the following practices are noted:

- soil testing and analysis is required by the specification and will identify actions required to ameliorate topsoil. However topsoils may vary along the highway route so consider soil testing locations carefully;
- an effective method of reviving degraded and poorly structured fine textured soils is to incorporate organic matter. Up to 10% of compost for example, may be added. Organic content in excess of 10% may resulf in uneven subsidence. Composts should be well aerated, relatively stable and conform to the NZ composting standards (NZ Standard NZS/AS 4454);
- another additive to ameliorate soils is gypsum (calcium sulphate di-hydrate), an abundant natural mineral used as a soil conditioner and fertiliser which will improve soil texture, drainage, and aeration. Gypsum is appropriate for the remediation of compacted soils, exposed subsoils, or soils affected by salinity (e.g. estuarine berms);
- gypsum has an advantage over certain other fertilisers/minerals, as it is pH neutral.
- Mychorrhizae fungi and 'compost teas' can also be incorporated (through inoculation by spray) into topsoil horizons;
- organic mulch can be incorporated to a depth of 50 to 75 mm depth. This will assist with reduction of frost heave, and will break down over time to enhance organic content in topsoil;
- a slow release N-P-K fertiliser may be required;
- mulches absorb water, so need to be spread on moist soil before dry weather. Care should be taken before applying mulch to poorly-drained areas, as mulch reduces water loss and therefore can exacerbate development of anaerobic conditions.

Note: soil amelioration measures require tailoring to the soil type and problem, recommendations will be made following soil analysis.

Image : Thermal highway route source: Tourism NZ

4.13 SLOPE MANAGEMENT

The integration of highways into the topography responds to both highway geometric, engineering and landscape design considerations. Slopes, both cut and fill, are a significant features of highway landscapes.

Slopes (cut and fill) need to be integrated with their context. Where possible, earthworks should be graded out to integrate with the surrounding landscape. This involves reducing the steepness of earthworks and blending them with the natural landform alongside the highway corridor. But ensuring adequate cut-off drains to prevent water moving onto and over batter faces.

However, grading out of large cut-and-fill batters is often not practicable because of the cost and the fact that it usually involves extending the earthworks well out of the designation area into adjacent land. A balance is required between disturbed footprint or existing vegetation disturbance and landform mitigation. The trade-off is particularly significant in urban areas (across expensive land) and in natural areas (highly valuable farm land, vegetation or ecosystems).

Landscape treatments are best implemented and managed within the following slope limitation:

Maximum slope breaks: To achieve successful vegetation cover on a cut slope or fill batter the earthworks and slope angles need to be designed accordingly:

For planting with topsoil and mulch: 1:3 is the maximum slope (for mass revegetation in rural areas 1:2.5 max slope may be acceptable)

For grass areas to be mown 1:4 is the maximum slope

Customised planting schemes and proprietary products such as coconut or wool matting are required for slopes greater than 1:2.5

Where ground is flat to rolling; generally all landscape treatments can be implemented

Designing with slopes: Careful design and management of slopes can be used to provide:

- more sustainable landform for growing vegetation;
- screening;
- visual integration;
- a means of creating a gateways or transition between speed zones;
- allowing fill areas to be located away from the immediate vicinity of the highway.

For successful visual integration of the highway, any associated earthworks should be natural looking and respond to:

- the wider topography;
- any smaller scale local landforms;
- geologically significant features;
- water systems and stormwater management;
- fill/ stock pile treatment (note the susceptibility of fill areas to leach water through to compacted fill material;
- the appearance and integration of cuttings and embankments can be improved by:
  - blending and feathering of the ends of slopes (as noted above);
  - rounding the top and toe of slopes and blending them with the slope of adjacent ground
  - ensuring the length of the slope matches the scale and angle of the surrounding topography by varying the angle of slopes along their length with gentle transitions between slope angles;
  - avoiding the appearance of unnatural steepness over short lengths of slope;
  - incorporating naturally occurring landforms and features within the earthworks that are immediately visible from the highway including ridgelines, natural drainage channels and features such as rock outcrops;
  - avoiding disturbance to water bodies by providing transitional bell- mouthed swales and gentle transitions at the point where slopes intersect with water courses;
  - using locally sourced rock typical in scale and formation to that occurring naturally if 'rip-rap' is required for erosion protection.

Balance tradeoffs between reduced roading footprint and earthworks and retention of native forest (Source: Tourism NZ)

Geometric slopes fit poorly with the adjoining topography should be avoided

Vertical cuts through create a showcase for the overbridge as well as limiting the width of earthworks to protect adjoining native forest

Benched slope unnaturally step across the landscape . The heavily earthworked banks show inconsistent grass cover due to slope grades and limited topsoil

Where possible the exposure of local geology with the cut face of slopes can become a feature. When exposing rock on stable slopes, a random cutting or blasting method should be employed to ensure the rock face resembles natural fractures. Pre-split blast line should be avoided. Geotechnical limitations should be understood early, especially in relation to any risk associated with rock slides, freeze thaw movement, and seismic events. Rock faces should be treated to match naturally occurring ones by:

- scarifying horizontally rock faces to mask residual drill lines;
- spraying scarified rock faces with liquid fertiliser to encourage rapid revegetation, especially where moss can be expected;

Or

- clean so that little vegetation will establish allowing the retention of outstanding, stable geological features;
- avoiding benching (stepped contouring). In areas where slope stability is a concern, irregular staggered bench sections should be used with risers that resemble natural rock strata lines. Benches should be random with a minimum width of 2 metres so revegetation can soften and naturalise their appearance;
- careful site preparation, quality and placement of topsoil, the selection of appropriate plant species and planting formations are fundamental to creating planted batters that establish well and lessen maintenance requirements.

For detailed specifications relating to slope gradients and batter treatment, refer to Section 11.7 of the Austroads Rural Road Design: A Guide to the Geometric Design of Rural Roads. In addition refer to the Transport Agency Erosion and Sediment Control standard for state highway infrastructure www.nzta.govt.nz

Steep slopes: The decisions made at the engineering design/ geotechnical investigation phase of a project determines the grade of batters and embankments and requires input by the Landscape Architect to ensure integrated landscape treatments are considered early and incorporated into the Landscape and Visual Assessment (LVA). The recommendations of the LVA need to then be translated through the Landscape Design phases to ensure that slope management for landscape integration is achieved. When involved early, the Landscape Architect can integrate slope management, and propose design alternatives if required.

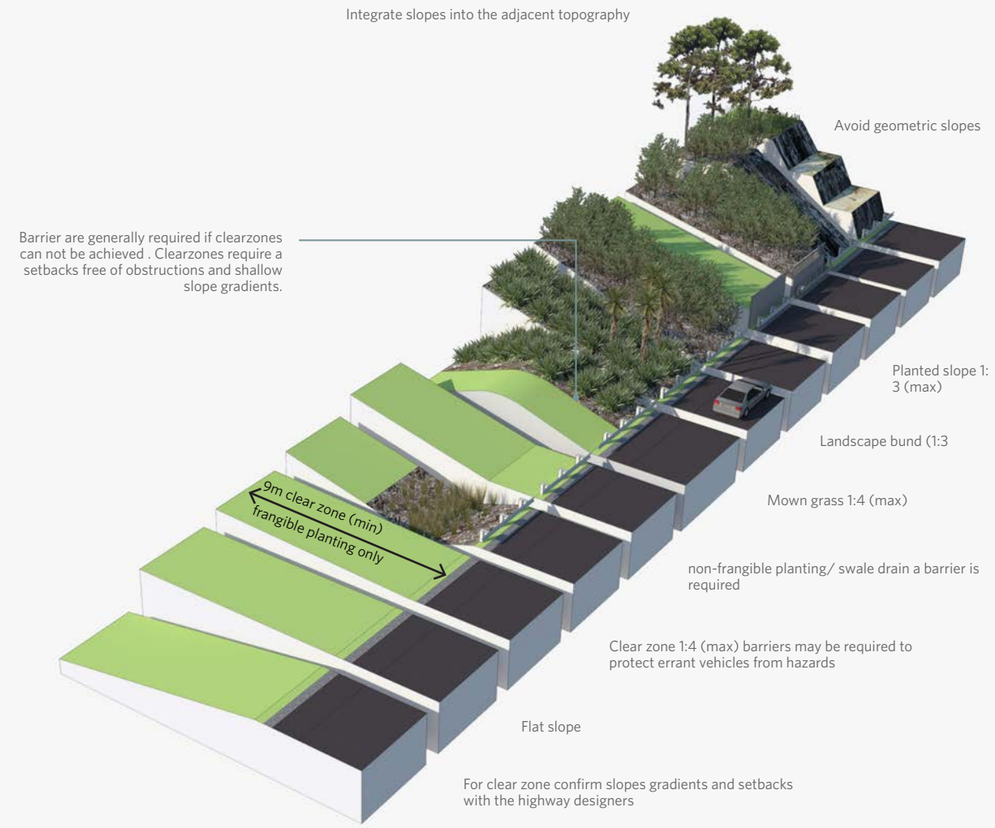
The steepness of batters affects the ability to plant and maintain these areas. For example, a grade of 1:3 or less is optimum for soil preparation, mulching and plant establishment (note 1:2.5 slopes may be acceptable in some situations). When slopes are steeper vegetation will struggle to establish and require specialist treatments and plant species (e.g. kiokio fern). In extreme situations the use of ladders, and safety harnesses can be required for contractors to access these areas, making planting and maintenance difficult and costly.

Often on steep slopes hydro-seeding is seen as an easier option, being far simpler to implement. However, hydro-seeding can quickly revert to weeds and gorse, meaning long-term maintenance will be more onerous than a well-designed and planted bank.

The nature of the surrounding land use and highway setting will also influence the decision to plant or hydroseed.

Another important factor to consider is the mature size of plants, and whether species selected are appropriate for the scale of the bank and the distance to the road shoulder. The long term maintenance of the plantings is always an important consideration.

SLOPES



Generalised slope breaks for highway landscape treatments

* All grass slopes shown may be planted

Barriers avoid the need for errant vehicle clear zones, and non-frangible planting nearer the highway

A bund planted with lush flax screens the highway from adjoining private land for visual and acoustic reasons

Example of exposed local geology (source: Landcare Research)

Example of native Kiokio fern on a steep bank

Erosion control and planting: Early intervention is needed to assist in stabilising sloped areas disturbed by earthworks, particularly cut/fill batters. The following are suitable vegetative and bioengineering erosion-control methods that can be employed for erosion control:

- grassing
- mulching (organic or rock/pebble)
- hydro-seeding
- mulch-seeding
- textiles and mats, if biodegradable
- brush layering (bundles of saplings layered into batter slopes)
- layering of seed bearing brush (e.g. Manuka slash)
- pole planting (deep rooting trees and shrubs)
- placing branches and short sections of logs over the ground
- using reinforced geotextile layers or socks
- gabions and reno matrices

Successful use of vegetation on slopes requires:

- understanding the site: to identify site conditions such as soil type, soil water saturation levels, and risk of movement;
- appropriate species selection: to ensure species selected meet engineering requirements and are in keeping with the form and shape of surrounding vegetation;
- forward planning: to ensure seed stock and plants suited for site conditions are available on schedule;
- contingency planning: to determine what extent of soil movement is expected before alternative solutions should be investigated;
- ongoing monitoring: to ensure plant establishment is at the projected rate.

Berms/mounds: Mounds can help screen the highway and reduce noise. Their screening function and visual integration can be greatly improved when combined with planting. Designing mounds for effective noise reduction needs to be carried out in consultation with an acoustic expert to ensure berm design mitigates the noise. Gaps between berms can accentuate noise if not designed and located appropriately.

Mounds should be designed to appear natural (unless they are 'art features'). This can be done by varying their height, length and alignment, and by avoiding sharp profiles when blending them in with the surrounding landform. A surface of variable slope to encourage entrapment and infiltration of water for healthy plant growth can be useful as plants on berms can be more prone to drying out.

The points below relate to successful berm design achieving a 'better fit' with the scale and form of the landscape:

- the scale of the surrounding landscape should be used to guide final design length for mounds;
- mounds are set back at least 2m from road edge vegetated down to the flat area and preferably including at least 2m of the flat area to avoid views from the road into the base of the vegetation which is generally unattractive. Note: Mounds can be an overturning hazard for vehicles and should be designed in accordance with the clear zone requirements specified in the Transport Agency State Highway Geometric Design Manual;
- berm side slopes should not exceed 1:3 (slope), to allow for plantings and 1:4 (slope) to allow for mowing if grassed.

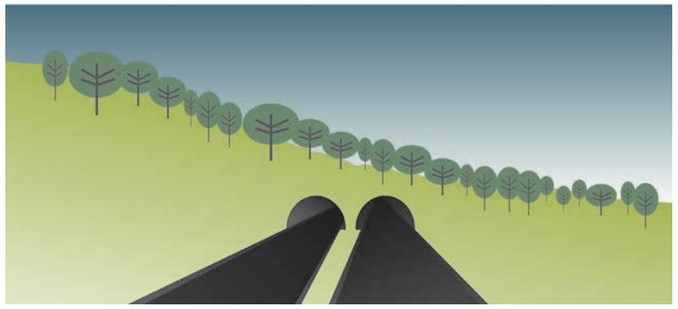
ROADING ALIGNMENT AND LANDSCAPE INTEGRATION

A shorter section of road but more earthworks cutting

A longer section of road, but the roadside slopes can be contoured back into the landscape

Road with skyline cutting and a straight alignment with a vertical curve

Alternative road aligned to fit the landscape and with excavation to eliminate the uphill mound



Tunnel avoiding the large cutting and providing for landscape connection (e.g. protected ecological corridor)

Image source: NZTA

4.14 PLANTING AND VEGETATION MANAGEMENT

Without vegetation, highway landscapes lose their natural capacity as habitat and as a buffer between the highway and surrounding activities. Vegetation acts as a green veil screening buildings and structures, it also offers visual amenity. Well located planting can deliver multiple benefits including, stormwater management function, enhancement of ecological values, shaping of landscape patterns and visual quality.

Vegetation considerations include:

Aesthetics – Planting aesthetics can be understood as a function of form, pattern, texture, tone, and colour

Character - Use vegetation that promotes a regional identity and a sense of place.

Form – Planting form refers to the stature and growth pattern of individual specimens through seasonal variations. Manipulated forms can direct the viewer's gaze, frame views, form a screen, or orient a space.

Pattern – Plant patterns and layout, generally straight lines, and geometric patterns should be avoided. Sometimes, however, this is a component of the landscape design and may define the highway corridor with avenues, boulevards or gateways or intersections.

Texture – Texture represents a perception change from fine to coarse; in plants this can be soft and voluminous versus stark and harsh. Low, spreading plants tend to soften straight edges; spiky plants add verticality to the centre of planting beds or contrast with fine-grained plants such as grasses to add visual diversity.

Tone – Tone relates to the darkness or lightness in terms of plants due to their leaf density and foliage. Tone is important where it can provide for light and shadow and it will accentuate space and edges.

Colour –Colour combinations are important considerations within a design. They can provide seasonal interest and for visual diversity. They can lead the eye to a particular part of the landscape. Colours can also combine seamlessly along gradients based on 'colour wheel' spectrums.

Diversity - A variety of native plant species should be utilised in highway projects to add diversity. To aid diversity deliberately avoid the use of single clones and single species mixes. Clones are usually bred for a consistent look, and are less resilient than plants grown from seed which have genetic diversity from wide seed stock. Resistance to diseases, unusually severe weather, and climatic variability is best achieved by using a variety of plants and not having large areas of one single species. Where a uniform look is desirable, use species with similar form, colour or texture. As a general rule of thumb use at least three species. Aesthetics over short and long term is similarly, best achieved using several plants together; fast growing amongst slower growing, longer-lived plants. Rare plants should be introduced as appropriate, to their context and only if the harvest of their seed does not compromise the existing population[23].

Ecology– Ecological planting is the use of native species, planted in a manner that is representative of a like-environment for native plant communities and native fauna. Native species survive well, and may lead to less replacement and maintenance during the life of the planting. Use only non-invasive plants that are nursery grown, legally harvested, or salvaged for reuse in a sustainable way. Certain species occur across environmental gradients responding to hydrology, exposure, and natural ecological plant communities. They include multiple tiers from ground cover and herbaceous plants to shrubs, mid-canopy and emergent canopy trees. To establish true ecological plantings with a range of plant species, plant associations and microclimates may need to be established over successive years of planting. For example, some species require shade from canopy cover to establish.

Cultural reference - Consider special features such as trees planted during official opening and powhiri ceremonies, etc, or trees of significance to a region (e.g. Northland Kauri). Consider the inclusion of plants as a cultural resource for future sustainable harvesting; for practices such as weaving, construction and carving.

23. The inclusion of 1% rare species has been implemented by the Auckland Motorway Alliance in all new highway planting areas

CMJ Auckland, Left image: Weed tree species dominating motorway bank (BEFORE), Right image: Clearance works, native trees retained and revegetation undertaken with appropriate native seedlings (AFTER), Auckland Motorway Alliance

Weed species can invade landscape areas and if not managed overrun the area and become costly to remove. A consistent maintenance approach is preferred, over reactive maintenance once infestations have taken over an area

Baby rainbow skink (invasive species) their eggs can be transported to site. Only use reputable plant nurseries with pest and weed control processes in place. Consider biosecurity issues as part of the landscape planning, design, implementation and maintenance

Existing vegetation protection works retaining native trees during viaduct works (Northern Gateway)

Screening – Vegetation can assist in screening. Shrubs can serve to screen headlight glare along berms, medians and at road ends. Trees can screen the highway from surrounding land uses and properties; provide shade from the sun and shelter from the wind. Screening vegetation can also assist with the integration of highway structures and the surrounding environment.

Fit for purpose -Use native and appropriate non-native plants adapted to the site conditions, project scope, local climate, and design intent.

Sustainability - Use vegetation to reduce urban heat island effects. This could be the use of trees, green roofs, or vegetated structures (e.g. trellises) in association with non-vegetated surfaces such as walkways, rooves, or walls. Select vegetation-based methods to achieve stormwater management goals for a site. Plants that provide valuable ecological services to adjacent landuses, e.g. pollinating insects. Shade in summer is another important consideration:

Maintenance - 'whole of life' aspects of the planting and the likely extent of plant growth should be considered when selecting plant species. Ensure plants do not encroach into road edges, sight-lines or signage at a later date. Set plants back from the road edge, barrier and road edge maintenance spray zone. Closer to the road edge, plants which are more spray resistant (e.g. Oioi, shiny coprosma) are preferred over spray sensitive species (e.g. Carex grasses). Plants that have a high risk of failing should generally be avoided (e.g. astellia, rengarenga, carex, dianella), in favour of hardy species (e.g. flax, muehlenbeckia, manuka, griselinia).

Weed and pest control – Control and removal of invasive species limits damage to local ecosystems, as well as impacts on new planting. Control measures should be tailored to the project and levels of infestation. In addition, consider possible issues of dormant weeds sources that may emerge when taller trees are cleared. Check that contractors and suppliers do not inadvertently bring weeds (e.g. plant pests within nursery stock) or other pests (e.g. rainbow skink eggs) to the site.

Plant pest and disease control - Maintenance works should also extend from designation boundary to boundary to aid establishment. These works protect highway landscape assets from being infested by adjacent weeds sources within the designation corridor, and are part of good landscape management practises. Plant pest control outside of the construction works should be determined on a case by case basis in association with landscape and ecological advice prior to clearance.

Other considerations - In situations where the highway adjoins private land, trees shall be setback from shared boundaries to achieve clear zones, and reduce trespass nuisance onto the highway from tree roots, branches and leave litter. Plants that may be toxic to livestock (e.g. Ngaio, Oleander, tutu) should be avoided along boundaries with rural land.

4.15 VEGETATION TYPES

The following vegetation types generally apply in highway landscapes:

A: Existing vegetation (protection, retention or removal)

Mature native and/or exotic trees provide character within a landscape setting and should be retained where possible. Mature trees are significant for their ecological, cultural, aesthetic, or historic relevance. An assessment is required to establish which plant species are healthy and viable for retention under modified conditions. This is particularly important for rare or threatened plants.

Every effort should be made to retain existing vegetation. Areas of existing vegetation should be identified early on in the scoping phase of a highway project. Individual trees should also be identified for protection during on-site works.

Balancing the steepness of batters to reduce the footprint of disturbance to natural areas around trees may be required.

Any removal of existing vegetation shall only be undertaken following approval, and in consultation with an ecologist, and a suitably qualified and experienced arborist.

B: Revegetation bush planting (ecological, slope stabilisation and screening)

This planting type will result in a relatively self sustaining bush type environment with a mix of trees, and shrubs suitable for the specific conditions of the site. The plants will form a complete canopy cover over time which will reduce the need for maintenance during the life of the planting.

This planting is implemented using 1 litre grade plants often at a density of 1 plant per m^2 (or a greater number of small plants). Enrichment planting of 2.5 litre native trees planted at a 7m spacing (minimum) in the second planting season following initial establishment can be included.

C: Buffering existing vegetation:

The edges of existing natural stands of vegetation are important as they provide a buffer zone to the interior of the stand. Removal of the buffer zone can result in major changes to the microclimate within the sub-canopy of natural stands of vegetation resulting in diminished species composition. These events can then have significant implications for the health and structure of existing stands.

To reduce the effects of the removal of the bush edge the following approaches can be adopted:

- thinning in advance of road construction can stimulate regrowth and create a natural looking protective buffer when the edge of stands of vegetation are exposed through the highway construction works;
- once the edge of the vegetation has been removed, planting a nurse crop of fast-growing native pioneer species to quickly re-establish a buffer zone is another approach.

D: Low growth natives and groundcovers:

Hardy groundcovers (e.g. coprosmas and muehlenbeckia) require less frequent maintenance and can reduce maintenance costs compared to carex species or mown grass. Over time this vegetative cover reduces weed invasion and maintenance.

These species are ideal in many highway situations, including:

- mass planting of roundabouts, central medians and other traffic islands;
- along the top of walls where larger plants are set back from the edge;
- under planting to larger trees and shrubs to achieve ground coverage and minimise weed growth;
- an alternative to small areas of mown grass which can be costly to maintain.

E: Wetland and Riparian planting (Stormwater ponds, Stream margins, Coastal edges)

This planting type will result in low/mid-sized plants designed to mimic the natural patterns of planting around wet areas. The primary function of this planting is to provide improved water quality, habitat, slope stabilisation, and shade for the water's edge. Planting will require periodic maintenance to ensure that weed species do not overrun the planting.

This planting is often implemented using 1 litre grade plants at a density of 1 plant per m^2 (or greater), wetland species can be planted as dense as 4 plants per m^2 or more.

Wetland species can cope with intermittent wet and dry periods, and are tolerant to saltwater or brackish conditions if near the coast.

Riparian plantings associated with highway corridors should generally feature native species. Care should be taken to ensure that invasive species do not populate the area as they can easily be spread through waterways.

Riparian planting can be used in ecological restoration along highway corridors that are in close proximity to lakes, wetlands, or that traverse rivers and streams.

Wetland species should be considered for roadside swales, drains and channels to assist in soil-stabilisation and filtration of contaminants from runoff water, reduce runoff speed and encourage local infiltration. Provided that the planting will not impair the drainage function or clear zone requirements of these areas.

F: Amenity planting (roundabouts, intersections, interchanges, rest areas, urban plantings)

This planting type will result in low/mid sized plants set in an ordered and controlled manner. The planting will be shrubs suited to the specific conditions of the site. The structured plants will require periodic maintenance and upkeep to ensure a tidy look is maintained.

This planting is generally implemented using 1 litre grade plants at a density of 1 plant per m^2 (or a greater number of plants if of small growing habit).

Trees and shrubs within amenity areas are sought where they can grow without obstructing the road and impacting on safety through vegetative material dropping on the road or obstructing visibility for highway users.

Within rest areas planting should be set out to create a sense of separation from the highway, while maintaining visibility for passive surveillance. Trees can be used to provide shade within rest areas.

Nursery grown plants in trays can create great efficiency for contractors when planting on site

Riparian restoration of an urban waterway utilising nursery grown plant stock

Consider plant hardening of all nursery grown stock. For example Nikau Palms need to be sun hardened prior to planting in the open

Large swathes of native planting across the Te Rapa Section of the Waikato Expressway

A limited plant palette for native nursery species can be established then infilled with native climax trees during the second planting season

Mix of natives illustrating the contrasting texture of NZ native plants

A mix of native trees and shrubs with vertical planting along a noise wall. Note vertical plant supports integrated within the noise wall structure

Open grass area requiring mowing operations, with grazing to the edge of the clear zone

G: Vertical planting (climbers or creepers to steep vertical structures)

This planting type will result in coverage of a vertical wall structure or near vertical slope. The climbing or creeping plants will require periodic maintenance so safe access should be integrated within the design. This planting is generally implemented using 1 litre grade plants at 1 metre centres along the base of the structure. To install this type of planting it should be assumed that a climbing support will be required. Vertical planting should not interfere with the structural integrity of highway structures or the highway operations (e.g. bridge inspections). The structural supports associated with this planting regime are a key consideration. Structural engineering expertise is required, as this is outside of the landscape architects area of expertise. Ideally where vertical planting is planned the required supports would be integrated at the engineering design stage.

H: Specimen Trees (single feature, groves, avenues)

This planting will be implemented with specimen trees at 45 litre grade at time of planting. These large grade trees require special site preparation, 1m radius of mulch (if not within a planted areas) and appropriate stakes and ties to ensure their survival during the establishment period.

The layout of specimen trees is subject to growth habit, design intent and site constraints, existing services, slope etc.

Specimen trees on slopes can impede mowing, imposing dangerous turning motions on mowers leading to damage of the soil holding the grass. Do not place specimen trees on slopes greater than 1:4 gradient.

Transplanted trees are also an option. However this requires specialist input by an arborist and is dependent on cost, the tree size, complexity and location of the transplant are all key factors to consider.

I: Open mown grass areas

Grass areas are featured across the highway network. The majority of the network through rural environments features grass berms. Any grass areas must be specifically designed for the site and local conditions in consultation with a turf grass specialist.

Grass areas should be appropriate for particular applications:

- rural areas where pasture or grassland is a significant element in the landscape and surrounding environment;
- erosion control on steep slopes and batters;
- within safety clear-zones along the shoulder/ berm of the highway (refer clear zone).

Mown grass areas can be costly to maintain where longterm maintenance is not considered during the design process (refer Part 4: Highway Landscape Management and Maintenance Considerations).

4.16 FURTHER PLANTING CONSIDERATIONS

Plant quality

Quality plant material is essential on highway projects. All nursery stock shall have well developed root systems, be true to form and habit, and free of disfigurements. Nursery-propagated plant stock should always be used (never collect plants from the wild). For sites exposed to the coast or high winds, plant stock should be 'hardened off' to cope with climatic conditions. This usually requires one to three months of controlled exposure to the conditions. Species such as Nikau palms should also be sun hardened prior to planting in open areas.

All plant stock shall be well watered prior to planting, free of weeds (e.g. African clubmoss) and pests (e.g. Argentine ants, copper skink). The introduction of pest plants from nursery stock has major detrimental implications for highway landscape areas, where they could result in areas being dominated by weed species in only a few growing seasons. All plant stock shall be sourced from a reliable nursery(s) with strict standards in relation to weed and pest management.

Plant procurement

Early plant procurement can save money and add certainty on the availability of plant stock. When propagating eco-sourced plants (including any rare species), early procurement is essential. Eco-sourced species require a lead in time of more than 1 growing season (e.g. more than 12 months from autumn). Certain species may also take longer to procure due to the variability in seed available during any given year.

Transportation and delivery requirements, temporary secure storage and irrigation (if required) also need to be established prior to plants arriving on site.

Eco-sourcing

Ecosourcing conserves natural, genetic and phenotypic diversity in local native plant populations. These plants are also more likely to adapt to local growing conditions). Refer to Ecosourcing Code of Practise and Ethics.

The use of nursery-raised eco-sourced plants is the most commonly used technique for acquiring plant stock for highway landscape treatment. Plants should be propagated utilising seed or cuttings where appropriate and only by certified practitioners.

Considerations associated with eco-sourced plants include:

- the availability of eco-sourced plant stock commercially available;
- lead in times required for the collection of seed, and plant propagation to meet project requirements;
- eco-sourcing from within the ecological district (and if not then the ecological region) from multiple parent individuals is the approach advocated to ensure genetic characteristics of a local population are not overwhelmed by the mass introduction of a remotely occurring relatives.

Plant Grades

For highway landscape treatments the following plant grades generally apply:

- plant sizes at 1-1.5 litre are considered standard for mass planting;
- infill native tree planting at 2.5 litres are considered standard;
- individual specimen trees at 45 litres are considered standard.

Plants that are available in trays of the plant size grade required (as opposed to individual pots) can achieve efficiencies for planting gangs carrying plants over large planting areas.

Smaller plant sizes, such as root trainers may be acceptable in certain situation, as they can be wedged tightly into soils in flow paths, and can fit into biotechnical materials in association with stormwater management without affecting their structural integrity.

Plant grade size 1 litre (and above) are more likely to survive establishment (including pukeko browsing).

Pint Bag to Litre conversion

In New Zealand the commonly used soft plastic bags (PB) have been utilised by the nursery industry for a long time and were first introduced when pints were still the measurement for volume. Accordingly, a standard plant grade plant is a PB3 (3 pint bag) has a root system contained in 3 pints of soil mix. The height and age of the plant will vary considerably depending on the species but you could generally expect a plant about 30 - 60 cm tall (one to two feet tall in old measurements). The PB3 equivalent volume is 1.7 litres and the hard plastic pot equivalent might be either a 1.5 litre or 2 litre pot[24]. Below is a conversion table, setting out some standard grades used within highway landscapes:

CONVERSION TABLE

PINT BAG TO LITRE SIZES

	PB	SIZE	LITRE conversion	LITRE POT SIZE AVAILABLE
PB	2	90 x 90 x 200	1.136	1
PB	3	100 x 100 x 200	1.704	1.5
PB	5	120 x 120 x 230	2.84	2.5
PB	10	120 x 120 x460	5.68	5
PB	12	160 x 160 320	6.816	10
PB	18	180 x 180 360	10.224	10
PB	95	300 x 300 x 600	53.96	45

1 PINT =	0.568	litres

Native plant procurement from the nursery, checking plant quality

Quality ground preparation, topsoil, mulch and plant stock, achieves a quality outcome

Plant grades

24. Source: www.oratianatives.co.nz

Result of weed mat in highway planting

Mulch and planting, note weed control operations

Mulching operations

Mulch prior to planting

Set out and composition

Site preparation prior to planting should ensure the site is free from residual herbicides and is weed free.

Following an approved planting scheme, indicating composition/ mix and spacing of plants. Plants should be placed in accordance with their environmental tolerances, directed by a suitably qualified and knowledgeable supervisor. Plants should be staggered in odd numbered groups (for plant numbers less than 10), unless otherwise intended by the planting design.

Plants may be required for specific purposes such as visual screening to reduce headlight glare; to mitigate adverse visual effects of the highway; or for the integration of the highway elements such as noise barriers, earthworks and structures. All planting should avoid creating concealment areas that may threaten pedestrians' perception of personal safety.

Generally all plants should be laid out for approval prior to planting to ensure appropriate lay out. Plants which are problematic if planted too close to the road edge or barrier should be set back or integrated within the general planting.

Fertiliser

If initial soil nutrition, pH and depth are adequate, soils supporting perennial, un-mown vegetation will rarely need fertilising. Pale green and yellowing plant foliage is often due to inadequate aeration, not inadequate nitrogen, so check the soil physical condition before the application of fertiliser. However, where fertiliser is determined appropriate in nutrient-deficient soils, slow-release tablet fertilisers can be applied into the base of the planting hole for roots to absorb the nutrients.

Fertilisers should be avoided in planted areas immediately adjacent to watercourses. Bioretention and filtering devices should not be fertilized, as they receive nutrients from offsite during stormwater flows.

Timing of planting

Planting times vary according to environmental conditions. The ideal planting season will be between late autumn – early spring, from April to September. Earthworks will be in place in time for planting and the co-ordination of earthworks, grading and soil preparation co-ordinated within the construction contract works as a whole. Planting within the planting season will achieve optimal plant establishment and survival, with reduced re-planting and additional maintenance.

Planting in open water and wetland areas should occur in late spring to early autumn (September to October and March to May) when water levels are low and the water is warm. Hardy frost-tolerant species can be planted in autumn and frost-sensitive species in spring.

Careful timing of planting at the right season will reduce the need for emergency watering. However, in dry spells young plants may require more watering to assist with their establishment.

Enrichment trees or plants that need shelter or shade can be planted one or two years later, once adjacent canopy cover has developed.

Mulch

Mulch is a surface layer generally wood chip and organic material; however stones, gravel material may be required within stormwater treatment areas. Mulch should be laid at depths of 100mm, except around the immediate base of shrubs and trees to avoid rot in the plant stem. Carefully consider the use of bark mulch for planting areas contributing runoff to the stormwater management network. The stormwater assets are regularly adversely affected by bark blocking channels and catchpits due to excessive bark mulch washed off planting areas. Bark can often appear in ponds affecting the water quality and quantity management capacity of the asset and requiring an increased frequency of maintenance. The planting area edges should always be considered to avoid mulch spread.

Mulch provides the following functions in landscape treatments:

- weed suppression until a dense vegetation cover is achieved. Kikuyu and other rhizomous plants may be advantaged by mulches and should be controlled prior to mulching;
- short-term surface stabilisation through prevention of a surface crusting, rilling etc;
- plant nutrition (for organic mulches);
- increasing moisture supply and retention during plant establishment, especially as irrigation is generally not included within highway projects;
- cushioning the impact of foot traffic;
- it creates short-term interest and amenity, and reinforces the planting area.

Grass clippings or animal waste should not be used as mulch as they may act as a source of contaminants, such as nitrogen and faecal coliforms.

An erosion control fabric is recommended for areas subject to water flow or on steep banks. A matting that combines weed suppression, mulching, and erosion control is applicable in this situation. Biodegradable matting should be used as it contributes to soil biology. Non-biodegradable weed mat should not be used.

Technical considerations:

- coarse graded, long fibred mulch that self-binds is preferred as it avoids mulches that float such as bark nuggets;
- mulch should not include treated timber products;
- mulch should be well aged and free of weed seeds, soils, roots, and plant fragments;
- mulch made from composted green waste will usually provide valuable plant nutrients, while avoiding nitrogen stress. Ensure that no plastic/ rubbish is present in green waste mulch;
- coarse and bark mulches generally last longer than fine mulches;
- most organic mulches will enhance removal of contaminants and therefore extend the treatment life of a raingarden;
- establishing a dense, low cover of plants can be an effective alternative to mulch. This method is especially useful on sloping banks (generally greater than 1:3) where mulch will not hold or where loose mulch may contaminate a watercourse (Boffa Miskell 2007).

Alternate planting methods

In natural environments alternate methods of revegetation may be required, for example, direct seeding. Direct seeding sows the seeds onto a prepared planting surface. For native plants this method is only suitable for pioneering shrubs and early succession species (e.g. manuka). Success of this technique depends largely on:

- relatively large amounts of viable seeds;
- timing that coincides with optimal seed viability and germination periods;
- a suitable microclimate;
- favourable climatic and soil conditions during germination;
- control of competition from weed species;

These methods would be applicable in:

- areas where remnant vegetation is highly specialised and needs to be used for conservation purposes;
- At isolated sites;
- to gain cost efficiencies (which would require justification).

Another example would be salvaging epiphytes (only found in older or larger trees) from forest that is required to be cleared. The epiphytes being placed in areas adjacent to the highway, thereby enriching biodiversity.

Biodegradable wool matt pinned to a steep bank stabilises the surface of the slope and suppresses weeds while the planting establishes

Filter socks pinned in place retain the adjoining mulch

Planting into reinforced coconut fibre matting. The matting stabilises the slope while the plants establish

Planting of coconut fibre matting within a swale feature. These areas combine stormwater management with landscape treatment

Stormwater management areas can also have an amenity focus

Engineered pond softened and integrated with planting

Ponds can benefit from planting. Shallow ponds can result in algal blooms, so shading of the pond is advisable. However trees should not be planted in areas that will not effect the ponds stability

Pond engineered to represent a natural wetland. Planting associated with the pond mimics the natural wetland margins.

25. Landscape and ecological values within stormwater management 2008 Auckland Regional Council

26. ibid

27. ibid.

28. ibid

Water

Ideally plants within the highway network should not need watering. Soaking plants prior to planting in line with best horticultural practise is required. All planting should take place at the right time of year to minimise water loss to the plants.

Irrigation is not generally sought. Where irrigation is absolutely required. Specialist advice shall be sought to ensure that the supply of water to the area is sustainable and that the irrigation system can be managed as part of typical highway landscape maintenance and operations.

4.17 STORMWATER MANAGEMENT

Dry Ponds

Stormwater infiltration type assets such as dry ponds have proven effective measures for the Transport Agency in areas of New Zealand with free draining soils. Dry ponds help manage the excess runoff generated by impervious surfaces such as newly constructed roads, or existing surfaces. They allow larger flows of water to enter but limit outflow, this provides functions such as extended detention, and retention through infiltration and evaporation of stormwater. Dry ponds are often used in conjunction with swales, which may also have a dry detention component.

Dry ponds are generally grassed. The grass needs to be able to withstand inundation, and the shape should allow for a mowable slope. Dry ponds can also be planted provided the plant species, mulch and surface treatments are tailored to the function of the dry pond. Any planting needs to withstand the dry nature of the permeable soils as well as temporary inundation. It must not wash out and clog neighbouring stormwater assets. Plant species selected need to withstand the wet and dry conditions.

The infiltration capacity of dry pond features can be improved through the use of stone columns and infiltration trenches. This is subject to ground water levels on site.

Wet Ponds

Constructed stormwater wetland ponds are systems built to replicate the water cleansing processes of natural wetlands. The landscape design for ponds should be undertaken in collaboration with the stormwater engineer and stormwater maintenance specialists. There are three main types of constructed wetland: surface-flow wetlands, sub-surface wetlands, and floating wetlands[25].

A surface-flow (SF) wetland consists of a basin of varying water depths with soil or other media to support wetland vegetation and a water control structure that maintains water depth above the substrate. Water is treated as it flows across alternating zones of deep water pools and shallow shelves of wetland plants[26]

A subsurface flow (SSF) wetland is constructed of a sealed basin filled with a porous media. Stormwater is treated as it passes through the media and root zones of wetland plants. Stormwater remains below the surface of the substrate at all times. SSF wetlands are best suited to water inputs with relatively low solid concentrations to prevent clogging, and relatively uniform flow conditions to ensure plant survival (Davis 1995)[27]

A floating treatment (FT) wetland is a raft that supports wetland plants, growing in a hydroponic manner, within a deep water basin (Headley & Tanner 2006). FT wetlands are still a relatively unproven technology in stormwater ponds but field testing has revealed there is significant potential for these systems; where they filter fine sediments or contaminants in solution. They are also likely to be highly effective for shading open water[28].

Infiltration type stormwater assets (e.g. SSF, DT) are not always desirable due to the rate of clogging that is caused by the sheer amount of CRAP (Crude road accumulated pollutants). Raingardens, biofiltration, planter box can clog very quickly and increase the risk of surface flooding to the highway. Infiltration assets are generally not a good whole of life solution in relation to operations and maintenance, which is high. However infiltration can form part of the treatment train and should be site or region specific.

Image: Highway stormwater management Auckland central (overview)

Pond Location, Form and Structure

Ponds need to be located a safe distance away from the carriageway, or be separated from the carriageway by barriers as they represent a significant hazard. In designing a constructed pond/wetland consider these safe distance setbacks and maintenance access.

In addition these features can provide multiple functions including amenity and ecology where they attract a variety of wildlife. Wetland design should ideally provide an irregularly shaped shoreline to maximise the length and variety of edge habitat.

As a rule, 25–50 % of the water surface area in a treatment pond should be shallow enough to support wetland plant establishment, and 50 – 75% of the water surface should be greater than one metre in depth to stabilise water temperatures.

Other measures include:

- physical change in terms of water depths to provide for open water and shallow shelves and topographic variation along the shoreline;
- moving water to provide riffles;
- different plant communities (open water, emergent: from 1.0m to 0.2m below design water level, Littoral: greater than 0.2m below design water level, edge planting, Terrestrial zone: including existing vegetation);
- islands (can act as bird roosting habitat on large ponds >0.5ha);
- habitat features such as fallen logs, boulder outcrops, and alternating dense vegetation, gravel beaches, and hard edges. Note loose placed round river run rocks should be avoided in stormwater features. These rocks can be a safety risk (when run over by tyres they can become missiles);
- a deep refuge pool to support fish and aquatic insects on the occasions that the pond is drained for maintenance;
- margin habitat for plants, fish, and aquatic insects;
- floating wetlands.

Wetland & pond planting

Wetland planting should be carried out in early spring (September to October) or early autumn (from March) when water temperature are warm and plants are growing vigorously.

Think about plant species and the result sought. Some wetland plants can generate excessive biomass, raupo for example can create issues if not managed. Excessive biomass will take up the stormwater quantity management capacity, that is reduced channel cross sections and water capacity. The excessive biomass may also impact on stormwater quality improvement performance and ponds may require increased frequency of maintenance to retain sufficient water quality volume for the treatment performance required.

No fertiliser is to be used in wetland plantings.

Topsoil on wetland shelves will require either erosion control fabric or to be worked into subsoil and lightly compacted.

Plants should initially be planted in water no deeper than 100mm, with a minimum 150mm of plant foliage above the water level. Once planted the water level is gradually increased.

Plants need to be firmly planted to a minimum depth of 40mm within the substrate; the plant needs to be well anchored so that it is less prone to uprooting or floating. In summary ideally a minimum 250mm of plant foliage shall extend above the topsoil.

Vegetation that is intended as a physical barrier may require a temporary fence such as a 1.2m high silt fence for protection until the planting has established.

Consider planting of specimen trees for shading of ponds and streams to manage thermal impacts and ecological provisions for fish, flora and fauna passage. The location of trees is important to provide sun, shading and edge stability; further to this pipes which may be affected by tree roots need to be considered.

Where pukekos, which often pull plants out soon after planting, are a concern, plants should be 1 litre grade or bigger, or the plants staked in place with biodegradable stakes at 45 degrees to help prevent their removal.

Image: Highway stormwater management Auckland central (on the ground)

Planted pond margins can mimic the natural environment and local plant ecology

Maintenance access to landscape stormwater management assets is vital. Access considerations for operations and maintenance should be integrated early as part of the landscape design

Planted swale illustrating a mix of suitable species (AMA Swale trial)

General wetland/ pond maintenance

Once vegetation has been planted, intensive maintenance will be required over the first two years including physical repairs, mulching (if required), weed removal, and possible replanting.

Continual monitoring and maintenance will ensure wetland plants establish, and that both the aesthetic appearance and functional operation of the wetland or pond are secured.

Corrective maintenance may also be required including slope and erosion repairs. During periodic maintenance of ponds, such as forebay sediment cleaning it is not always practical to protect all planting. There are time and access costs and where the delivery of operational activities causes some damage to planting; replanting of damaged plants may be required.

Ongoing management and maintenance of stormwater wetlands or pond is likely to include:

- inspection of structures for blockage by plants, mulch, or algae;
- monitoring sediment accumulation around plants and at inlets and outlets;
- regular checks for problem weeds which can lead to control of potential invasions early when it is relatively easy;
- checks for insect pests, particularly midges and mosquitoes;
- supplementary watering, potentially by siphoning or pumping from pre-treatment ponds;
- general observations on water quality, algae, clarity, odour, insects, vandalism. A good technique is to take photos from fixed points;
- in the event of a perceived water quality issue, implement a water quality monitoring programme to where water levels and target contaminants are sampled. This will determine what management actions to take;
- flooding can cause plants to be scoured from a wetland and/or drowned. If a large area of plants is lost (>5 m^2), re-establishment will need to be carried out. Small areas will generally recover naturally.

Swales and filter strips

Swales are vegetated channels that convey stormwater, slowing the velocity of flows and filtering coarse grained sediments.

A filter strip similarly filters stormwater using a planted slope with a dispersed (or laminar) flow. Both devices are readily applied to primary treatment of stormwater runoff from roadways. The Transport Agency stormwater standard encourages this use of a "treatment train" approach, which swales and filterstrips form a part of, along with dry ponds, wet ponds, detention basins and wetlands.

Swales can be grassed or planted. The Transport Agency seeks planted swales for a number of reasons:

- when ground water is within 1m of the base of the swale, grassed swales are compromised;
- planted swales not only help to delineate and define the asset for operational purposes, but if frangible act as a good deterrent to errant motorists, that is motorists pulling over to answer phone calls seldom park in the 'garden'.

Planted swales also act as a good deterrent to maintenance operators, for example mowers passing through a grassed swale area which is comparatively flat can damage the swale profile resulting in ponding and boggy ground. Planted swales defer this and create the potential for continuous planting along the network.

General swale and filter strip treatments

As for other devices, filter strips and swales can be integrated into existing landscape elements by:

- a legible relationship with natural flow paths and topography;
- integration with adjacent planting schemes or natural plant communities;
- wide undulating channels as subtle overland flow paths;
- the use of rock weir structures or logs as check dams in naturalised swales.

Typically swales and filter strips are located along berms. Therefore, they frequently define edges to the landscape. This can provide for the following functions:

- separation of landscape treatments from traffic;
- separation of pedestrians from traffic;
- glare protection and screening unwanted views;
- shading impermeable areas using canopy trees adjacent to the swale or filler strip as appropriate;
- lead the eye along straight areas or continuous curves to focus driver attention on the road ahead;
- soften hardscape areas and reduce roadway expanses.

Swales and filter strips are extreme environments experiencing both rapid inundation and drought. Plant species are a function of expected flow rates and frequency.

Filter strip devices can provide for important transitional buffers to receiving environments, both in terms of hydrology and for buffering interior habitats, such as remnant native bush. They can also provide a suite of environmental benefits, common to all devices, for water and air quality, interception of dust, cooling of ambient temperatures and more.

Refer to Transport Agency's Stormwater Swale Planting Improvements – 2011, Auckland Motorway Alliance, www.nzta.govt.nz

Closely planting swale planting, with plants at 300mm centres

Mulch can block stormwater assets. Landscape treatments need to retain mulch to avoid this situation

Within highway landscapes a large apron around services makes for easy identification and maintenance

Poor practise of spraying swale

Best practise of manage vegetation cover within swale

Hard to manage boggy area (BEFORE)

Same area featuring an integrated swale planting as frangible vegetation (AFTER)

4.18 MATERIALS SOURCE AND SUPPLY

All materials require natural resources which are extracted, manufactured, and/or processed for human use. The proper selection and use of materials can contribute to highway landscape design, and the cost efficiency and whole of live value for money of landscape treatments. A sustainable approach to material use in landscapes is sought and it seeks to incorporate and reuse as much of the existing site materials, (including soil, vegetation, mulch, etc as practical.

Examples of the selection and re-use of materials in highway landscapes

Use of onsite materials

Before procuring and purchasing new materials, seek opportunities for the design to reuse any existing materials, including existing on-site elements or those salvaged from off-site. Reduced materials consumption, through designing elements that provide the design intent with the least amount of materials is important. On site material such as feature rocks and logs can also act as habitat features.

Locally sourced materials

Research options for plants including ecosourcing and seek that materials be grown or sourced locally. For timber, choose certified, sustainably harvested wood. Through selecting materials that require reduced energy for production, transport, and operation, greenhouse gas emissions can be decreased. Involving the local community in aspects such as plant propagation can also have multiple benefits to highway projects with an ecological restoration focus.

Evaluate the whole of life costs of materials

In line within international best practise such as Green road, consider the environmental and maintenance effects of each product within the design, all the way through the products life. Consult with Asset Managers (e.g. in Auckland, the Auckland Motorway Alliance) to see what issues currently exist within the network to avoid landscape treatments in designs that are a maintenance and operational liability. Select products that are less damaging and require less repair or replacement throughout their life cycle. Consider materials that can be recycled or deconstructed and reused rather than disposed of to landfill.

During construction and demolition, look for ways that materials that can be reused or recycled, both on-site and at other nearby highway project sites. Continue looking for options to reduce waste throughout the life of the site. Mulching and composting landscape waste can be recycled as materials for use in landscape areas (provided it meets the specification).

Urban greening

Use vegetation to reduce the heat island effects in urban hard surface areas and minimise microclimatic impacts. Replace hard constructed surfaces with vegetated surfaces where possible.

4.19 HARD LANDSCAPE TREATMENT SUMMARY

Hard landscape finishes are required within highway environments for pedestrian paths and cycle route surfaces. There are also landscape areas that cannot accommodate planting for a range of reasons; narrow gore areas, or where maintenance inaccessibility means that planting is impractical.

There are highway landscape situations that are hard to access for maintenance such as behind highway barriers, beneath wire rope barriers, around the base of highway structures or the apron around a manhole cover, these areas all require a hard surface finish, to integrate long-term maintenance costs. Whole of life value of landscape treatments can be achieved in these hard to manage areas through the use of hard surface.

The hard surface type/material chosen will be guided by its use in the area, cost, safety in design matters and the landscape design generally. Hard surfaces shall be co-ordinated throughout the corridor. Loose aggregates such as gravel chip, local sourced crushed rock or river washed stones are used in many situations. There are also a range of asphalt and concrete finishes and paving types required for paths and other areas, the selection of the finish should be co-ordinated within the corridor and with the project engineering team.

Hard surface around the base of signage for ease of maintenance. Note, however, that this situation is also an isolated grass area with no access provided making it an inefficient and expensive landscape asset to maintain

Isolated landscape areas (e.g. gore areas) are better to be hard landscape/ gravel than planted/ grass due to difficulty in access for mowing and maintenance

Isolated area, narrow gore area and continuous safety barriers make this future landscape area very difficult to access and maintain

Poorly integrated structures and slopes create a safety from falling and safe maintenance issue. This area requires costly weed eating and is a hazard. These types of integration issues do not deliver whole of life value for the NZTA and should be addressed at the design phase

PART 4: HIGHWAY LANDSCAPE MANAGEMENT & MAINTENANCE CONSIDERATIONS

This section provides guidance for the designer where long-term maintenance and management of the highway landscape asset needs full consideration during the design process. Part 6: Operations and Maintenance Phase provides guidance for the long-term aspect of delivering high quality highway landscapes.

The long-term maintenance requirements of a highway landscape, together with the funding to facilitate maintenance are an integral component of the design process. Where consideration of the long-term maintenance is not made as part of the design process, the potential of the landscape will not be achieved. The following are key considerations for integrating maintenance thinking into design.

4.20 BUILD IT ONCE, BUILD IT RIGHT...

For highway landscapes to be successful and endure, the operations and maintenance aspects of highways must be embedded within the landscape design. Maintenance constitutes the majority of the Transport Agency's investment in highway landscapes overtime. Similarly design must immediately consider and address any legacy issues associated with vegetation adjacent to the highway corridor within the Transport Agency's control. A particular example is in relation to the management of pest plants to reduce compromising landscape assets at a later date.

Over the life of a highway, poorly planned, designed and implemented landscaping will become a costly liability for the Transport Agency. In addition the intangible costs of poor landscape outcomes can impact on Transport Agency customers through loss of network efficiency, increased safety risks (e.g. from lane closures requiring lane changing) and amenity impacts.

Recognising and integrating operations and maintenance aspects early on in a project is therefore a major factor for delivering whole of life value for the Transport Agency. The section below outlines some of the design aspects for achieving whole of life value, and landscape outcomes which align with highway operations and maintenance requirements.

It is the designer's responsibility to represent value for money in design proposals by taking into account site specific maintenance considerations for any project. This generally requires the designers to:

1. identify maintenance issues (e.g. central grassed median between continuous barriers);
2. address how landscape and stormwater pond areas will be accessed for maintenance, including safe pull off maintenance bays and areas for offloading and reloading. Consider how the design and positioning of these access areas can reduce the need for costly traffic control measures;
3. consider maintenance runs of a significant area/length in the design. This will allow maintenance efficiency where repeated off loading and reloading of crew and equipment are avoided;
4. rationalise grass areas for tractor mowing, by allowing space for manoeuvring, and co-ordinating elements such as, sign posts, gantries and other highway infrastructure with planting;
5. avoid or minimise the planting of grass across slopes that are too steep for tractor mowing and reduce the extent of grass where possible, in line with whole of life value considerations which are specific to each project;
6. design low maintenance solutions to address areas such as under guard rails, along barriers, around signs, light columns, gantries, roadside cabinets etc;
7. seek to engage with the local Transport Agency's Operations and Maintenance team. This can assist in knowledge sharing and scoping issues within the local network. It can also assist to futureproof the Landscape design for ease of handover.

DESIGNATION WIDE MANAGEMENT

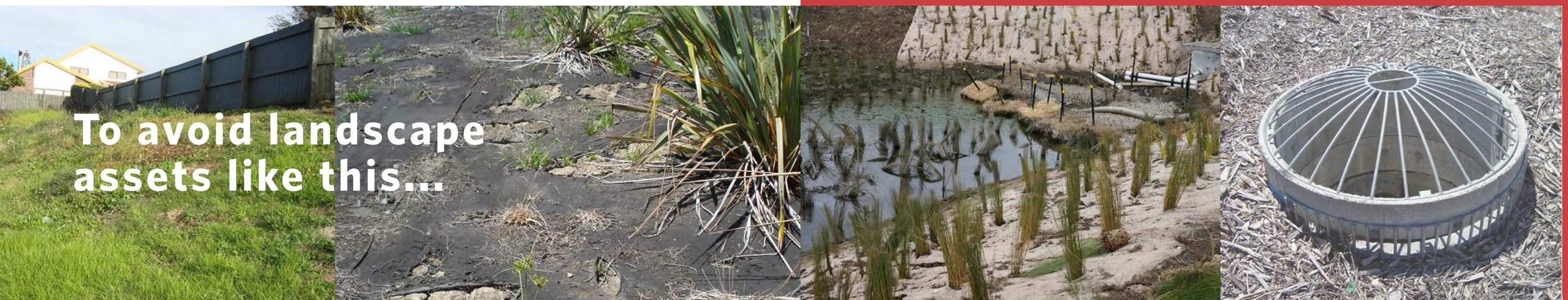
The Transport Agency manages the entire corridor from boundary to boundary (fence to fence) within the designation. This includes the management of all new landscape including planting, and grass; and areas not planted or grassed such as remnant bush areas, existing pasture, and peripheral areas within the designation.

Throughout the country the Transport Agency co-ordinates maintenance contractors. These contractors can have a lot of 'on the job' knowledge about what landscaping outcomes work and are successful within the corridor. Local territorial authorities, the Department of Conservation, adjacent landowners and others may also be able to provide vital insight into what has been successful within a particular area.

Asking maintenance questions

A key element of highway landscape design involves asking specific questions that focus on operations and maintenance (O&M) for highways. The questions should include:

- what are the current landscape maintenance issues for the network within the local area? Discussing what issues have been encountered or that persist with O&M personnel who can inform the designer so to avoid repeating past mistakes, and to gain insight into O&M health and safety concerns.
- what maintenance is required? For planting, what is required to achieve canopy closure and maintain this coverage?
- what needs to be maintained and when?
- who will perform the maintenance? Does the design require operation and maintenance specialist input or will someone with general maintenance equipment and training be able to accomplish it.
- how can the design provide safe access for maintenance?
- can the design provide a means for the maintenance contractor to reduce the time on site to conduct maintenance, inspections and perform maintenance?
- how will maintenance be performed? The simple instruction to remove vegetation can become complicated if there hasn't been any provision made to allow equipment access to landscape areas or even to the site. Are gaps between barriers provided, is there gated access, are locks used to limit public access to an area? If security features are used then there has to be a common key to allow easy access.
- what is the timing of the operations?



Routine pond maintenance to remove sediments captured in the pond

Highway crew weed eating areas not accessible by a mower

While visually appealing grass behind barriers within high traffic urban environments is costly for the NZTA to maintain

Safety from falling for landscape maintenance. All fencing and barriers should be coordinated with the urban and landscape design

ACCESS AND SAFETY DESIGN CONSIDERATIONS

Considerable cost can be incurred through temporary traffic management (TTM) in association with routine landscape maintenance activities. In particular gaining safe access for maintenance of grassed areas behind barriers, or grass areas within central medians behind barriers. Currently approximately fifty per cent of on-going grass maintenance costs for the Auckland Motorway Alliance (AMA) are weed eating areas otherwise unable to be mown with a tractor mower. Grass should be sufficient distance away from the live lane as to not require any significant traffic control (i.e. attenuators) when mowing is in progress or when unloading the equipment. This distance from the live lane requires due consideration being given to area specific safety concerns. Ideally mowers should be able to get to the next area without needing to access the motorway which requires traffic management.

When landscape areas are located more than 5m away from the edge of a live traffic lane they do not require TTM, and provided safe access is available these areas can be accessed directly off the highway (Transport Agency's COPTTM manual provides specific details of TTM requirements). In effect this removes the requirement for costly attenuator trucks and TTM when maintaining the area. Designs which address these issues lead to network efficiencies and cost savings for the Transport Agency in relation to the maintenance of landscape assets.

Safe access points and space to park vehicles during regular operational and maintenance activities are required for traffic control free landscape maintenance. These can also be co-ordinated within the design to double as inspection points for stormwater assets, IT assets and structures. These access points can be achieved through the provision of gaps in guardrails and/or barriers.

If unavoidable, narrow areas behind structures such as noise walls should have appropriate maintenance access for spraying.

PLANTING VS. GRASSING

A balance between upfront capital costs and long term whole of life value for money needs to be addressed in the landscape design when considering planting or grassing treatment. For example, in general, successful planting which can establish canopy cover quickly requires less maintenance in the long term, whereas grass areas require continual investment through mowing. Planting will have higher upfront cost, while grassing is cheaper initially.

In a number of situations across the highway network a costly liability for the Transport Agency has been created where grass has been implemented on steeper slopes which are hard to mow. The costs to maintain these areas includes associated traffic control and weed eating over time far exceeding the expense and upfront investment in a planted landscape treatment.

An optimum design will generally not require traffic attenuators to be used for the purpose of protecting regular maintenance activities such as grass mowing.

The "DO / DON'T " diagrams within this section are presented to illustrate grass and planting area maintenance issues.

Further considerations to achieve successful outcomes for grass and planted areas are addressed below.

GRASS AREAS

To ensure longterm efficient management of grass areas specific design is required.

- grass mixes specifically designed for the site conditions;
- drainage included where necessary to avoid mud tracking onto the carriageway from grass mowing, following wet weather;
- non-motorway access via local roads may be appropriate in some areas;

Slopes

NZTA's Standard Professional Services Guideline PSG/3 - Asset Management Guide Version 1, (March 2009) can be used as a design guide for mowable slope grades. It states "Ride-on mowers require slopes less than four horizontal to one vertical"(I in 4).

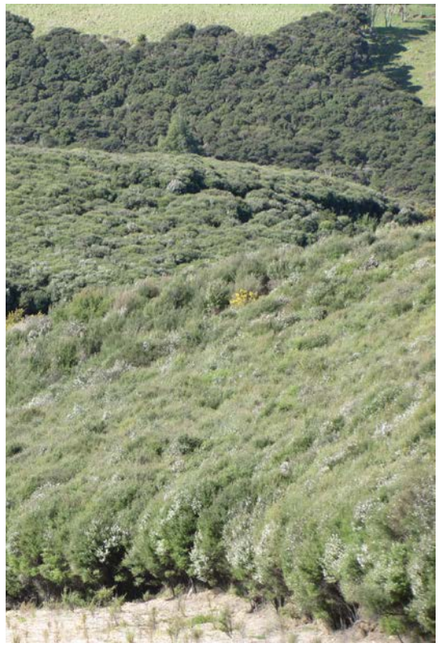
Grass slopes 1 in 3 and steeper are strongly discouraged because of safety and efficiency reasons. These steeper slopes should be planted. An area of reduced grade within a slope can be an acceptable solution to allow safe mowing operations. Where steeper grades are required allow a shallower area within the slope, where possible, for safety.

Where slopes are mown they need to be even with no bumps or holes/soft-spots/rutting/obstacles to mow around, particularly when getting up to slopes of 1 in 4. Safety in design should be a key consideration, (for both the mower operator and highway users). Tractors will roll over through a combination of; slippery/wet conditions, bumps and hollows/soft spots (e.g. caused by water seeping out of a slope), imperfect or eroded slopes, turning on slopes, small loss of pressure in the downhill tractor tyre, and operator error including speed.

All slopes can only be safely maintained if there are no impediments to mowing the whole slope. Having to manoeuvre around isolated trees can be very dangerous when the tractor is required to turn uphill. There are simple design solutions to avoid these issues and give due consideration to the tractor mowing plan as part of developing the design.

CRITICAL SLOPE CONSIDERATIONS FOR MOWING MAINTENANCE OPERATIONS

SLOPE	SLOPES WITH RUNOFF AREAS	SLOPES WITH DROP HAZARDS	COMMENT
< 1 in 12	General consideration of mowing requirements.	General consideration of mowing requirements.	NZTA levels of service likely to be met .
1 in 7 to 1 in 12	General consideration of mowing requirements.	Slopes to be specifically designed for mowing runs e.g. tractor turn areas, obstacles to mowing such as vegetation, poles, evenness of slope, avoidance of need for tractor to go close to edge. Produce tractor mowing plan.	NZTA levels of service unlikely to be met for slopes with drop hazards when the slope is wet even with runoff areas. Separation from the top of the drop needs to be considered.
1 in 4 to 1 in 7	Slopes to be specifically designed for mowing runs. Produce tractor mowing plan. Consider tractor turn areas, evenness of slope, poles and safe runoff area. Also consider vegetation.	No grass generally and preferably planted, but considered on a case by case basis, mindful of mowing safety issues and whole of life considerations.	NZTA levels of service unlikely to be met when slopes wet - even with runoff areas. Slopes need to be well constructed with no bumps or hollows. Consider planting.
1 in 3 to 1 in 4	Only where unavoidable and practical. Subject to criteria above. These slopes are above the desirable safe mowing slope and would only be able to be safely accessed at certain times of the year and during dry weather. Line trimmers would be required to manage the slope when it is unsafe to access with machinery.	No grass; planted only	Steeper than the 1 in 4 that NZTA PSC/3 recommends for tractor mowers. Planting recommended.
> 1 in 3	No grass; too steep	No grass; planted only	Line trimmers would be required to manage the slope as it is unsafe to access with machinery.



Northern Gateway establishing Manuka

Northern Gateway batter revegetation trial area (2005)

PLANTED AREAS

The design of corridor vegetation, the establishment of slope gradients and ground conditions, and the placement of other corridor assets within the corridor (elements such as guard rails, barriers, lighting columns, gantries and signs) should be jointly considered as part of a holistic corridor design.

Key factors for planted areas include:

- avoid plants growing to full height and encroaching into live lanes, over barriers and guardrails, obscuring signage and other adverse impacts from poorly placed and/or selected planting. The designer should specifically address this matter when selecting plant species;
- consider all parts of the plant. For example specific attention should be given to avoiding planting flax where flax flower spikes will grow to considerable heights and encroach into live lanes;
- avoid cabbage trees near to grassed areas as their leaves clog mowers;
- consider short lifespan species such as Whau only as part of a staged restoration planting otherwise seek long lived species or planting that will be enriched with longer lived species. Note: Costs to bring landscaping up to full establishment after the end of the Defects Liability period through an enrichment methodology should be clearly identified and funded from the project through suitable arrangements in these situations;
- planting in front of barriers and guard rails should only be used where there will be no safety risk from vehicles striking the vegetation and crossing over the guard rail or barrier. For example avoid the use of flax due to the ability of the thick base to launch or overturn an errant vehicle;
- vegetation planted in medians and similar areas such as gore areas requiring on-going maintenance should be avoided unless they can be safely accessed without any significant traffic management;
- where vegetation is planted in median and gore areas, it shall be designed so that it will require minimal maintenance.

SPECIAL FEATURES AND OTHER CONSIDERATIONS

The positive legacy of a highway landscape design may diminish quickly if the knowledge around the features and its maintenance leaves with the project team. Highway operations and maintenance (O&M) recommend that all special features (designed and/ or pre-existing) be identified early on. For example landscaping can reduce graffiti offending, particularly in front of fences and noise walls so planting should be maintained to achieve this outcome.

When co-ordinating operations and maintenance aspects, the following should be considered and reflected on the landscape plans:

- maintenance of tree health and aboricultural best practices i.e. trimming needs to both maintain sight lines and tree health by cutting branches to a place where the tree can rapidly heal itself;
- maintenance access to stormwater management areas;
- the interface with walls and structures, gates and fences;
- the interface with urban design features and artworks;
- graffiti mitigation;
- special features, historic places, special interest areas such as time capsules, grave sites, special blessing stones, sculptures, trees and, taniwha areas;
- special landscape agreements with landowners and their associated levels of service;
- any other feature whose history or future treatment is not otherwise obvious;
- confirmation that all construction consents have been closed out;
- supporting documentation of any ongoing consent requirements if in place (i.e. a summary of what the network outcome contractor is required to do).

These elements should be covered within any asset owner's manual, where relevant explanation of their significance and other information should be provided.

A SCIENCE BASED APPROACH

A scientific approach is advisable to ensure highway landscape assets are robust. This requires planned investigation into what landscape treatments will be successful on a site.

Scientists such as ecologists, botanists, soil scientists and other environmental scientists may act as advisors to the design team.

This expert input can aid decision making in specialist areas such as soils, mulches, plant species selection and revegetation methodologies.

Where projects are large scale and have a longer lead time the opportunity to take a scientific approach to reaching decisions can greatly enhance the outcomes.

Examples of the trials undertaken on projects include the Northern Gateway where trials included:

Batter revegetation treatments trials; where different geotextile systems, compost mixes and seed were laid and monitored against different control plots. In these trials further to direct seeding mature specimens of desired plants were planted at the top of the slope to provide a seed source.

Manuka establishment trials; where manuka slash (branches from locally sourced manuka trees with mature seed heads formed on them) were laid over the ground with different compost mixes and seedling establishment monitored. This was compared with planting nursery grown young plants (propagated from locally sourced seed) at different grades (root trainer, 1 litre, 1.5 litre).

On Mackays to Pekapeka (M2PP) trials have been undertaken to investigate the effectiveness of the different types of mulch available at suppressing weed growth.

Plant species establishment trials with 1.0 metre spacings have also been undertaken.

Where this type of trial is able to be undertaken the outcome of scientific trials can be applied to the planting process. The positive outcomes contribute to less risk of the landscape asset failing to establish, leading to long term ease of maintenance for the contractor within the defects liability and maintenance period. Further to this in the long term maintenance identified under the O&M contract.

Establishing planting trials at M2PP

Trials utilising different types of mulch available to suppress weed growth (M2PP)

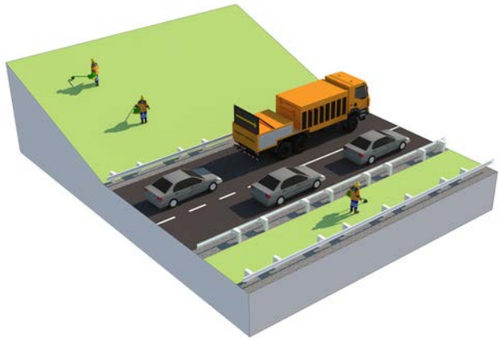
Species trial planting at 1.0 metre spacings (M2PP)

Establishing species trial plantings at 1.0 metre spacing a year later (M2PP)

DO's

Maintenance co-ordinated in the design

DONT's

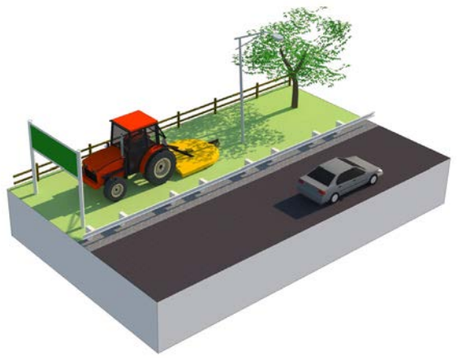


Grass verges and medians surrounded by barriers requiring traffic control and weed eating operations

DO's

Space created for practical mowing operations as part of the design

DONT's

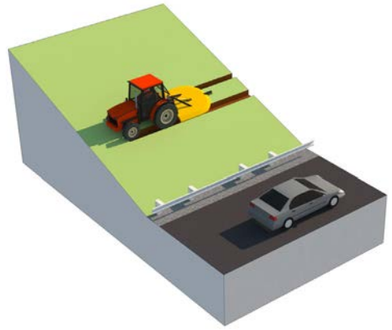


No consideration for practical mowing operations

DO's

Slope planted to deliver whole of life value

DONT's

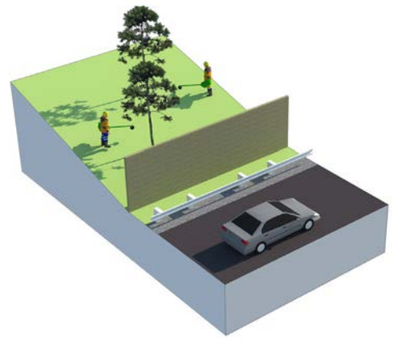


Slope too steep to mow year round, causing unsightly rutting and tracking of mud, consideration of mowable slope and whole of life values required during design

DO's

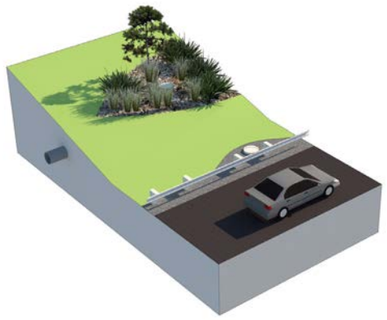
Integrated land management and whole of life considerations associated with structures

DONT's



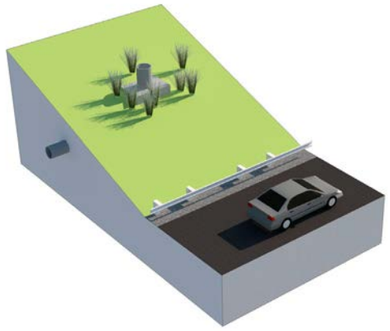
No recognition of NZTA land management beyond noisewall

DO's



Maintenance co-ordinated in the design with screening of services and ease of maintenance

DONT's



No integration of landscape and services and maintenance thinking

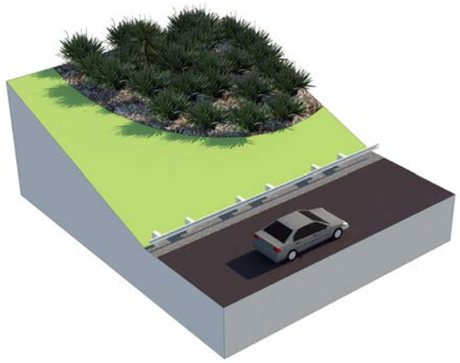
DO's

Co-ordinated highway furniture

DONT's

Highway furniture placement not co-ordinated with the landscape design and maintenance thinking

DO's

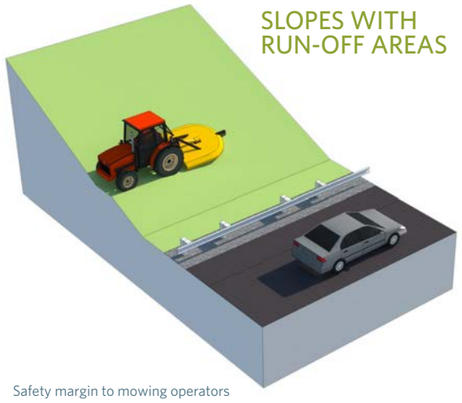


Maintenance co-ordinated in the form of the design, with curves to mow against

DONT's

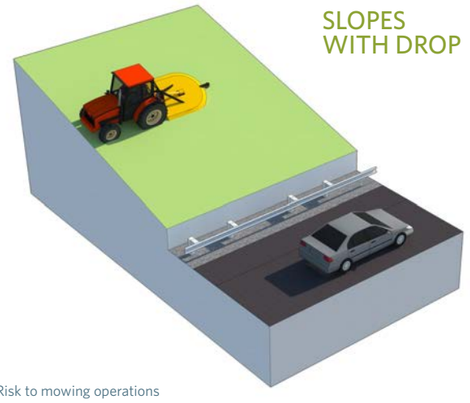
Geometry not conducive to practical maintenance (mowing)

DO's



Safety margin to mowing operators

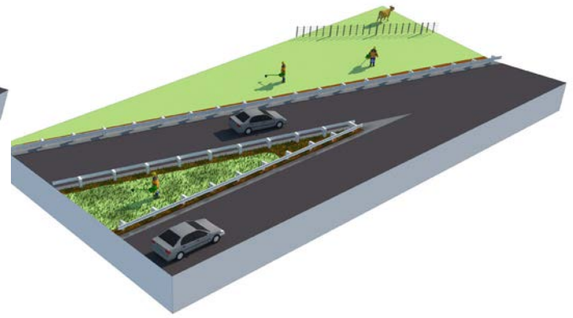
DONT's



Risk to mowing operations

DO's DONT's

Design gore areas with hard surfaces at the narrow end, to avoid plant establishment and maintenance issues. Planting to start at 2 metre width.



Avoid barren gore area where planting struggles due to narrow space, over heating and spray zone effects

CONCEPT DESIGN CHECKLIST FOR WHOLE OF LIFE VALUE

	Item
✓	Review the whole designation area (and all the Transport Agency property) in terms of landscape management.
✓	Identify any legacy issues such as pest plants which provide a risk to the establishment of the landscape.
✓	Identify cut and fill areas and check the adequacy of earthworks, drainage and topsoil to provide a suitable growing environment.
✓	Ensure slope gradients are suitable to sustain landscape treatments and allow safe access for maintenance.
✓	Check safe access secured to all landscape areas for maintenance on all Transport Agency land; include access points to limit the necessity for costly traffic control measures.
✓	Check management of special areas such as sensitive ecological areas, heritage and cultural sites are covered.
✓	Check earthworks and topsoil supply and storage methodology; check sufficient topsoil volume (noting subsidence); check topsoil is suitable for use in landscape areas.
✓	Specify mulch for landscape areas and check mulch supply and placement methodology.
✓	Check plants and plant ancillaries are suitable for use within landscape areas. Remember the environmental setting. Check long lived species or planting that will be enriched with longer lived species and check short lifespan species only as part of restoration stages.
✓	Rationalise hard and soft landscape treatments to avoid traffic control access for maintenance.
✓	Include hard landscape treatments in areas which would otherwise fail as soft landscape.
✓	Ensure that grass areas are designed to facilitate maintenance tractor mower access and manoeuvring.
✓	Check landscape plan against all required setbacks, sight lines and clear zones.
✓	Check the location of structures, services, lighting, signage and other infrastructure and avoid conflicts with the landscape design.

4.21 INNOVATION AND KNOWLEDGE SHARING

The Transport Agency are always seeking to improve the standard and delivery of highway landscape assets. They seek to work with teams who carry out scientific trials to investigate the best methods through which to achieve positive outcomes.

Design teams should be proactive in communicating any creative ideas for trials or new and innovative solutions that they have back to the Transport Agency's national office.

A great way to foster new ideas for design teams is to consult with highway operators and maintenance organisation (O&M) to get an improved understanding of the local network landscape needs and issues.

It is essential that any lessons learnt by the Transport Agency within capital works and O&M are captured as part of a growing body of knowledge on highway landscapes. Consider post project review and evaluation specifically including landscape related aspects of the project so that the lessons learnt can be applied to the next project. This includes what went well and what did not. The Network Outcome Contract should contribute to this document.

Improvements to highway landscapes can span both the social and environmental performance, as well as deliver whole of life value for money and cost efficiencies.

The landscape architect and others involved should actively communicate key lessons learnt within highway projects and talk throughout the process which resulted in positive outcomes for the Transport Agency.

Knowledge share within consultant teams

Knowledge share within construction crews

PART 5: DEFECTS LIABILITY AND MAINTENANCE

4.22 INTRODUCTION

The defects liability and maintenance period is the time during which the contractor is responsible to make sure that the installed landscape meets the specifications. It is an integral part of the landscape implementation. Together good construction practice which meets specification and a suitable length defects liability and maintenance period ensure that the landscape improves over time.

This section addresses the issues during this period and the reason that the defects liability and maintenance period is important.

4.23 DEFECTS LIABILITY AND MAINTENANCE

It is the way that highway landscapes are implemented which leads to their establishment and improving performance over time. This helps with longterm maintenance resource and cost efficiencies.

Where implementation does not meet specification securing whole of life value for money for the Transport Agency and the travelling public, issues which arise include:

- die back of plants, re-infestation of weed species and poor plant establishment can result from ground preparation not meeting specification, or insufficient topsoil;
- poor plant establishment on cut and fill slopes resulting from poor drainage;
- blocked stormwater systems due to washouts of soil and/or mulch from landscape areas;
- a lack of co-ordination between highway structures and landscape design resulting in 'land locked' or problematic access to landscape areas;
- non-compliance with the requirements of the designation or consent.

As set out in the Defects Liability and Maintenance section of Landscape Specification (Appendix 2) as a minimum standard one of the following landscape defects liability and maintenance options should be selected:

A. 2 years defects liability and maintenance period

Generally only applicable to small project with limited complexity. For projects that may be small, but which have a component of mass planting or ecological planting, 5 year defects liability and maintenance is recommended.

B. 5 years defects liability and maintenance period

Generally applicable to large urban projects with high visibility, high traffic volumes, detailed amenity planting, or for large projects with a component of mass planting/ ecological planting. Note– Defects Liability and Maintenance are two separate things:

Defects liability *relates to the contractor making sure the works installed meet the specifications (and the Transport Agency's landscape performance criteria) at the end of the two or five year Defects Liability Period.*

Maintenance *relates to works in maintaining the planting during the initial two or five year Defects Liability & Maintenance period.*

On large projects a 5 year defects liability and maintenance would generally be standard, but longer periods may also be required in some situation. Examples might be alpine environments or exposed coastal areas where a longer period will be necessary to reach the required level of establishment.

During the defects liability and maintenance period established for any project, the quality implementation required shall be carried out. The specification includes sign-off at all stages.

The sign off process is established to ensure quality outcomes for the Transport Agency; and as the contractor follows the required standards the contractor ensures that remedial works they will be required to complete during the defects liability period are minimised.

Landscape maintenance includes all aftercare and maintenance of the works to establishment. Designation landscape maintenance include designation boundary to boundary maintenance, for example plant pest control outside of the works area but within the designation. If this work is not carried out there will be impacts on the highway landscape.

The completion of any capital project is just the beginning for the Transport Agency's state highway landscape assets hence achieving the specified standard during the defects liability and maintenance period is a critical component. Following completion single or multiple organisations contracted by the Transport Agency undertake operations and maintenance for any particular section of the highway network.

These organisations together with the Transport Agency sustain the highway for the life of the asset. Capital projects occur over a relatively short time frame, typically 5-10 years from planning, to design and creation. Whereas asset operations and maintenance (O&M) carries on well beyond this for perhaps more than 50 years.

At the conclusion of a capital project the landscape works are handed over to long term management. This long term landscape maintenance is an integral part of achieving the Landscape Principles set out in the Transport Agency Landscape Guidelines. Refer to Part 6: Maintenance and Operations Phase.

Planting should be setback from the road edge and all barriers (flax set back off barrier)

Verge planted with a mix of native grasses, flax and cabbage tree

Tractor mowers require a minimum 2m width to operate

Adequate space between planting areas and planting beds shaped to facilitate tractor mower access make for efficient mower maintenance

MONITORING THE MAINTENANCE OF LANDSCAPE

- Landscape treatments take time to establish and flourish. A consistent and proactive approach to monitoring the progress of the landscape works, maintenance and the remedy of any defects is required as landscape assets can soon fail if neglected. Landscape needs to be monitored and continually maintained to aid the establishment process. When executed correctly landscape maintenance should descend in intensity as planting flourishes. Maintenance during the early establishment period is therefore vital so that the landscape treatments can be self-reliant and handed over in a quality state at the end of the project.
- Monitoring of the maintenance by the Landscape Architect will ensure that any defects or omissions are captured, thereby allowing both the functional and aesthetic components of the design intent.

Ongoing or corrective maintenance may also be required and shall be progressively rectified throughout the defects liability and maintenance period. Such maintenance is likely to include:

- modifications to planting to align with changes in ground conditions;
- modifications to planting around structures and barriers to ensure setbacks are maintained;
- modifications to planting around signage and along access routes (pedestrian and cycle ways) to ensure vegetation will not obstruct visibility or access;
- modification of planting around wetlands and stormwater management areas to align with water levels;
- regular checks for problem weeds to arrest early infestation when control and access is relatively easy;
- checks following severe weather events or prolonged wet or dry periods;
- general observations for any damage from pests or diseases in plants, insect pests, vandalism (including fly tipping within landscape areas).

Animal pests, such as the goats seen here, within native restoration planting, can be a risk to the landscape assets and highway users.

AT HANDOVER

- vegetation should be handed over as a new asset at the end of the landscape Defects and Liability Period (DLP) without any immediate remedial actions being required of the Network Maintenance Operator. The landscape should be completed as per the Landscape Specification;
- handover without any immediate remedial actions being required will be assumed where the landscape architect has attended all necessary inspections as required by the Landscape Specification.
- handover records should include specific details of any special areas if not otherwise addressed;
- maintenance boundaries and relevant details of agreements with neighbours and others relative to the on-going maintenance shall be clearly stated and summarised in the handover documents (Asset Owner's Manual);
- any ongoing consent requirements and related permissions that impact on the maintenance and operation of the network shall be clearly stated;
- confirmation that all construction consent requirements have been closed out shall also be provided;
- if the specified establishment has not been achieved the maintenance will be extended until the defect is remedied or required canopy coverage achieved;
- the landscape architect nominated shall complete a producer statement. The producer statement shall confirm that the contract works have been undertaken in accordance with the plans and specifications.

Pest plant, gorse

Consider all parts of the plant when designing highway landscapes. Flax stems can overhang barriers causing a potential hazard if planted too close to the highway

Vandalised noise wall. Poor landscape treatment and maintenance has resulted in gaps in the planting and an opportunity for tagging.

Sign-off by registered professionals

4.24 ASSET OWNER'S MANUAL: LANDSCAPE SECTION

At sign off and issue of the Defects Liability Certificate when the contractor is released from responsibility for the established landscaping an Asset Owner's Manual (AOM) is required. The AOM outlines the standard approach to the maintenance of the landscape assets and any special features of the highway landscape such as cultural features, art works, special ecological or landscape areas. It is a guide for the owner to follow as the asset is managed for the future.

Details should include all background information on the design intent and the planting and maintenance techniques utilised, frequency of maintenance, as well as any details about access points, and health and safety.

Content of the plan

A list is referred to within the NZTA's Professional Services Guide (PSG/15), Minimum Standard Z/15 – Asset Owner's Manual. The following list below augments that list with additional examples and specific reference to landscape related items. The selection and incorporation of this information in to the AOM shall be appropriate to the project.

The list is not exhaustive or exclusive, and the Consultant is expected to consider all project specific issues that may be relevant or stipulated in the scope of the physical works contract:

As Builts

The standard for presentation of as-built drawings is set out within the NZTA's Professional Services Guidelines PSG/9 - Delivery of as-built documentation.

Further to the guideline the Consultant is expected to consider the specific logic in presenting the drawings for the landscape asset. This logic is to include establishing a method of presenting information on the plans which allows the extent of the landscape asset to be logically understood for maintenance. For example referring to maintenance areas from an asset management perspective by beginning with safe access points at the start and end.

ATTRIBUTE	EXAMPLES OF INFORMATION REQUIREMENTS IN RELATION TO LANDSCAPE UNDER TYPICAL AOM HEADINGS
Asset Information Systems	Maintenance boundary and access points for landscape maintenance NZTA designation Any legal covenants
Bridges	Detailed maintenance requirements for vegetation next to structures
Drainage	Maintenance requirements of planting associated with drainage Maintenance requirements for fish passage
Cycleway/Pedestrian Facilities (NZTA Owned Only)	Maintenance requirements for all landscape treatments
Earthworks	Cut and fill areas that have received landscape rehabilitation Topsoil suppliers Details on ground preparation (e.g. depth of topsoil)
Graffiti Guard	Any planting associated with anti graffiti and vandalism
Intelligent Traffic Systems (eg ATMS, Tolling, ATIS, VMS etc)	N/A to landscape
Landscape treatments	Background on landscape treatments and design intent Planting zones/ character areas. Post construction maintenance requirements Supplier contact details for landscape treatments
Landowners	Land Entry Agreements Land occupied for the works (lease expiry). Compensation requirements Licenses to occupy
Legal Boundary - Draft NZTA Maintenance Boundary	Final land settlement Designation confirmation requirements
Motorway Alignment Geometrics	Geometric design as-builts
Other Structures (eg Sign Gantries, Tunnels etc)	As-builts Detailed maintenance requirements
Pavements and Surfacing (Include PSF/3b)	As-builts, particularly for alternative designs. Details of pavement repairs Pavement marking details

ATTRIBUTE	EXAMPLES OF INFORMATION REQUIREMENTS IN RELATION TO LANDSCAPE UNDER TYPICAL AOM HEADINGS
Proprietary Systems (Applicable to a particular asset e.g. green engineered slope or stream bank)	Design details Maintenance requirements
Resource Consents (Ongoing)	Copies of all consents and conditions. Rehabilitation requirements Expiry date Ongoing monitoring requirements eg frequency/who performs the monitoring
Retaining Walls Noise Walls	Detailed maintenance requirements to maintain any vegetation associated with these structures
Road Safety Features (eg Road Safety Barrier Systems)	Maintenance Requirements to maintain any vegetation associated with these structures
Roadside Facilities and Furniture	Maintenance requirements to maintain any vegetation associated with these structures
Roundabout/Traffic Islands	Planting maintenance requirements. Sight line requirements
Shoulders and Berms	Planting maintenance requirements. Sight line requirements
Social and Environmental Management Form	Updated PSF/13 Form (in accordance with Z/6). Relevant information could be contained in Contractor's Social and Environmental Management Plan (Z/4)
Stakeholders (other) with Ongoing Maintenance Responsibilities	Other stakeholders and their maintenance obligations
The location of any protected sites, or significant features or community related landscape treatments	Plans showing locations
Street Lighting	Maintenance requirements to maintain any vegetation associated with these structures
Stormwater Ponds, Treatments and Devices	Vegetation maintenance requirements
T.D.M. Systems	N/A to landscape. Maintenance requirements to maintain any vegetation associated with these structures
Traffic Signals	N/A to landscape. Maintenance requirements to maintain any vegetation associated with these structures
Utilities/Services	List Service Providers and contact details. Location of assets and services
Maintenance requirements to maintain any vegetation associated with utilities/Services	Maintenance handbooks showing requirements from providers
Other	As-built drawings for landscape (including % plant coverage)

PART 6: OPERATIONS AND MAINTENANCE PHASE

4.25 INTRODUCTION

The landscape works component of the construction contract is complete at the time that the nominated landscape architect finalises the producer statement at the end of the defects liability and maintenance period. The highway asset is then handed over to the supplier of the network outcomes contract to commence the operation and maintenance (O&M) phase of the asset. The issuing of the producer statement confirms that the landscape works have been completed, per the specification and that there are not any immediate remedial actions required. The Asset Owner's Manual (AOM) (refer 4.23 Asset Owner's Manual: Landscape Section) is a critical item completed at handover. O&M use the information provided in the AOM to develop the ongoing management strategy for all the assets within the highway corridor including landscape assets.

4.26 ROLE OF THE O&M CONTRACTOR

Landscape works undertaken as part of the capital project are often a mitigation requirement under the Resource Management Act and may be needed to mitigate adverse effects, such as visual or ecological impacts from the capital project. The on-going success and performance of the landscape post completion of the construction contract is handed to the O&M contractor, who must ensure on-going compliance with the statutory requirements. Failure of the landscape asset could potentially lead to non-compliance with the relevant conditions of the designation or resource consent.

Actions such as poor management practices, including both pest plant management and weed control, insufficient maintenance, overspray, and vandalism can lead to asset failure.

"As-built" plans included in the AOM which are transferred to the O&M contractor enable the Transport Agency to measure the performance of the management of the asset over time.

4.27 CONSIDERATIONS AT THE TIME OF HANDOVER

The positive legacy of highway landscape design may diminish quickly if the knowledge around the features and its maintenance leaves with the construction team, hence the AOM needs to draw attention to all special features which are part of the design and which require specific maintenance to continue to be effective in the long-term. For example, where it has been recognised in the design process, that planting in front of fences and noise walls can reduce graffiti offending then it needs to be noted that planting is to be maintained in a dense, full state to achieve this outcome.

When providing material necessary to achieve operations and maintenance aspects sought, the following should be considered and reflected in the AOM:

- Where the access points and access routes to the landscape areas are;
- Tree maintenance and best arboricultural practice. When cutting back branches on trees, which may be required to maintain sight lines, ensure that branches are cut back cleanly to a place where the tree can rapidly heal itself;
- Maintenance access is kept clear to stormwater management areas as required;
- The desired clearance is achieved at the interface between planting and walls, structures, gates and fences;
- The maintenance level required adjacent to urban design features and artworks is established so that the design intent is achieved;
- Graffiti mitigation;
- Requirements around special features which may be quite specific are noted. These features could include historic sites or features, grave sites, special blessing stones, time capsules, sculptures, notable trees, special ecology sites, sacred sites;
- Any specific landscape agreements that have been made with local authorities, Iwi, or adjacent landowners and their associated levels of service;
- Any other feature whose history or future treatment is not otherwise obvious;
- In some projects there can be ongoing consent requirements in place. There may be supporting documentation which needs to be handed on to the network outcome contractor so that it is clear what they are required to do.

A project may have other specific elements which should be covered in any AOM. Relevant explanation of their significance and other information should be provided. This includes as built landscape plans which shall be included. Important items should be referred to on the as-built drawings (refer 4.23).

Overspray in a narrow area of planting has led to poor plant establishment. The cumulative effect of overspray causing poor plant establishment impacts on the "front line" appearance of the landscape asset and can over time compromise the whole asset.

The success and on-going performance of the landscape component of a capital project is reliant on good maintenance based on the information provided in the AOM.

4.28 TYPES OF MAINTENANCE

Maintenance can be broken down into four types where maintenance is required in different ways, as set out below in descending order of priority:

Corrective maintenance occurs where elements within the landscape treatment have failed. Those items normally considered as corrective maintenance include, in order of priority of change, include:

- soil remediation and replanting of failed landscaping;
- embankment and slope repairs;
- erosion and slip repairs;
- removal of debris and sediment;
- elimination of pest plants trees, and any animal pests threatening the planting;
- general practice maintenance;
- boundary fence repairs.

Preventive maintenance depends on the type of landscaping for which maintenance is being carried out. Grass areas, slopes, swales and filter strips need routine mowing to maintain performance while fully established planting areas may not need maintenance more than annually. As such, prioritising is not as important as ensuring that it is done. Preventive maintenance includes:

- grass mowing;
- plant pest control;
- managing vegetative cover;
- managing plant ancillaries (e.g. stakes and ties for specimen trees);
- trash and debris removal and disposal;
- other specific practice maintenance requirements.

Aesthetic maintenance primarily enhances the visual appearance of the highway landscape. Aesthetic maintenance is most important within those areas that are highly visible. The following activities can be considered as aesthetic maintenance:

- graffiti removal;
- vegetation trimming and arboriculture;
- weed control;
- miscellaneous items such as painting, pruning, leaf removal.

Adaptive management enables a 'plan-do-check-act' approach where ongoing monitoring and reporting provides for the most appropriate response or solution to be utilised. Adaptive management is an analytical process involving structured experimentation and responses. Management is adjusted to achieve performance objectives.

Adaptive management recognises that knowledge about natural resource systems is uncertain and that some management actions are best conducted as experiments or "learning by doing". A key issue in implementing an adaptive management approach is to ensure that conditions clearly specify the level of effect that is anticipated. (Source NZCPS, DOC)

4.29 OPERATIONS AND MAINTENANCE GUIDANCE

Only with full understanding of the features of the design is maintenance able to be carried out to achieve the design intent. The following list (which is not exhaustive) provides questions for the O&M team to ask regarding the elements they are taking over and establishing maintenance regimes for:

- Are there areas within the planting where the contractor has had to complete particular remedial actions to achieve the specification and practical completion signoff?
- Are there any protected trees that existed on the site prior to the highway project which require specific management?
- Are there any special areas of planting requiring specific treatment? For example rare species which have been retained within the plantings and where spray control of weeds cannot occur as seeding of the rare species is sought.
- Outside the construction project boundaries are there areas where weed species exist with the potential to spread into the project landscape area? These weeds will require monitoring and potentially controlling. The Transport Agency is required to control pest plants on the their land through a Regional Council's Regional Pest Control Management Strategy.
- Is it clear where there are agreements with adjacent landowners? Who could be local farmers, council or DOC;
- Are there significant heritage sites, art installations, waahi tapu sites or other significant features, and is it clear how these areas are to be maintained?
- Is it clear how vegetation adjacent to walls and other structures is to be maintained? The maintenance of planting such as a dense hedge may be sought where this will prevent access for individuals seeking to graffiti structures.
- Is it clear how access to bridges is to be maintained for inspections?
- Is it clear how stormwater assets such as swales and ponds are to be accessed for maintenance?
- Is maintenance of planting areas to be undertaken through agro-chemical spraying? Is it clear what the extent of the spraying zone is? Is spraying an acceptable method of maintenance? This may not be the case where ongoing regeneration of desired plants through seed germination is sought.
- Is appropriate trimming and pruning to protect drivers sightlines and visibility understood?
- Grass areas. Is the level of mowing maintenance required clear? The frequency of mowing and height which grass is to be cut to will vary depending upon the surrounding environment e.g. rural or urban.
- Are special environmental areas noted? For example bird nesting areas which are not mown or maintained during nesting season or areas which are special habitat for other fauna such as native bats, insects or lizards which require special management.
- Do roadside areas support particular native plant species which are to be left unmown and not sprayed? Such areas may be ecological links or special amenity areas.

Landscape management is an on-going process; the highway landscape and surrounding environment is under constant change through social pressures, legislation, policies and plans. Other factors such as improved stormwater treatment requirements, pest management strategies or reduced tolerance to agro-chemicals (herbicides or pesticides) may lead to change. Operations should review and refine maintenance requirements periodically to ensure the landscape assets function, health and appearance are maintained. The big picture is that the biodiversity management sought as a wider outcome is achieved.

All these elements of landscape maintenance sit within the context of the Transport Agency maintaining and improving the safety of highways for both local communities and the national economy.

Routine maintenance activities

Consider safety in design for maintenance and operations

Inspection for barriers and planting

Image: Mitre Peak, an iconic mountain in the South Island of New Zealand (Source: Tourism NZ)

4.30 CONCLUSION

The guidelines have been compiled with industry input captured since the documents inception in 2011. Four major themes emerged from this consultation which helped define Highway Landscape trends:

1. highway landscapes are multipurpose in that they provide '**green infrastructure**'; they combine the treatment of storm water, create important habitat, and provide carbon sequestration and visual amenity;
2. highway landscapes need to be planned and designed with '**whole of life**' value and safety in mind;
3. highway landscapes are part of a '**wider system**' They are not an isolated corridor, highway landscapes are part of our natural and built systems. When these elements are recognised as part of a larger system they can be designed to provide a safer network which is also managed to achieve higher ecological and infrastructural performance;
4. highway landscapes can positively enhance the 'road users experience and create a '**sense of place**'. The landscape plays an important role in our national identity. As character and a sense of place for community's, as habitat for flora and fauna, and as cultural landscape.

This document sets out actions that implement the goals of the Transport Agency. Some of the guidelines recommendations will require close coordination within project teams and with Transport Agency staff and Transport Agency representative.

The Transport Agency see compliance with these national guidelines as giving effect to best practise and improving the quality, sustainability and beauty of our highway network environments.

4.31 LANDSCAPE LEXICON / GLOSSARY

For landscape design incorrect or misunderstood terminology can cause confusion. For the purpose of these guidelines the following landscape terminology has been set out. This includes a selection of terms (not necessarily used in the guidelines) but which you may come across while working on highway landscape projects. Maori cultural concepts have been included to outline and give context to Tangata Whenua environmental values and are by no means the full and complete definitions. The Transport Agency acknowledges that different Iwi and Hapu may have views differing from those expressed below.

Abstract native planting: Abstract planting is an artificial representation of natural plant communities. Highway landscapes provide an opportunity to plant both natural systems (adjacent to receiving environments and bush remnants) and abstract systems (in line with deliberate planting schemes). The best fit in many circumstances is to plant native species for biodiversity outcomes while responding to the landscape and urban framework. Examples of abstract planting include:

a. Exotic plants may substitute a native where they are prevalent in the urban or rural landscape. In this instance, avoid any plant that is listed as an environmental weed, check with the local authority or Department of Conservation. An environmental weed is any plant likely to seed freely and naturalise away from the site.
b. Native plants can be massed in single-species bands. This may improve the efficiency of green infrastructure function, reduce maintenance requirements, and may also artificially reinforce natural patterns.
c. Native communities can be abstracted in ways that differ from their natural composition such as clipped shrubs as hedges or native street trees.
d. Natural processes may be compressed, by short transitions between ecosystems, unusual groupings or successional phases, and reduced plant diversity.
e. Native plants outside of their typical habitat in a modified environment can create a unique micro-climate. For example riprap areas or green rooves in a different environment may benefit from coastal or alpine species.

Acoustic/ noise barrier: Noise barriers need to be considered in the context of providing effective noise relief, while also addressing issues of appearance, urban design, site constraints, maintenance (including whole-of-life costs), safety, graffiti, cost (value-for-money) and sustainability. To this end, it is important that the increasing number of noise barriers being constructed for the Transport Agency should be built with a coherent, consistent approach, rather than ad hoc solutions to individual sites. Refer to http://acoustics.nzta.govt.nz/noise-barrier-design-guide

Advanced nursery stock: (see specimen tree).

Aesthetics: Planting aesthetics can be understood as a form, function, pattern, texture, tone, and colour.

Agrichemical: Any substance whether inorganic or organic, manmade or naturally occurring, modified or in its original state, that is used in any agriculture, horticulture or related activity to eradicate, modify or control flora and fauna (NZS 8409 New Zealand Standard Code of Practice for the Maintenance Specification 3 General Requirements NZTA Somac - 2010 Vegetation Control NZTA1234: Vegetation Control Example MS 18 Management of Agrichemicals).

Amenity: The quality of being pleasant, attractive, desirable or a useful feature of a building or place.

Archaeological site: Archaeological site is fully defined in section 2 of the Heritage New Zealand Pouhere Taonga Act 2014. In this guideline an archaeological site could include an object or material.

Barrier: See road safety barrier.

Biodiversity: The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems (source: www.iucn.org) For the purposes of this guideline biodiversity means indigenous biodiversity.

Biosecurity: The protection of people and natural resources, including biodiversity and agricultural production, from unwanted organisms capable of causing harm.

Bridge: A bridge is any structure carrying traffic on, under or over the highway, and includes any CULVERT with a waterway area greater than 3.4m^2. It includes but is not limited to CULVERT, stock or traffic underpasses or over bridges and conventional bridges.

Canopy closure: When plants grow and expand towards each other and merge this is called canopy closure. Canopy closure should be attained as quickly as possible for a number of reasons including:

- increased shading as a weed suppressant
- habitat and shelter from emergent plants
- reduction of water stress on plants during summer periods
- reduced frost intensity or elimination
- increased shelter from wind (note buffer planting at the native forest edges should also be considered important for shelter)

Carriageway: The portion of a road or bridge devoted particularly to the use of vehicles, inclusive of SHOULDERS and auxiliary lanes. Divided roads are considered to have two carriageways.

Clear Zone: The main function of a clear zone is to provide a safe run-off or clear recovery zone adjacent the highway. Only frangible vegetation shall occupy this zone, with sightlines and continuous visibility to be maintained in association with the highway. On state highways with a design speed of over 70km/hr a clear zone of 9m from the edge of the lane should be provided. See frangible vegetation.

Climbers: climbing planting (creepers, vines) supporter by an engineered structure.

Colour: Colour combinations are important considerations within a design aesthetic, for seasonal interest, for visual diversity, and to lead the eye to a particular part of the landscape. Colours can also combine seamlessly along gradients based on 'colour wheel' spectrums

Conservation: As defined in the Conservation Act 1987 (in respect of conservation areas), conservation means the preservation and protection of natural and historic resources for the purpose of maintaining their intrinsic values, providing for their appreciation and recreational enjoyment by the public, and safeguarding the options of future generations.

Construction techniques: The type of technique used to construct the highway. These can be reviewed to avoid or minimise works that will affect the 'receiving environment', especially during breeding periods.

Contract growing: A contractual arrangement with a reliable nursery to produce a specified quality, size and number of plants.

Crime Prevention through Environmental Design (CPTED): is a crime prevention philosophy based on proper design and effective use of the built environment. The use of CPTED is intended to reduce crime and fear of crime by reducing criminal opportunity and fostering positive social interaction among legitimate users of space.

Cultivar: A cultivated variety / domesticated type of plant.

Cultural landscapes: Cultural landscapes are the patterns and forms of heritage that can be seen in a landscape. They are a useful way to recognise the interrelationships of heritage values, heritage places, and heritage events, and can be recognised and acknowledged in the landscape (see Maori Cultural Landscapes).

Culvert: One or more adjacent pipes or enclosed CHANNELS for conveying a watercourse or stream below the formation level of a road.

Defects Liability Period: The period of a construction contract during which the Contractor is Responsible for repairing or rectifying defects that appear in the Works. The period usually commences upon practical completion of the works and runs for a specified time frame.

Designation: An area identified within a district plan for public works. Each designation can include particular rules or requirements distinctive to it.

Ecological District: A local part of New Zealand where the features of geology, topography, climate and biology, plus the broad cultural pattern, interrelate to produce a characteristic landscape and range of biological communities unique to that area. Two hundred and sixty-eight Ecological Districts in New Zealand have been identified and mapped at 1:500,000 scale.

Ecological Region: An aggregation of adjacent ecological districts with very closely related characteristics form an ecological region. In some cases a single very distinctive ecological district is given the status of ecological region to emphasis its uniqueness (Park et al. 1985). There are eighty five Ecological Regions in New Zealand.

Ecosourcing: Practices using native plants in landscape design and revegetation that preserve and continue natural, genetic diversity (biodiversity) in local native plant populations. Ecosourcing has 2 key aspects:

- using local native seeds for local plant production and planting;
- collecting representative diversity from the local population (by e.g. collecting seed from many individual plants from within the wild population, by collecting from different habitats within the population area).

Reference: Ecosourcing Code of Practise and Ethics

Ecosystem: A biological system comprising a community of living organisms and its associated non-living environment, interacting as an ecological unit.

Ecosystem Services: Fundamental life-support services provided by nature without which human civilisations would cease to thrive. Includes purification of air and water, detoxification and decomposition of wastes, regulation of climate, and regeneration of soil fertility, pollination and production and maintenance of biodiversity.

Endemic Species: A native species, which breeds only within a specified country, region or locality

Epiphyte: is a plant that grows non-parasitically upon another plant, often a tree and derives its moisture and nutrients from the air, rain and sometimes debris accumulating around it rather than the structure it is fastened to.

Erosion Protection: Erosion control/ protection is the practice of preventing or controlling wind or water erosion in construction.

Exotic: See Introduced Species

Exotic grass: Grass cover that is not native to New Zealand

Filter socks: Filter socks are used to intercept, filter and contain 'dirty water' associated with earthwork sites ensuring that any water leaving the sites meets local authority guidelines and regulations. Erosion Control Socks are a practical solution that provides a sound alternative solution to silt fencing for smaller catchment areas. In landscape these socks can be filled with a growing medium and planted.

Fire break: Generally a vegetation restriction area of 20m (min) including the highway within fire prone areas (e.g. forestry)[29].

Frangible vegetation: Any plant with a stem less than 100mm in diameter at maturity, measured 400mm above the ground is considered to be frangible.

Grass berm: Grass maintained at a low level for functional and aesthetic reasons.

Green infrastructure: The term 'green infrastructure' is most widely used in reference to open space and natural areas that surround and go through cities and town. More recently, the concept has grown to describe low-impact and multifunctional infrastructure networks that support an environmentally sound approach to design and planning in urban and urbanising areas. The recognition that green infrastructure provides essential ecological services elevates their perceived value in communities. Further when these elements are recognised as part of a larger system, they can be designed and managed to achieve higher ecological and infrastructural performance.

Green roads: The Greenroads Rating System is an international third-party, points-based system available to certify sustainable roadway and transportation infrastructure projects. The system provides metrics to measure the effect of design and construction practices, which can be implemented on a project to earn points toward one of four certification Green Roads awards

Ground cover: Low growing and spreading planting (woody or herbaceous).

Habitat: The place or type of area in which an organism naturally occurs. See also ecosystem.

Hapu: Generally consist of a collection of whanau (extended families) and named after an eponymous ancestor. Economic and social activities, for example horticulture, fishing, and village life generally occurred at a hapu or whanau level. For a large number of iwi groups, hapu are the holders of mana whenua.

Headlight glare screen: Screening the glare from headlights from oncoming traffic not part of the immediate highway, or screening headlight to avoid glare effects on property adjoining the highway.

Heritage: As in historic heritage; defined in the Heritage NZ, Pouhere Taonga Act 2014 as those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures.

Hydroseeding: Mechanical broadcasting of seed, generally grass, by spraying a mix of water, seed and fertiliser.

Indigenous plants: Plant species native to New Zealand

Introduced species: A plant or animal species which has been brought to New Zealand by humans, either by accident or design. Also termed "exotic species".

Invasive species: An animal pest or weed that can adversely affect indigenous species and ecosystems by: altering genetic variation within species; affecting the survival of species; or the quality or sustainability of natural communities. In New Zealand, invasive animal pests or weeds are almost always species that have been introduced into the country.

Iwi: Generally consist of a collection of hapu, who are closely genealogically linked. As such, iwi are internally diverse and their collective territories can be very wide. Issues addressed at an iwi level are generally of a political nature.

Kaitiakitanga: Tangata Whenua have a responsibility to safeguard the 'mauri' of natural and physical resources under their stewardship, particularly in relation to any adverse impacts of human activity. This responsibility includes the effects of people from outside a tribe's particular rohe. Various 'tikanga' and 'kawa' (see Tikanga) are exercised by 'tangata whenua' to manage human impact, such as placing restrictions on collection of certain resources at certain times.

Landscape Ecology: Landscape ecology has many definitions, but is generally understood as the interrelationship of size, shape, and connecting elements for habitat systems. Linkages between habitat areas are important to allow the drift of individuals and genetic material for resident populations. Linkages can be established by movement corridors and/or 'stepping stones' of supporting habitat across the landscape. This applies to birds, lizards, fish and invertebrates across their life cycles. Stormwater devices may need to establish a micro-climate to support plant communities. Maximising the core area of habitat forms interior conditions suited for specialised habitats and reduces the potential for weed invasion.

Mana Whenua: Is a status exercised by a hapu or iwi, secured and maintained according to inter-tribal custom and law. Mana derives from the divine, and as such is closely associated with tapu. Mana is power, encompassing spiritual and social connotations. In relation to land, mana whenua includes certain rights as well as responsibilities. A group having mana whenua over a certain area are recognised as having sovereign and absolute control over that area, particularly in relation to the use of natural resources or the right to occupy. Responsibilities of a group having mana whenua include the obligation to provide manaakitanga or hospitality in times of peace, at the exercising of kaitiakitanga.

Maori Cultural Landscape: The fabric of the Maori cultural landscape includes all physical and spiritual dimensions of whanau, hapu and iwi as expressed in living environments – whenua (land), kainga (living spaces), whare (buildings) and public spaces[30].

Matauranga Maori: Maori traditional knowledge.

Mauri: Simplistically translated as life force or life energy, all things are said to be invested with mauri. The mauri of something is unique to it, and can be adversely affected and eroded, for example the over-exploitation of a resource; or positively affected for example proper observation of protocol. If the mauri of a resource, a person or object, is extinguished, that thing is effectively dead. For example, if a waterway is extremely polluted and becomes stagnant, it is no longer able to support life and is termed wai mate, dead water.

Mechanical Mulching: The machine shredding of organic wood chip sized to be mechanically broadcast as mulch.

Median: A central road reserve which divides the carriage way.

Mulch: Untreated, wood chip or post peelings. Spread across planted areas and around trees to 100mm (min) to suppress weeds and retain soil moisture levels.

Native Species (to NZ): Those species that lived here at the time New Zealand became a physically separate landmass, or which evolved or migrated here, without help from people. They are well adapted to localised conditions. An average of 80% of our native species live nowhere else in the world (see endemic). Some native species are present naturally through many regions or areas of the country. These species can be described as native to each such region or locality. Some native species exist only in one region or localised area of the country. Such a species is therefore endemic to that area. For Maori, all native species have a whakapapa which links back to departmental gods, and as such are viewed as taonga.

Non-frangible vegetation: a plant with a stem over 100mm diameter at maturity measured 400mm above the ground or planting which is very dense and tight such that it creates an overturning hazard for errant vehicles.

Nurse crop: existing vegetation (native or exotic) or purpose planted vegetation used to provide initial shelter for establishing taller forest. This is a useful technique for planting on exposed site.

Peri-urban: Areas at the periphery; which surround; or are adjacent to towns and cities

Plant Diversity: Wherever practical, plant materials delivered to a site should be ecosourced materials extracted as seed from remnant vegetation as close as possible to the site, and from a similar ecotone (a similar environment in terms of climate and elevation). Multiple plants should be sourced with varying phenotypes (physical variations). This will increase the gene pool for cross-pollination and provide for a resilient plant community.

Plant grades: Plants are generally supplied in pots or planter bags these come in 'PB' sizes (Pint bags) or lt sizes (litre pots or bags).

Powhiri: A process of extending welcome and hospitality to guests onto a marae. A less formal process is the Mihi Whakatau, which may occur during occasions such as during the opening of a section of state highway (where the Transport Agency or future users of the building might be welcomed by mana whenua).

Protected Natural Area (PNA): In the context of the PNA Programme, a PNA is a legally protected area, characterised by indigenous species or ecosystems of landscape features, in which the principal purpose of management is retention of the natural state (see Department of Conservation, DOC).

Raingarden: Rain gardens are a stormwater management device associated with LID stormwater solutions. They help remove pollutants and slow down stormwater flows, recharge freshwater bodies and look attractive. They filter stormwater through a soil mix and plants. These absorb and filter contaminants before stormwater flows to surrounding ground, pipes, drains and streams, and eventually to the sea.

Receiving environment: The environment that will be impacted on by the construction work. This environment may be habitat for a species and wider than the actual area of construction.

Rest areas: A designated area adjacent to a highway where vehicles can stop temporarily for the rest and relaxation of drivers and passengers.

29. Refer, NZ Fire service guide to flammable native plants

30. http://www.tearanga.maori.nz/page.php?m=152

Restoration: The active intervention and management of degraded biotic communities, landforms and landscapes; carried out to restore biological character, ecological and physical processes and their cultural and visual qualities. Different from regeneration or revegetation which may be used to mean the return of some vegetation, not necessarily native or ecological in nature.

Revegetation: Planting to cover an area to achieve canopy cover. Methods include:

- assisting natural regeneration through control of grasses and weeds (requires a sufficient adjacent seed source)
- directly sowing seeding (e.g. laying Manuka slash when in seed[31])
- establishing a nurse crop then enrichment with forest climax species
- mass planting

Rip rap: is rock or other material used to armour shorelines, streambeds, slopes, bridge abutments, pilings and other structures against scour, water or ice erosion.

Road Safety Barrier: (a) A physical barrier, including guardrails, designed to resist penetration by and out-of-control vehicle and so far as is practicable, to redirect colliding vehicles back into the travelled path and, (b) a barrier meeting the specification requirements of TNZ M/23.

Roadside: The area of land from the edge of the carriageway to the boundary of the road reserve.

Roadside Facilities: Roadside facilities include but are not limited to:

- road furniture
- road safety barrier systems
- lighting columns
- fences
- rest area furniture
- pedestrian refuges
- pedestrian facilities
- handrails
- culverts
- stormwater management systems
- bridges
- pay stations
- other structures

Road reserve: A legal description for the area of land which accommodates the public road including the public footpath and ancillary roading areas.

Rohe: Area or region over which the mana of a particular hapu or iwi applies, including land, sea and rivers. Many areas and resources are recognised as having shared jurisdiction, however most resources will come under the jurisdiction of one group.

Rural: For the purposes of landscape design any area that is not urban classifies a rural area. Details of these areas are available from Statistics New Zealand (www.stats.govt.nz) and the Transport Agency's Spatial Viewer (https://spatialviewer.Transport Agency.govt.nz/).

Sedge: Generally a wetland rush or grass.

Shrub: A woody perennial plant smaller than a tree.

Sight lines: Sight lines are specified by the engineer and the landscape architect is then tasked with integrating these requirements with the physical landscape treatments. For example low growth vegetation is a useful landscape treatment where sight lines need to be maintained within roadside batters and traffic islands

Soils: The categorisation of soil classes identifies potential areas for groundwater recharge and flooding, erosion issues, and media for plant growth. Soils information informs the site layout, dictates earthworks and protects good soils from mixing and vulnerable soils from compaction. In Auckland soil classes can change over a distance of only tens of metres across the surface.

Soil conservation: Survey existing soils in order to isolate soils that are vulnerable to compaction, and set up soil mixing controls to optimise drainage properties for stockpiled and re-spread topsoil).

Specimen tree: Advance nursery stock 45lt grade (or greater), planted with stakes and ties with a specified tree pit.

Stormwater Management: In this guideline the term is applied to the management of run-off from roads. It refers to all activities which actually or potentially affect the rate, quantity and quality of run-off from roads in relation to landscape design and landscape treatments.

Strobing: The flickering of light and shadow cast by structures or vegetation, which can distract or impair driver's vision.

Sustainable use: The use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations (Convention on Biological Diversity).

Swale: a grass or planted channel, refer to Stormwater Swale Planting Improvements – 2011 ref. www. nzta. govt.nz

Taonga: A prized possession, including natural, physical and non-physical objects, resources or qualities. All humans are taonga also.

Tapu: In a spiritual sense, with which tapu is more commonly associated, people, places or objects are said to be tapu when connected into cultural beliefs. In an environmental management sense, resources whose mauri needs to be strengthened are placed in a temporary state of tapu so that this can occur. This practice of a temporary restriction is known as rahui. Tapu is a potent cultural influence and violation of tapu has serious implications for the offenders' physical and spiritual well-being.

Threatened Species: A species or community that is vulnerable endangered or presumed extinct. Refer to Department of Conservation (DOC).

Tikanga: Tikanga is embodied by customs and rights, which are based on fundamental cultural perspectives of truth, morality and lore. Tikanga is reflected in a localised and practical sense through kawa, or protocol and tribal law. This can lead to variation in tikanga and kawa between Maori groups, accentuating the importance of establishing dialogue with Mana Whenua (Iwi/ Hapu).

Traffic islands: A traffic island is a solid or painted object in a road that channels. These can also be planted or grassed subject to the context and roading environment.

Tree: Large woody perennial plant with a trunk.

TTM: TTM is an abbreviation reference to 'temporary traffic management' on state highways and local roads. It includes levels of temporary traffic management, signs and forms used, and traffic management plans. These activities are a requirements for many highway related operations.

UDLF: Urban Design and Landscape Framework

Urban: Towns and Cities and their metropolitan settings (peri-urban to rural)

Vascular Plants: Plants with well developed conductive tissues for internal transfer of water and nutrients. Includes ferns, flowering plants and trees, but does not include mosses and liverworts.

Waahi Tapu: Places which are sacred to Maori or particular Maori groupings such as iwi or hapu. There are many ways in which a site can attain a waahi tapu state. Examples include, but are not limited to:

- areas where significant events have occurred
- burial grounds
- battle fields
- pa sites
- any area where blood has been spilled
- areas prohibited from use in order for its mauri to regenerate
- areas prohibited from use due to spiritual reasons
- areas prohibited from use due to contamination.

Weed matting: biodegradable: Can include coir matting, or wool matting or similar products, which are utilised as weed a weed suppressant matting and to protect exposed slopes from erosion. These products are generally pinned to the ground utilising biodegradable pins, stakes, or similar. The matting is generally a temporary measure providing coverage while planting established.

Wetland: A wetland is a land area that is saturated with water, either permanently or seasonally. Part of stormwater management highway ponds can be designed to mimic wetland environments for ecological benefits.

Whakapapa: whakapapa is commonly understood as genealogy, although it has wider reaching cultural, social and spiritual connotations.

31. For example Northern Gateway – Manuka slash trials

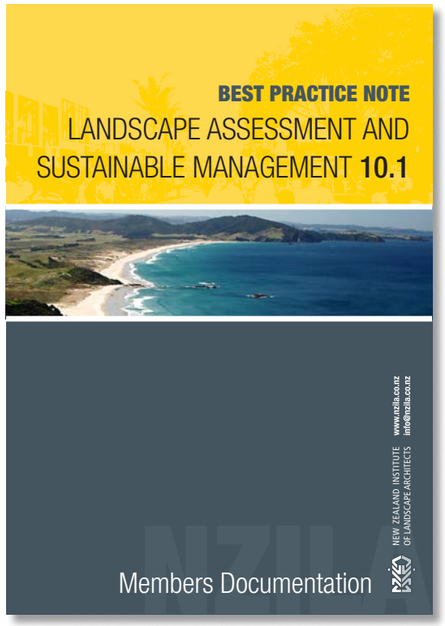
APPENDIX 1: NZTA LANDSCAPE AND VISUAL ASSESSMENT GUIDELINES

1.0 INTRODUCTION

32. This guideline is consistent with the general approach and principles contained in the 'Best Practice Note 10.1: Landscape Assessment and Sustainable Management', 2 November 2010, published by the New Zealand Institute of Landscape Architects (NZILA).

33. The ULDF has a design (outcome) focus, whereas the LVA has an RMA (effects) focus. The LVA gives weight to the principles and design solutions of the ULDF and incorporates them into the RMA process.

These guidelines promote 'best practice' for landscape and visual assessments (LVA) for New Zealand Transport Agency (NZTA) projects[32]. LVAs are technical reports forming part of Assessments of Environmental Effects (AEE) for applications for resource consents and Notices of Requirement for designations (NoR). LVAs are therefore focused on RMA processes. They are a parallel 'work stream' to that of landscape design (including preparation of the 'Urban and Landscape Design Framework' (ULDF)[33]. However, the two work streams are necessarily closely interwoven as illustrated by Diagram 1.



4.1 PRINCIPLES

The purpose of an LVA is to assist the decision-makers[34] when consent is sought. It should be:

- Tailored to the relevant RMA issues;
- Tailored to the specifics of the project;
- Succinct and readable;
- Integrated with the design process (to seek to avoid, remedy and mitigate adverse effects as far as practicable, and seek opportunities for positive effects as part of the design[35]) and linked to other disciplines (such as urban design, ecology, civil engineering);

4.2 CONSISTENCY WITH CODE OF CONDUCT

An LVA should also be consistent with the Code of Conduct for Expert Witnesses[36],not least because the LVA may be the foundation for subsequent evidence. It should therefore:

- Be i**mpartial**;
- Include **all relevant matters** (including those detrimental to the client's case);
- Explain the **facts, assumptions** and **reasons** behind the opinions expressed;
- List any **literature** relied on;
- Describe the **methodology**.

4.3 LEVEL OF DETAIL

The LVA should have a level of detail that corresponds to the scale and significance of the effects the activity may have on the environment (following the principle set out in RMA s88). LVAs for a project where potential effects are not likely to be significant should be brief, whereas complex or large scale highway projects with potentially significant effects require a more comprehensive assessment.

34. For instance; District and Regional Councils, Requiring Authorities, the Environment Court, Boards of Inquiry.

35. While the RMA does not require an application to have positive effects, decision makers are required to take effects (both adverse and positive) into account when recommending or deciding on an NoR or resource consent application.

36. Environment Court of New Zealand Practice Notes, Expert Witnesses Code of Conduct, http://www.justice.govt.nz/courts/environment-court/legislation-and-resources/practice-notes/expert-witness.html (retrieved 12/03/12)

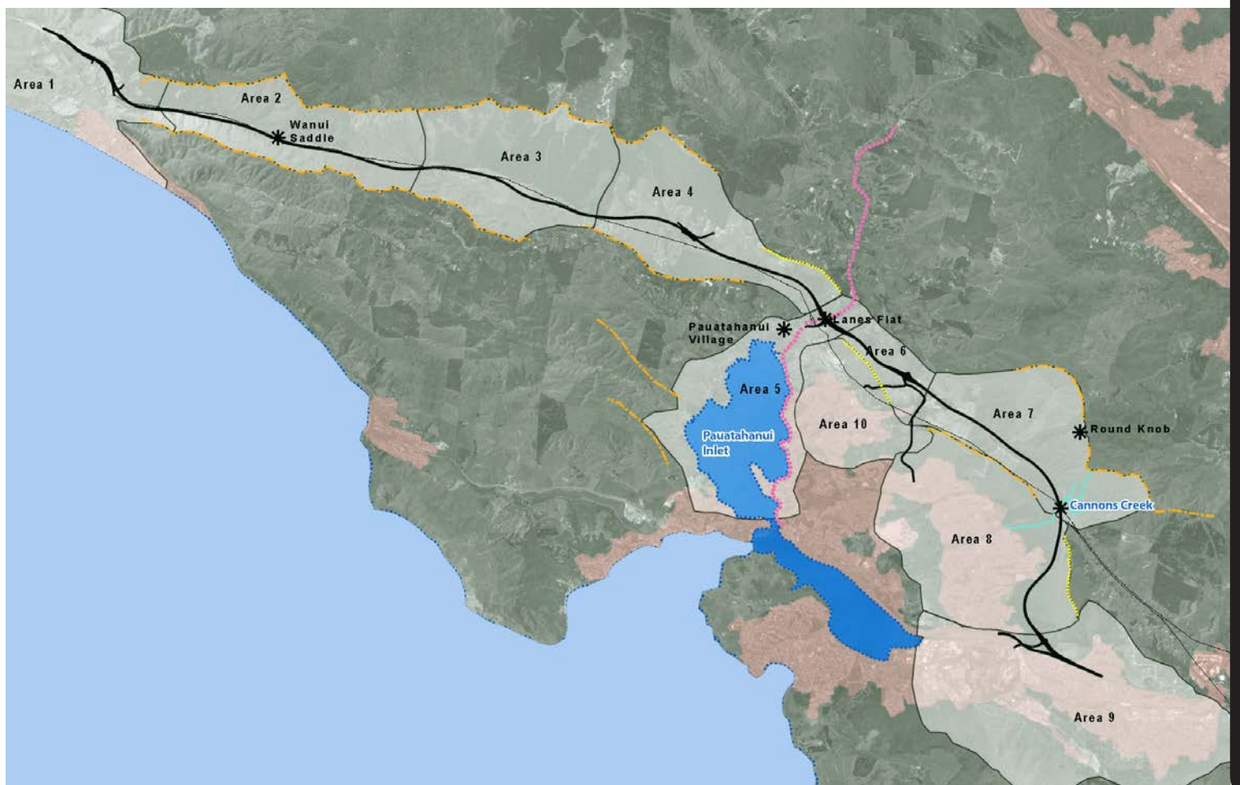
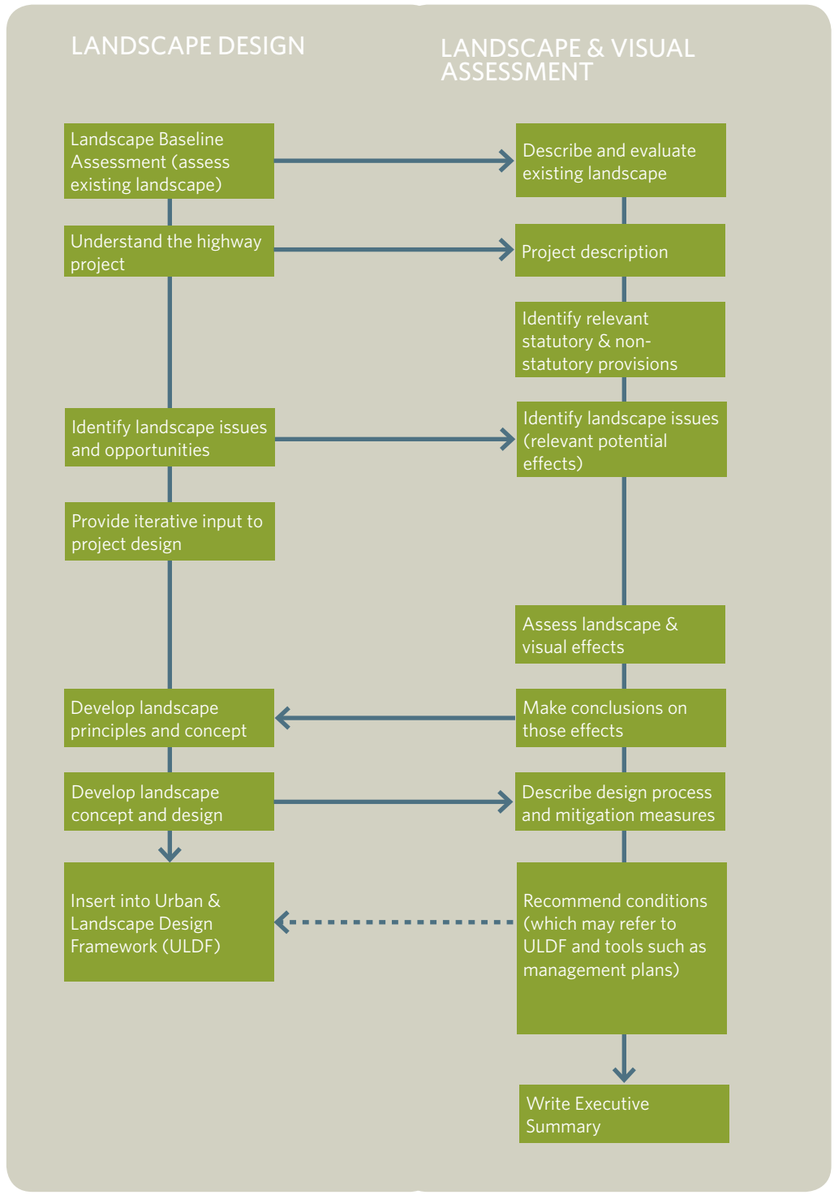


DIAGRAM 1: GENERALISED PROCESS OF LANDSCAPE WORKSTREAMS 'LANDSCAPE DESIGN' AND 'LANDSCAPE & VISUAL ASSESSMENTS'



5.0 CONTENTS OF AN ASSESSMENT

Organise the LVA under the following **main headings**:

- Executive Summary
- Project Description
- Relevant Statutory and Non-Statutory Provisions
- Existing Landscape
- Alternatives
- Design and Mitigation Measures
- Landscape and Visual Effects

Such a structure addresses the matters that need to be included in an AEE as listed in RMA Schedule 4(1)[37].

However, the **sub-headings and content** should be tailored to the specifics of each project. For instance, the sub-headings under 'Existing Landscape' and 'Landscape and Visual Effects' should reflect the particular landscape context and the issues specific to the project. Avoid following a formulaic approach that includes too much irrelevant material and insufficient focus on the matters pertinent to the specific landscape and the particular issues arising from the proposal. Such an approach is often the result of an uncritical reliance on templates. While the main headings listed above provide a basic template, a critical approach needs to be taken to the sub-headings and content within this basic structure.

Use **appendices** to keep the main LVA succinct. Much of the detailed analysis and background material (including the methodology, lists of relevant statutory and non-statutory provisions, detailed assessments and inventories) is best placed in appendices.

The LVA should also outline the role of the author (or the author's firm) in the project. Landscape should be an integral part throughout the planning and design of a highway project. It is desirable for the LVA author (and person who will subsequently give evidence) to be involved in the design development process.

Aerial view of Battle Hill Farm Park and Transmission Gully route

37. While the LVA is not itself an AEE, It is helpful to follow a similar format because the AEE will draw on material from the LVA along with other reports.

NZTA POLICIES AND GUIDELINES

The following NZTA documents are relevant to landscape matters:

NZTA DOCUMENTS	DESCRIPTION
Environmental and Social Responsibility Policy	High level policy which includes NZTA's over-arching goal of promoting an accessible and safe transport system that contributes positively to NZ's economy, society and environment, and a commitment to acting in an environmentally and socially responsible manner.
Bridging the Gap: NZTA Urban Design Guidelines	Guidelines covering a wide range of issues related to urban and landscape design.
Landscape Design Guidelines	Guidelines covering aspects of landscape design, construction and maintenance in State highway projects

FAMILIARITY WITH RELEVANT CASE LAW

LVA authors should be familiar with definitions, principles and interpretations covered in decisions from the Environment Court and Boards of Inquiry relevant to landscape matters including:

- Definitions of 'landscape' and 'visual'
- Relevant aspects to consider within the scope of 'landscape'
- Definitions of 'natural' and 'natural character'
- Principles for identifying outstanding natural features and landscapes

38. Consideration of alternative locations or methods is required where an activity will result in any significant adverse effects on the environment (RMA 4th Schedule). Alternative methods include matters of design. Apart from such requirements, an explanation of the alternatives considered can be a useful way of explaining the rationale for a design.

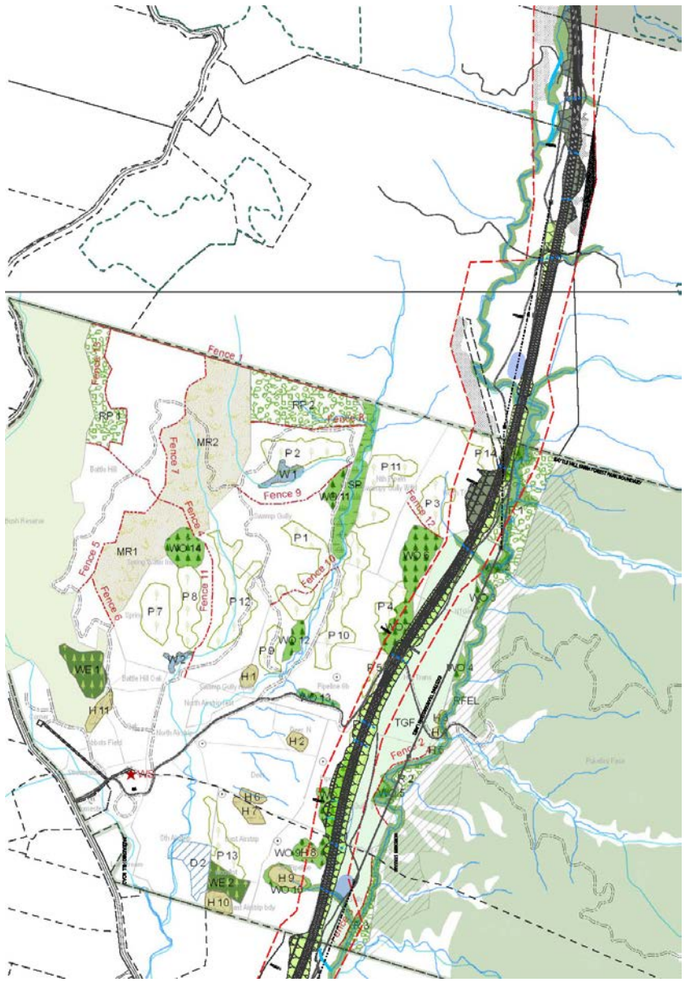
6.0 AN EXECUTIVE SUMMARY

The Executive Summary should summarise the matters pertinent to the decision-makers:

- identify the main landscape & visual **issues** (potential effects relevant to RMA considerations);
- summarise any **alternatives** considered[38];
- summarise the effects (their **nature** and **magnitude**);
- summarise the design measures incorporated into the project to **avoid, remedy or mitigate** potential adverse effects, and similarly summarise measures incorporated into the design that **achieve positive landscape effects**;
- provide a **conclusion** with **reasons** on each landscape issue.

The Executive Summary should be a coherent **stand-alone statement**. It is sometimes extracted and copied straight into the AEE, and may be the only part of the LVA some people will read.

An executive summary should be approximately **1-3 pages** depending on complexity of the project.



7.0 PROJECT DESCRIPTION

Succinctly describe the physical works proposed[39], highlighting those aspects relevant to the LVA. Such aspects are likely to include the general road alignment and basic parameters[40], earthworks, vegetation clearance, stream crossings and structures.

While the description should be consistent with the official Project Description (**PD**) (usually prepared by the Planners or Engineers), its purpose is not to replicate the official PD. Rather it should:

- Be **concise** (it may be as short as a paragraph and should be no more than **1 page**);
- Focus on elements **relevant** to the LVA; and
- Refer to the **official Project Description** with which it should be consistent.

39. The description should be factual: Discussions of benefits, justification or history of a project should not be included.

40. For instance the number of lanes, whether it is a split carriageway or has a median etc

Photosimulation of 'Transmission Gully' highway at Duck Creek (Isthmus)

8.0 RELEVANT STATUTORY AND NON-STATUTORY PROVISIONS

Because the role of the LVA is to assist the decision-makers, it should be written in a way that addresses the landscape matters the decision-makers will consider under the RMA. In other words it is important the author understands the RMA context of the project. It is recommended that the relevant RMA context be discussed and clarified with the project planner or lawyer.

As a general guide, matters to be considered when deciding an application for resource consent or a NoR are set out in RMA s104 and s171 respectively, and those relevant to an LVA are likely to include:

- **Landscape and Visual Effects** of the proposal;
- **Policy statement** and **plan provisions**[41] relating to landscape and visual issues[42];
- **Alternative** locations or methods[43]; and
- **Other relevant matters** (e.g. non-statutory documents such as existing regional or district-wide landscape assessment reports)

The matters listed above are subject to **Part 2** of the RMA which has the over-riding purpose of promoting the sustainable management of resources. Those sections of Part 2 likely to be **most relevant** to a LVA are listed below[44].

Section 5	Purpose and principles of the RMA
Section 6 (a)	Preservation of the natural character of the coastal environment ... wetlands, lakes, rivers and their margins, and the protection of them from inappropriate subdivision, use and development
Section 6(b)	Protection of outstanding natural features and landscapes from inappropriate subdivision, use and development
Section 7(c)	Maintenance and enhancement of amenity values
Section 7 (f)	Maintenance and enhancement of the quality of the environment

Recommended wording to use in relation to the relevant provisions of the RMA itself is included in the side bar on page (17). Seek advice from the project's planner on the relevant provisions of policy statements and plans.

This section of the LVA should typically be **1 to 2 pages** long. Highlight only the most pertinent points and place any further detail in an appendix.

It is stressed that the LVA is not a planning assessment. It is the planner's role to assess the project against the relevant provisions. The purpose of identifying the landscape provisions in the LVA is solely to frame the assessment in a way that focuses on the landscape matters that the decision-makers will need to consider.

41. There is a hierarchy of statutory documents whose purpose is to give effect to the RMA, including national policy statements, regional policy statements and regional plans, and district plans. Other documents (such as a landscape assessment undertaken by a District Council) can be covered under the 'other matters' heading.

42. These might include landscape objectives and policies in the policy statements and plans; landscape assessment criteria; and special landscape status such as areas identified as 'outstanding natural features and landscapes' or landscape overlays

43. Where there will be significant adverse effects on the environment

44. Other matters, such as s6(c) (the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna) may also be relevant, although they are usually dealt with by other disciplines. Those listed are the matters usually most relevant to landscape.

45. New Zealand Institute of Landscape Architects, 2 November 2010, 'Best Practice Note 10.1: Landscape Assessment and Sustainable Management'.

46. Visual appearance and views are a subset of 'landscape'. 'Visual effects' are a subset of 'landscape effects' and are usually associated with a specific method, see below.

47. It is recommended that a baseline assessment is carried out early in a project in order to help inform the project design. Such an assessment can then be used as the basis for the description of the existing landscape section of the LVA

48. The list is similar to a list contained in the 'Lammermoor decision' (Maniototo Environmental Society Incorporated and others v Central Otago District Council and Otago Regional Council Decision C103/2009, paragraphs 201 to 204). The list is not exhaustive or fixed or a formula. It merely provides typical factors. . The relevance of any factor will depend on the context.

49. i.e. Natural and Cultural features, patterns and processes

50. The factors listed in the table cover all those in the so-called 'Pigeon Bay criteria' which have been used for some years. Although the 'Pigeon Bay Criteria' are gradually falling out of favour as a framework for describing landscape, the factors to which they refer are still relevant, there is a body of case law that refers to the 'Pigeon Bay criteria', and they are incorporated in a range of documents and plans. Landscape Architects should therefore be aware of them and ensure that the landscape factors contained within the 'Pigeon Bay criteria' are addressed one way or another when carrying out LVAs.

Cross-section of Transmission Gully flyover at SH58 (Isthmus)

9.0 EXISTING LANDSCAPE (DESCRIPTION AND EVALUATION)

9.1 DEFINING 'LANDSCAPE'

Include a definition of the term **'landscape'** in each LVA. The definition contained in the NZILA Practice Note[45]10 is recommended:

> *'**Landscape** is the cumulative expression of natural and cultural features, patterns and processes in a geographical area, including human perceptions and associations'.[46]'*

9.2 DESCRIBING THE EXISTING LANDSCAPE

Describe the landscape[47], highlighting those aspects relevant to the project, and ensuring that each of the main aspects contained in the definition are covered (in other words make sure the description covers natural and cultural aspects, and human perceptions and associations). The following table lists typical factors that might be relevant[48].

Typical sub-headings	Typical factors
Geographic aspects (sometimes referred to as 'biophysical aspects' –i.e. natural and cultural features and patterns)[49]	Natural • Geology and geomorphology • Topography and drainage patterns • Vegetation and soil patterns • Ecological and dynamic components • Cultural (i.e. 'human') • Road and settlement patterns • Land use
Perceptual Aspects ('sensory' aspects)	• Geomorphic legibility (how obviously the landscape expresses the geomorphic processes) • Orientation legibility (visual clarity of landmarks, edges, and different character areas) • Visibility, public and private views • Aesthetic qualities (presence of water, contrast of shadow and light, perspective depth) • Coherence (the extent to which human patterns reinforce the underlying natural landscape)
Associative aspects	• Historical associations • Tangata whenua associations • Recreational use • Emblematic aspects (e.g. an icon for an area) • Note: Consideration of the factors listed above should take into account things that may be present only occasionally or seasonally or in different weather conditions (i.e. 'transient factors')[50]

RECOMMENDED STANDARD TEXT FOR THE PART OF THE 'RELEVANT STATUTORY AND NON-STATUTORY PROVISIONS' SECTION WHICH ADDRESSES THE PROVISIONS OF THE RMA ITSELF

"Both a notice of requirement for a designation and an application for resource consent must, among other things, provide information as to the effects that a proposed Project would have on the environment and the ways in which any adverse effects would be mitigated. For resource consent applications this assessment

- is required to be undertaken to a level of detail which corresponds with the scale and significance of the effects that the activity may have on the environment; and
- Is specifically required to include consideration of landscape and visual effects and effects on both the immediate neighbourhood and, where relevant, the wider community.

When considering a notice of requirement for a designation or an application for resource consent a Council, Board of Inquiry or the Environment Court must, "subject to Part 2 of the RMA", consider (among other things):

- The effects on the environment of allowing the requirement or activity.
- Any relevant provisions of an operative or proposed RMA plan or regional policy statement; and
- Any other matter they consider relevant.
- Under Part 2 of the RMA they must, among other things:
- Recognise and provide for:
  - › The preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development:
  - › The protection of outstanding natural features and landscapes from inappropriate subdivision, use, and development:
- Have particular regard to:
  - › The maintenance and enhancement of amenity values
  - › The maintenance and enhancement of the quality of the environment.
  - › Any finite characteristics of natural and physical resources.

USE OF THE TERM 'MINOR'

Although the term 'no more than minor adverse effects' is often used in LVAs, it is only relevant to two specific RMA tests and it is best to reserve the use of the term for such instances:

a. the gateway test for non-complying activities under s104D(1)(a); and
b. the tests for public notification or limited notification (of applications for resource consent or NoR) under s95A(2)(a) and s95E(1)

NATURAL CHARACTER OF THE COASTAL ENVIRONMENT, WETLANDS, LAKES AND RIVERS AND THEIR MARGINS

A specific task relates to section 6(a) of the RMA which requires decision makers to recognise and provide for, as a matter of national importance:

"the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use and development".

These provisions have application to most projects because 'rivers' are defined to include 'continually or intermittently flowing streams and watercourses' (RMA s2).

Take into account the following points:

- The extent of the term 'margin' is not defined. A common usage is the 'Queen's Chain' (i.e. 20m from the stream) but it depends on context taking into account the size of the river and the importance of any backdrop.
- The 'coastal environment' is an environment in which the coast is a significant part or element. It includes the active coastal zone and the land backdrop. The first ridge is a useful boundary in many cases, but the extent depends on context.
- 'Natural character' is not a scientific concept. It includes biophysical aspects, and also perceptions of naturalness.
- The term 'natural' has the same meaning as for s6(b). It can include exotic pasture and trees.

The recommended approach is to focus on the landscape facts rather than be overly concerned with the definitions and delineations.

The following process is recommended:

- Determine whether the project might be within the coastal environment or the margins of wetlands, lakes and rivers based on context;
- Describe the aspects of the area's natural character, and assess the degree of natural character. As with landscapes, assessment of natural character should not be overly formulaic, and needs to be justified with reasons.
- Analyse the nature and magnitude of the proposal's effect on natural character, taking into account any remediation or mitigation proposed; and
- Provide a professional opinion, with reasons, on the extent to which the natural character is preserved from a landscape perspective. It may in some circumstances be helpful to provide a professional opinion, with reasons, why a proposal might be appropriate or inappropriate from a landscape perspective. However any such opinions should be qualified by a statement that the author acknowledges that landscape is only one of the matters that the decision maker needs to take into account in determining whether overall a project is appropriate in terms of s6(a) or whether overall the preservation of natural character is recognised and provided for (e.g. ecological factors are also relevant). The reasons should refer to the nature of the context and mitigation measures.

9.3 EVALUATING THE LANDSCAPE

Make an **overall evaluation** of the landscape taking into account the factors listed above. For instance:

- What are the **characteristics** that give the landscape its particular value;
- How **significant** is that value; and
- What are the **reasons** for your overall judgement?

The landscape description and evaluation should **not** simply be a catalogue of factors. Every landscape is the particular combination of its different factors. It is how the factors come together collectively that gives a landscape its particular character. The writer should therefore exercise judgement and art in describing the **pertinent** factors and how they **interrelate**. As discussed above, the sub-headings of this section of the LVA should reflect the particular context, and are likely to vary from one place to another.

Sometimes a scale is used to rate landscape factors as an aid to evaluation. While it can be a useful discipline, such 'scoring' should not be applied in a formulaic manner. An evaluation should rest on an overall professional appraisal and needs to be justified with reasons.

The 'Existing Landscape' section of an LVA should typically be **2 – 5 pages** depending on the extent and complexity of the project area[51].

10.0 ALTERNATIVES

The RMA requires that alternative locations and methods be taken into account where the adverse effects of a proposal on the environment will be significant.

The alternative locations (e.g. route alignments) and methods (e.g. tunnel v cutting) considered should be addressed under this heading where such alternatives fundamentally affect the landscape assessment. For instance, assessment of alternative alignments will be a fundamental aspect of a NoR for a highway through a greenfield route. On the other hand, discussion of alternatives considered in relation to matters of detail (e.g. alternative designs for a bridge) might best be addressed in the 'Design and Mitigation Measures' section.

THE 'ALTERNATIVES' SECTION OF THE LVA SHOULD:

- Summarise the **major** alternatives considered;
- Compare and contrast the **relative landscape and visual effects** [52]for the alternatives; and
- Provide **reasons for the preferred option** in landscape terms. However, the preferred option may not be the best in landscape terms given that selection of the preferred option entails several other factors. In such cases briefly summarise the reasons the preferred option was selected.

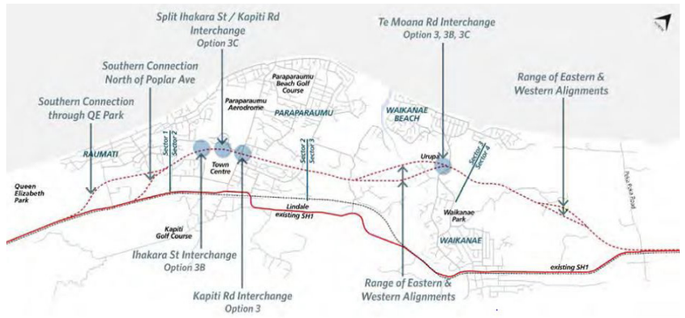


Image illustrating route selection options

51. It may be longer on the largest or most complex projects.

52. The relative nature and magnitude of the different effects

OUTSTANDING NATURAL FEATURES AND LANDSCAPES (ONFS AND ONLS)

Another specific task relates to section 6(b) of the RMA which requires decision makers to recognise and provide for, as a matter of national importance:

"the protection of outstanding natural features and landscapes from inappropriate subdivision, use and development".

Check the District Plan and Regional Policy Statement for classified ONF/ONLs. However, an assessment should still be undertaken if there is any likelihood of an ONF/ONL in the project vicinity. Even where ONF/ONLs have been identified in the relevant Plans there is precedent in case law that additional ONF/ONLs might be identified , and in some cases Councils have simply not undertaken the exercise of identifying ONF/ONLs.

Take into account the following points:

- The adjective 'natural' applies to both 'outstanding natural features' and 'outstanding natural landscapes':
- 'Natural' has a broad meaning: It can include exotic pasture and trees. So a pastoral landscape with few structures could still be sufficiently natural to be an 'outstanding natural landscape'.
- The test for 'outstanding' is an ordinary language one: i.e. is it "conspicuous, eminent, especially because of excellence". The frame of reference is usually 'relative' to other landscapes in a district. (ONLs do not have to be nationally outstanding). But there is no 'quota'. Some districts might not have any ONF/ONLs whereas other districts might contain a high proportion.

The following process is recommended to appraise ONF/ONLs:

- Delineate the spatial extent of the feature or landscape.
- Analyse the feature/landscape in accordance with the Existing Landscape (Description and Evaluation) section of these Guidelines.
- Apply a 'gateway' test of its naturalness: Is it sufficiently natural to be considered as an 'outstanding natural feature or 'outstanding natural landscape'?
- Taking the landscape as a whole (i.e. the combination of its aspects) evaluate whether it is 'outstanding' (see above). Justify the evaluation with reasons.

ASSESSING EFFECTS OF THE PROPOSAL ON THE ONF/ONL

- Identify the qualities that make the ONF/ONL 'outstanding';
- Analyse the nature and magnitude of the proposal's effect on such landscape qualities; and
- Provide a professional opinion, with reasons, on the extent to which the proposal might diminish the ONF/ONL in any significant way.

BASELINE LANDSCAPE ASSESSMENT

A baseline landscape assessment is a component of the route selection process, in which ***landscape units*** are 'scored' as part of a multi-criteria analysis in terms of the following attributes:

Landscape quality

Assess the landscape in terms of its components. Assign a relative overall 'score' to each landscape unit. While it is accepted that landscape cannot readily be reduced to a 'score', such numerical ranking is a tool to enable landscape units to be compared relative to each as part of a multi-criteria analysis involving other disciplines. The purpose is to help route selection by identifying landscapes of lesser or greater value, and lesser or greater ability to accommodate the road.

Absorption capability

Assess the landscape in terms of its ability to absorb the road. In essence this is an estimate of the ***likely level of effects***, taking into account:

- Topography (likely extent of earthworks)
- Settlement density (likely degree of visual amenity effect)
- Extent of vegetation (likely degree of screening)
- Land use complexity (likely extent of existing modification)

The landscape units should be drawn to distinguish different landscape types or character areas in a way that lends itself to sensibly comparing alternative routes: For instance landscape units may be long and narrow to enable comparison of parallel routes.

Because the 'highway' alignment is not known early in the project, the focus is on landscape attributes rather than actual effects. This is the only phase at which 'absorption capability' is relevant.

(Note: At the SAR phase the assessment can focus on the effects of an alignment and design).

11.0 DESIGN AND MITIGATION MEASURES INTEGRATED IN THE DESIGN

This section of the LVA should describe those measures proposed to **avoid, remedy or mitigate** potential adverse effects. It should discuss those measures **incorporated into the design** of a project to avoid or minimise effects, as well as subsequent measures **added to the design** (such as screen planting) to mitigate effects. Positive design measures incorporated into projects (or measures incorporated to avoid potential adverse effects) are often overlooked because of the tendency to focus solely on 'mitigation' measures. It is important that such measures taken to avoid potential adverse effects or promote positive effects are explained and taken into consideration. It should be remembered that the purpose and principle of the RMA includes '**avoiding**, remedying and mitigating' any adverse effects and that the definition of 'effects' in the RMA includes **both 'positive and adverse**' effects.

This section of the LVA should explain the **design process** and the overall design. It can take a 'whole of project' approach in explaining the principles and **overall design** concept compared with the more reductive approach taken when discussing mitigation of individual effects (see following section of the guidelines).

'Best Practice'

A 'best practice' example of the 'Design and Mitigation Measures' section might include the following:

a. an outline of the extent to which landscape issues were considered **throughout the design process** from route selection through to the project design;
b. summary of the **landscape input to the design process** including:
   - reference to a **'baseline' landscape assessment** carried out as part of the design process (as demonstration that the existing landscape qualities, constraints and opportunities were taken considered during the design process);
   - the design decisions taken or measures adopted to **avoid** potential adverse landscape effects;
   - opportunities taken to incorporate **positive landscape effects** into the design;
   - landscape measures taken to **remedy or mitigate** residual adverse effects[53]; and
   - **alternative design options** considered e.g. alternative designs considered for a bridge.

A **description of the design** including:

- reference to the '**Urban and Landscape Design Framework**' (ULDF) as the guiding document for the landscape design;
- the landscape design **principles** and **overall concept**;
- how the design is resolved at **different scales**, such as how it responds to broad landscape patterns and processes, as well as detailed elements of the project;
- the extent to which design attention has been applied to all **elements of the project** (as far as practicable) to collectively reduce adverse effects; and
- the integration of landscape with **other disciplines** (such as ecology, civil and structural engineering) and any **cross-over benefits**;
- a summary of the proposed **implementation methods** to the extent necessary to provide confidence the works are **practicable**.

The design and mitigation section of the LVA can typically use bullet points to summarise matters already discussed. It should normally be in the order of **3-5 pages**, and should reference other documents such as the 'Urban and Landscape Design Framework' where relevant.

53. Such measures might include design within the corridor (barriers, highway furniture, edge treatment, structures), and measures to repair the underlying landscape (restoring stream and vegetation patterns, restoring recreation links and street connectivity).

12.0 ASSESSMENT OF (RESIDUAL) LANDSCAPE AND VISUAL EFFECTS

12.1 IDENTIFYING LANDSCAPE ISSUES

The main landscape issues should be listed at the start of the 'Effects' section and used as the subheadings for this section of the LVA. An 'issue' is an effect in the context of a statutory provision. For example:

RMA provision (context)	Examples of Landscape Issues[54]
s6(a) Natural Character of Coastal Environment, Wetlands, and Lakes and Rivers	• Effects on natural character (biophysical and perceptual) of rivers and streams
S6(b) Outstanding Natural Features and Landscapes	• Effects on the qualities of an outstanding natural feature or landscape
s7(c) amenity values	• Effects on landscape character • Effects on streetscape • Effects on recreational experience in a park • Effects on landscape context of an historical site • Effects on views • Effects on visual amenity from private property • Temporary visual effects during construction
S7(f) quality of the environment	• Effects on landforms • Effects on vegetation[55]

The examples listed above are typical, but there is a range of potential landscape issues and a key task is to identify those relevant to the particular context and project.

- The examples listed above are typical, but there is a range of potential landscape issues and a key task is to identify those relevant to the particular context and project.
- Effects include **potential** as well as actual effects. A potential effect might be avoided (or reduced) by design measures, which should be described in the 'Design and Mitigation Measures' section of the LVA.
- Effects include **positive** as well as adverse effects [56] While assessments typically focus on adverse effects, positive effects are also a relevant consideration[57] and should be described in the LVA[58].(It is also worth noting that RMA sections 7(c) and 7(f) require that particular regard should be had to the maintenance **and enhancement** of amenity values and the quality of the environment respectively).
- Effects include **temporary** as well as permanent effects (for example landscape and amenity effects are typically amplified during construction).
- Effects also include **cumulative** effects which will arise over time or in combination with other effects.

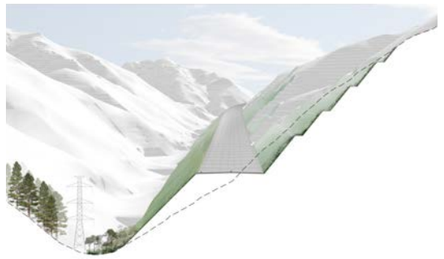
54. This list is not by any means exhaustive.

55. Sometimes there is overlap between different issues. Rather than repeat matters it is best to simply refer to other parts of the LVA.

56. RMA section 3.

57. For instance, RMA s104 and s171 relating to applications for resource consents and notices of requirement respectively. Note that positive effects are not relevant to decisions on notification.

58. However such positive effects should also be described in an impartial way. Avoid becoming an advocate.



Cross-section of Transmission Gully flyover at Te Puka Stream (Isthmus)

13.0 ANALYSING ACTUAL EFFECTS

NATURE OF EFFECT + MAGNITUDE - MITIGATION = ACTUAL EFFECT

Describe the precise nature of the effect. For instance change is not an effect per se. By way of example, it is not the quantity of the earthworks that is relevant, rather the effect of the earthworks on (say) visual amenity values or natural character of a stream.

Evaluate the magnitude of the effect. Magnitude is influenced by variables[59], for example the dimensions of a cut batter, distance from a viewpoint, extent of screening. Use a relative scale to rate magnitude, but always give the reasons to justify the rating. The following 5 point scale is suggested: It is symmetrical around a 'moderate' middle score, uses neutral ('objective') descriptors, and can be used for a range of effects or other purposes[60]

The same scale should be applied to both adverse and positive effects[61].

LOW	MODERATE-LOW	MODERATE	MODERATE-HIGH	HIGH

Discuss measures taken to mitigate each adverse effect where relevant: While such an approach is reductionist and repetitive, it helps decision-makers to consider each effect and its mitigation as part of their step-by-step deliberations. (This is in addition to the more over-arching design principles and concepts discussed in Section 8 of the LVA above).

A range of tools is available to assess landscape effects. A selection of such tools are outlined at the end of this section. Their uses should be tailored to the specific situation.

Conclusions on each Landscape Issue

Finally, provide an overall appraisal on the effects in relation to each landscape issue including:

- A summary of the **nature** and **magnitude** of landscape effects;
- An appraisal of the **likely effectiveness** of the mitigation measures (whether the adverse effects will be '**adequately mitigated**'); and
- A **professional opinion** on whether the effects will be 'acceptable' or 'not acceptable' in landscape terms. Such an opinion should acknowledge that **landscape is only one matter to be taken into account,** and **state the reasons for the opinion** such as the context, the nature and magnitude of adverse and positive effects, and the mitigation. The purpose of the professional opinion is to assist the decision-makers in their weighing of landscape issues with other matters.

The 'Landscape and Visual Effects' section is the main part of an LVA. Its length will vary depending on the complexity of the project and landscape issues, but the level of detail should be proportional to the potential degree of effects. It might typically be between **5-25 pages**, although it may be longer for the most complex projects.

59. In other words an assessment of magnitude can be thought of as an assessment of variables.

60. Always specify any scale used. For example an alternative acceptable scale is a 7 point scale where 'very low' and 'very high' are added at either end of the scale described above.

61. The net effects will fall in the range between 'high' adverse effects and 'high' positive effects. However, in most instances it will be too simplistic to mathematically synthesise adverse and positive effects of different types into a single overall 'score'. (i.e. to synthesise apples and pears). It is likely to be more sensible to make an overall assessment, after having described the adverse and positive effects separately.

14.0 RECOMMENDED CONDITIONS

Conditions are normally recommended as part of the 'planning' work stream and attached to the planner's evidence. To assist this process the landscape design and the proposed implementation methods should be sufficiently resolved that they can be effectively translated into recommended conditions. The LVA may also refer to the need for a condition to cover a particular aspect of the design. If a proposed design feature is relied upon for the LVA's conclusions, such a feature must be covered by a condition in order for the assessment to carry weight.

Landscape conditions might cover such matters as:

- A general outline of the proposed landscape works (usually by reference to the Landscape Plans);
- A process for further design development during subsequent stages of the project. For example the conditions might require a 'Landscape Management Plan' (LMP) that is to be consistent with the principles and guidelines contained in the ULDF;
- The content of any devices, such as LMPs, that are proposed to manage implementation;
- General implementation techniques[62] and
- Maintenance period, performance criteria, monitoring and reporting procedures.

Conditions may also require **consultation with nominated stakeholders** in the development of plans or management plans.

'Landscape Management Plans'

The recommended conditions may require a '**Landscape Management Plan**'[63] (LMP) (or a '**Urban and Landscape Design Management Plan**' (ULDMP)) be prepared to control aspects of the works. The conditions should outline the contents of such management plans and include sufficient information on the design principles and standards to be incorporated in order to provide sufficient certainty of the eventual outcome to the decision makers.

Role of the 'Urban Design and Landscape Frameworks' (ULDF)

NZTA policies require ULDFs to be prepared for major projects as part of a commitment to high quality landscape and urban design outcomes, including integration of NZTA projects with the landscape and urban environments through which they pass. The ULDF typically contains principles, guidelines and broad design concepts. It is the framework for the landscape (and urban) design component of the project at the NoR or consenting phase, and is also intended to guide the further development of the design during subsequent design stages.

The role of the ULDF in relation to the LVA includes the following:

- The ULDF explains and describes the landscape (and urban design) principles incorporated in the project design;
- The ULDF explains the context for the Landscape Plans that are likely to be referred to by the recommended Conditions;
- The ULDF provides a framework (including principles and guidelines) to guide further development of subsequent design stage of the project, and a benchmark against which such design development can be 'certified';
- The ULDF provides a framework for such devices as LMPs or LUDMPs, and a benchmark against which such management plans can be certified;
- Sufficient flexibility needs to be retained in an ULDF to enable:
- Design development, or evolution, during subsequent stages of the design process (for instance during design development as part of a Public Private Partnership (PPP), or design development in consultation with stakeholders);
- Incorporation of long term visions that may extend beyond the timeframe of an immediate project; and
- Incorporation of aspects that are the responsibility of other agencies (such as Local Authorities).

Further guidance on preparation of ULDFs can be found in Appendix 2 of NZTA Bridging the Gap.

62. This should be limited to sufficient information to provide confidence that mitigation measures are feasible or to provide the basis for conditions so there can be certainty work will be implemented as described. For instance they might include techniques for contouring and rehabilitating earthworks, and carrying out revegetation and other planting. In other words, to provide confidence that the mitigation plans are more than mere graphics.

63. Or Landscape and Urban Design Management Plan (LUDMP)
Or Landscape and Urban Design Management Plan (LUDMP)

ASSESSMENT TOOLS

The following are tools that may be useful to assess landscape effects (refer section 13, page 150), depending on the situation. They are not exhaustive.

Baseline Assessment	A baseline assessment is useful prior to route selection or commencement of the design. It will analyse the existing landscape and identify: • Areas or features to be avoided; • Potential adverse effects; • Opportunities to avoid or reduce potential adverse effects; • Opportunities for positive effects that might be incorporated into the design.
Calibration Assessment	A 'calibration assessment' is a useful technique to increase objectivity. For example an existing highway similar in character to that proposed may be used to calibrate the extent to which increasing distance diminishes the magnitude of visual effects. Other factors affecting the magnitude of effect (such as relative elevation, intervening vegetation, complexity of intervening landscape) would also be identified. Such exercises sharpen observation. However it is important not to let such an approach become formulaic. Such calibrations are only useful as a starting point to professional appraisal taking all factors into account.
Visual Assessment	Visual effects are a specific subset of landscape effects, typically assessed by the following method: • Identify and describe the area from where the project will be visible ("visual catchment", "zone of theoretical visibility"); • Identify the people who will see it ('viewing audience'), and the relative sensitivity of those types of audience to landscape matters; • Select viewpoints to represent the different locations and audiences (representative viewpoints). It can be a good idea to agree these viewpoints with the local authority. • Describe the nature and magnitude of effects on the view from each representative viewpoint. • Photomontages are often also done from the representative viewpoints. • Variations on the method include a sequential analysis from roads, and assessment of visual effects from properties (see below).
Property Inventory	An inventory is an effective way of dealing with a large number of properties, and also of identifying persons affected visually by the proposal (see RMA 4th Schedule). It should be placed in an appendix and summarised in the main report. It is a form of visual assessment. Use the following process: • Compile a list of properties using consistent numbering with other work streams (a GIS 'gatekeeper' is a useful way of ensuring consistency). • Use representative viewpoints for groups of properties (for instance urban areas or clusters of lifestyle properties) and individual entries for properties in rural areas or where there are unique circumstances. • Assess effects on the property in general with particular emphasis on the dwelling(s). (Bear in mind that effects are not limited to dwellings, but will be experienced in other parts of properties). Make assessments from road side in first instance, and make property visits where relevant and practicable. Summarise main points in the inventory. • Rank the effects against the five point scale making an overall judgement of the factors in each case.

Photomontages	Although photomontages cannot replicate actual experience, they are an important tool: • Photomontages generally involve merging a digital terrain model of the landscape / project with a photo using either terrain matching and/or control points. The works are subsequently rendered, including addition of proposed planting etc. • Photomontages should be produced at a size that represents correct scale for a nominated reading distance (400mm is recommended). This requires a calculation based on the lens and camera receptor details. • All photomontages in a series should have a consistent scale (i.e. be produced at the same reading distance). • Photomontages should include sufficient field of view to present a fair perspective. Ideally photomontages should represent a similar field of view to human binocular vision which is normally 124o horizontal and 55o vertical. A recommended practical approach is to present photomontages at a 400mm reading distance on 1 x A3 or 2 x A3 pages (i.e. facing A3 pages). The latter covers 120o horizontal field of view. Such panoramas require stitching of individual photos. • Lens focal length does not in itself affect perspective[64]. However it is important that the lens and camera is stated to enable correct scale to be calculated. • Data on each photomontages should include (i) the photographer (ii) the date and time (iii) the GPS location of viewpoint, ideally shown on a map (iv) the direction of view (v) the camera and lens (vi) the 'reading distance' at which the photomontage will represent correct scale • A qualifier should also be added that photomontages are an aid for on-site observations and cannot replicate human experience of the landscape. • NZILA Best Practice Guide, Visual Simulations, BPG 10.2 is a thorough and accurate guideline to preparation of photomontages.
ZTV analysis	Zone of Theoretical Visibility is a GIS analysis which identifies the 'visual catchment': the area in which there might be a potential line of sight to a project. While it can be a useful analytical tool for discrete objects (such a mast), it is less useful for linear features such as roads for the following reasons: • ZTV identifies locations from which any part of the road, no matter how small a portion, has theoretical visibility, and it doesn't identify the extent of the road visible. ZTVs therefore imply greater magnitude of visibility than is typically the case. • ZTVs do not account for screening by intervening vegetation, buildings etc. Visibility of roads typically drops away relatively quickly with increasing distance, particularly in flat or urban landscapes. ZTVs therefore tend to grossly exaggerate the actual visibility. It is possible to include vegetation and buildings into a ZTV by using a LIDAR survey to plot such features, but it is an expensive exercise to do over a wide area. • Variations on the tool can be more useful in some situations. For example a ZTV might be relevant for a particular element of the road (a specific cut face, or an interchange). Alternatively the ZTV can be reversed to show the portion of a road theoretically visible from a particular viewpoint.
Earthworks Inventory	An inventory of earthworks is an effective way of analysing landscape effects of civil engineering. As above, append the inventory to the LVA and summarise the findings in the main report. • Tabulate the earthworks, for instance each of the cut faces and fill batters. This might be broken into route section. • Measure length and height of earthworks. • Assess effects on landform, vegetation, watercourses etc. • Determine visibility and assess visual effects. • Propose measures to reduce effects of each group of earthworks Such an inventory can useful in an iterative design process because it focuses design refinement on the 'hotspots'.
Section by Section Analysis	An alternative approach is to divide the route into sensible geographical sections and assess all landscape and visual effects within the section. Submitters, for instance, may be only interested in that section in the vicinity of their properties. As above, append such an inventory to the LVA: The LVA itself is better structured to RMA issues rather than geographical areas. • Divide route into sensible sections (best if consistent between different disciplines) • Describe the relevant section of the project; • •Assess effects for the section of road.

64. There is often a misconception around lens focal length. Guidelines often incorrectly claim that a 50mm lens approximates human sight in terms of field of view or perspective. In fact human sight has a much wider field of view than a 50mm lens and perspective depends on the relationship between viewpoint, object and background (which is influenced by field of view).

APPENDIX 2: NZTA P39 STANDARD SPECIFICATION FOR HIGHWAY LANDSCAPE TREATMENTS

INTRODUCTION

To achieve consistency and quality in the delivery of highway landscape treatments a standard landscape specification has been developed that sets out the minimum standards as a template for all highway landscape projects in order to improve the quality and overall contribution of landscape works across the transport network and deliver the quality of asset sought by the NZTA.

This baseline landscape specification sets the required standards, quality and workmanship for the landscape treatments which are generally part of all highway projects.

This is to ensure:

- Statutory compliance - landscaping is required to mitigate a project not only visually but for ecological reasons. Plant failure can lead to non compliance with designation conditions.
- Whole of life value for money - poorly designed and implemented planting that leads to plant failure, creates a high maintenance cost, thus requiring reinvestment by the Transport Agency either itself or through its maintenance contracts.
- Visual and ecological benefits of the landscaping.
- Contractor requirements - landscaping is often implemented at the end of a capital project when the contractor's funds are tight. Landscaping funds can get redirected to other areas of the project compromising the overall outcome. By setting minimum standards and performance requirements, the contractor will need to place more emphasis on the quality of their work and maintenance through the defects and maintenance period to ensure the landscaping is established and self sufficient.

CONTENT OF SPECIFICATION

The baseline landscaping specification sets out standard requirements as they relate to:

Section A:	General
Section B:	Quality Control; Inspections and Reporting
Section C:	Site Preparation
Section D:	Plant Pest Control and Animal Pest Control
Section E:	Plant Propagation
Section F:	Topsoil Supply
Section G:	Planting
Section H:	Grassed Surfaces
Section I:	Hydro-seeding grassed (& specialist) surfaces46
Section J:	Irrigation (Design and Build)
Section K:	Defects Liability And Maintenance
Section L:	Maintenance Only

The full specification is available at: http://www.nzta.govt.nz/resources/landscape-treatments/

PERFORMANCE CRITERIA

The specification includes the following performance criteria which is aimed at achieving the quality landscape outcomes sought by the NZTA. The following performance criteria apply to all highway landscape treatments in the capital phase of the project:

	All ground preparation, topsoil and mulch shall support plant growth within highway landscape treatments
	All planting shall include quality plant stock, true to form and shape with healthy signs of growth
	At least five (5) different plant species shall be included in all planted areas, with the aim of supporting resilience within plantings
	For biodiversity reasons locally appropriate plants shall be specified. A minimum of 1% of plant numbers in all planting shall be comprised of species with regional and/or national threat status of 'At Risk' and/or 'Threatened'
	All associated plant ancillaries (such as climber supports, matting, tree stakes and ties) shall meet this specification
	All planting shall be 100% complete at practical completion, with 10% maximum plant loss being acceptable for grades smaller than 15lt/PB 28 at the completion of the defects liability and maintenance period, provided that the losses are spread evenly throughout the planting and there are not noticeable bare patches
	All larger plants grades 15lt/PB 28 and over shall be 100% complete at practical completion, with no loss being acceptable at the completion of the defects liability and maintenance period (by contract completion)
	Planting shall achieve an 80% canopy coverage of the ground by contract completion
	Grass covers and hydro seeding coverage shall achieve 95% coverage of the area by contract completion with no single area of exposed soil greater than 100mm diameter in any one location
	The effects of pest plants shall be managed to ensure the establishment of all plantings and amenity outcomes. Limiting the distribution of pest plants and costly retrospective maintenance across the network is also sought. Consistent control of pest plants is required through the contract period
	All defects shall have been progressively rectified during the defects period and prior to the issue of the Defects Liability Certificate
	At contract completion, the Landscape Architect nominated in the tender shall complete a producer statement. The statement shall confirm that the contract works have been undertaken in accordance with the plans and specification. The NZTA may accept the producer statement as evidence the landscape works comply with the landscape design and the requirements included in the NZTA Standard Specification for Highway Landscape Treatments.

If you have further queries, call our contact centre on 0800 699 000 or write to us:

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