D

Planning

PART D

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PLANNING

D1 Planning

Goal

Integrate environmental, transportation engineering, social, economic and site specific considerations for protecting and presenting the natural and cultural values into the planning of road corridors within the wet tropics region.

Principles

Planning of roads in the wet tropics region should be based on the following principles:

- As far as practicable protect and conserve the biodiversity and ecological integrity of the wet tropics biogeographic region.
- Complement the region's natural and cultural values through the provision of presentation opportunities to showcase the unique visual beauty of the wet tropics biogeographic region.
- Identify community values and needs utilising public consultation where appropriate.
- Consider the regional planning (such as FNQ 2010 and Local Government planning schemes), environmental, social and economic context and long term issues.
- Closed canopy forests in the region contain many rare, endangered or unknown species of plants and animals, disturbance of these areas should be avoided as far as possible.
- The remnant forest patches of the lowlands and tablelands provide important habitats and are representative of the natural vegetation of the area. Roadworks should avoid these as far as possible. In particular, riparian vegetation (along rivers and streams) provides important linkages between forests of the ranges and lowlands.
- The high rainfall and the regularity of extreme rainfall episodes means that it is essential that drainage, erosion and sediment control should be integrated in the planning of roads.
- The low-lying wetlands throughout the coastal plain are particularly sensitive to changes in hydrology patterns.
- Determine appropriate uses of the road and its function(s).
- Determine an appropriate design speed consistent with the appropriate uses and function of the road.
- Plan to reduce the potential for accidents, injury and death to both people and animals as a result of road conditions.
- Where possible accommodate predicted future traffic demands (to minimise the need for incremental upgrading).
- Protect the region's landscape and scenic values.
- Provide for visitor and recreational opportunities.
- Ensure a major consideration during planning is to minimise environmental impacts and provide mitigative measures where possible.

- Ensure an appropriate level of environmental impact assessment given the likely nature, extent, magnitude, duration and severity of impacts.
- Ensure an appropriate level of social impact assessment and community consultation.
- Minimise disturbance on all forest types and natural area's conservation significance and value where possible.
- Identify cultural heritage values and minimise impacts where possible.
- Protect natural drainage lines and maintain catchment integrity where possible.
- Plan to rehabilitate areas disturbed by previous or disused roads and roadworks.
- Give consideration to prudent and feasible alternatives. Where appropriate, evaluate project alternatives using cost benefit analysis.

D2 Planning Process

Overview of the Planning Process

The environmental aspects of the planning process are set out in section four. Essentially the planning process involves:

- **Initial Corridor Planning:** Requires the development of an Overview Report (which may also be called a planning or link study report) which sets out the project definition, concept estimate and program staging. This phase should be addressing corridor options within the regional planning framework and the conservation significance of any natural habitats traversed.
- **Project Concept Planning (DMR Form 2289):** This phase involves a more detailed definition of the project concept. Importantly, a Concept REF (Review of Environmental Factors) is prepared during this stage.
- **Planning and Preliminary Design (DMR Form 2290):** This phase is the main area in the planning phase where the potential environmental impacts are identified, possible impact mitigation strategies developed and a balanced decision is made on whether to proceed or not. The phase involves an evaluation of options, option approval, a Detailed Planning Report, a planning estimate, planning approval, resumption proposals and the completion of the planning Form 2290. As a minimum a Planning REF is prepared, if impacts are likely to be significant or are unknown, an Impact Assessment Study is undertaken. The EMP (Environmental Management Plan) Planning is prepared to set out the necessary environmental impact mitigation measures which are contingent on the approval of the project.

Note: Where an area has high conservation value or other community sensitivity, the Preliminary Design will involve more detailed design and needs to consider Section 6.0 Integrated Design.

Appropriate Level of Impact Assessment

The desired outcome is for environmental impact assessment to be commensurate with the magnitude, extent, severity, duration and reversibility of likely impacts and the significance of natural, cultural and social values affected.

Undertaking impact assessment for transport infrastructure decisions in Queensland is a requirement of Section 29, *State Development & Public Works Organisation*

Act 1971-1981. This Act requires public authorities and organisations to hold the duty and power of considering all possible environmental consequences of approving development or undertaking construction of transport infrastructure.

Because of the range of operations of DMR throughout the State and the diversity of environmental impacts, it is not appropriate to set thresholds which will trigger the preparation of an Impact Assessment Study for any particular project. The preparation of the Review of Environmental Factors will assemble all relevant information. The decision on whether or not an Impact Assessment Study is required should be made on the basis of specialist professional advice.

A Review of Environmental Factors should be prepared for all road projects within the wet tropics region. The REF should identify all possible environmental impacts so that a decision can be made on whether there are any potentially significant impacts which need to be assessed in detail in an Impact Assessment Study.

Best Practice Guidelines:

On the basis of initial scoping (eg., Review of Environmental Factors) determine the required level of impact assessment.

The character of the environment and likely or potential impacts of road development should be considered in order to evaluate whether or not the environment is capable of absorbing the predicted level of impact. These issues and the level of certainty in predictions are all important considerations in determining the appropriate level of impact assessment.

The impact on the environment of not constructing the road should also be assessed. For example, the existing route may have poor fauna crossing facilities and increased traffic will exacerbate the problem.

Targeting the Impact Assessment Terms of Reference

The desired outcome is to ensure that environmental impacts assessment identifies all likely environmental impacts and focuses on those that are most significant.

Scoping is generally the first step undertaken when conducting an environmental impact assessment. It determines the "scope" of the environmental analysis, which essentially identifies which biophysical, cultural and social attributes should be investigated in the assessment of the proposed project. Scoping determines what issues are considered within the Terms of Reference and hence the impact assessment itself.

Experience shows that the efficiency and effectiveness of environmental impact assessment depends on the adequacy of scoping and subsequent drafting of the Terms of Reference, Within the current framework both concept and planning Review of Environmental Factors provide a suitable scoping process. The Terms of Reference is facilitated by the REF.

Best Practice Guidelines:

An Impact Assessment Study for a major road project in the wet tropics region should include:

- full description of the project including background information such as associated operations;
- assessment of any prudent and feasible alternatives and the reasons for not selecting these;
- the consequences of not carrying out the project;
- objectives for the project, its purpose, methodology and anticipated results;

- full description of the existing environment (including rare and threatened species, natural habitats, vegetation communities and landscape values);
- likely environmental, cultural, social and economic impacts and consequences of undertaking the proposed development;
- mitigation measures to minimise the likely impacts; and
- community consultation and broad public display of significant impacts for the wider community.

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Focus the scope of the impact assessment toward critical issues by obtaining a complete knowledge and understanding of the project and completing a list of potentially adverse and beneficial impacts. Based on experience and expert advice, determine magnitude of impacts and priorities.

Meet with referral agencies (such as the Department of Environment and the Wet Tropics Management Authority) to develop an understanding of core issues to be addressed by the Impact Assessment Study.

Consultation and Social Impact Assessment

The desired outcome is for the community's concerns, aspirations and comments and the likely social impacts to be identified and considered during planning.

Consultation provides the community with an opportunity to have their say in the planning, design, construction and operation of road corridors. It assists the responsible authority in the identification of concerns, issues of priority and importance, potential impacts, management issues and generally provides greater understanding of the aspirations of the community. Community consultation also keeps the community informed.

Community consultation generally follows an invitation to comment on a particular project. Questionnaires and submissions may be called for by the DMR and they may arrange public meetings and workshops for face to face consultation with the interested parties. Separate consultation may be required when Aboriginal communities are involved in a particular project.

Social Impact Assessment is essentially the process of identifying, evaluating and managing the social effects of development (Institute of Applied Environmental Research 1993). Social Impact Assessment should consider a range of dimensions including structure, demography, lifestyle, economy and culture of a given population. In many respects Social Impact Assessment is similar to and forms part of the Environmental Impact Assessment when considering likely impact projections and impact assessment. Social Impact Assessment is seen as an important process responding effectively to the social needs and concerns of a given community.

Best Practice Guidelines:

Develop a list of identified stakeholders to ensure that the relevant sections of the community are involved. This can be achieved by communicating with likely groups and associations which may be affected by the proposed project. Advertising for public submissions regarding the proposed project will also help in identifying relevant stakeholders. Appendix 1 identified a number of key stakeholders in the wet tropics region.

The level of required consultation may potentially be influenced by the degree of public interest in the project and whether or not it is likely to become controversial.

Consultation should be undertaken by experienced professionals or relevant officers should undertake training in public consultation and facilitation prior to undertaking public consultation.

Disseminate information to stakeholders prior to meetings and workshops. The special requirements of Aboriginal people need to be considered in the information dissemination phase of the consultation program.

In order to ascertain likely social impacts, evaluation of social factors and concerns relating to predicted levels of impact and the ability of the social environment to absorb impacts should be undertaken.

Assess predicted levels of socio-economic growth and their impacts on the existing road corridor network. Identify how the future road corridor network may benefit or detract from the social environment.

Plan to promote increased public exposure and expectations of Social Impact Assessment. Plan to provide representative and accurate social profiles which reflect the needs and concerns of communities at localised levels.

Cumulative Impacts

The desired outcome is consider the cumulative impacts of proposals.

The environmental impact assessment process requires consideration of the cumulative, regional and long-term impacts and assess the capacity of the environment to handle developments. One of the objectives of environmental impact assessment identified in the National Strategy for Ecologically Sustainable Development is the need to "increase the sensitivity of the environmental impact assessment process, its planning and policy context and consequent decision-making to cumulative and regional impacts."

Cumulative impacts can take two forms:

- the combined impacts of various activities on an ecological process or ecosystem; and/or
- the accumulation of impact over time eventually resulting in irreversible change or collapse of ecological processes.

For example, the combined impacts of separate old road alignment, cane railway, railway and new road alignment crossings of a creek which disturb the riparian vegetation along a creek may result in a major threat to the integrity of the corridor, where individually one crossing may have an impact which does not cause significant ecological harm.

Both types of cumulative impacts are inherently hard to predict and require an understanding of ecological processes and the integrity of ecosystems likely to be affected.

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Best Practice Guidelines:

Consider the ability of the environment to endure cumulative, regional and long term impacts through the environmental impact assessment process.

Develop appropriate mitigative measures to avoid cumulative impacts.

Prudent and Feasible Alternatives

The desired outcome is to consider all prudent and feasible alternatives.

As part of its assessment criteria, environmental impact assessment considers prudent and feasible alternatives for proposed developments. These alternatives canvass specific actions differing in nature, provide similar user benefits with different environmental impacts and implement varied design and detail features.

In deciding whether there is an alternative to a proposed activity, the environmental impact assessment should address the following:

- any alternative site/corridor for the roadworks, either elsewhere in any natural habitat and/or protected area or outside the natural habitat and/or protected area;
- any alternative use for the proposed site corridor of the activity;
- any alternative way of carrying out the proposed activity; and
- the alternative of not carrying out, or postponing carrying out, the proposed activity.

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In deciding whether an alternative is prudent, the environmental impact assessment should compare the likely impacts of the alternative and the proposed activity. In evaluating whether an alternative is feasible, the environmental impact assessment:

- may have regard to issues of safety, health, economics, convenience, public interest and community disruption and any other relevant issue; and
- should decide the alternative is not feasible if it involves unproven technology or is impractical to implement or greater environmental impact is likely to occur.

Best Practice Guidelines:

Consideration to be given to any prudent and feasible alternative to a proposed road alignment.

Evaluate the possibility of alternative sites for road corridors throughout the wet tropics region.

Assess the range of uses, alternative design criteria and construction techniques for all road corridors throughout the wet tropics region.

Evaluate the outcome of the 'do nothing' option ie., maintaining road corridors (sealed and unsealed) in their current form throughout the wet tropics region.

Ensure when assessing the feasibility of alternative road alignments the issues of health, safety, environmental, socio-economic, public interest and other relevant issues such as assessing ways of reducing demand for road transport (of certain types) are considered.

When assessing alternative road alignments consider available technology and its capacity to meet the design criteria and construction techniques without adversely impacting the environment.

Making a Decision

The desired outcome is to ensure that road planning decisions take into account the likely environmental impacts.

The results of the REF or Impact Assessment Study are examined by the relevant decision makers who will act on the findings.

The possible outcomes are:

- the project will not have any major detrimental effects on the environment and detailed planning may proceed;
- the project will have some detrimental effects on the environment but may go ahead with conditional works to minimise this effect;
- an alternative exists with lesser impacts which may require further planning, design; or
- that the project not proceed owing to unacceptable environmental impacts.

Best Practice Guidelines:

The impact assessment documents should be used as a basis for decisions as to whether a road project should proceed, be

modified, an alternative adopted or the proposal terminated.

Decisions should consider the magnitude, extent, severity, duration and reversibility of likely impacts and the significance of natural, cultural and social values affected.

Decisions should reflect the implementation of Ecologically Sustainable Development. Further, any approval should be on the basis of the commitments for mitigation of potential environmental impacts.

Opportunities for public participation and comment in environmental impact assessment need to be promoted so the process reflects all community concerns.

Documents which are available for public comment and review should include draft environmental impact assessment and final environmental impact assessment. Availability of such documents encourages a publicly open assessment process and promotes a system of shared responsibility.

D3 Conservation Context

World Heritage and Natural Habitat Values

The desired outcome is to ensure protection and conservation of the ecological integrity of natural values and the biodiversity of the wet tropics region.

The wet tropics region is recognised as an internationally significant area of outstanding biological diversity. It contains tropical rainforest, open eucalypt forest, swamp and mangrove forests. These forests are habitat to 36% of Australia's mammal species and half of Australia's bird species making it the most species diverse region within the country.

The region contains tablelands and highlands, mountainous escarpments, coastal ranges and coastal plains, each having unique climate, vegetation, fauna and a range of historical and cultural values.

Clearing natural habitats reduces the ecological integrity of areas. Disturbances such as fire, changes in hydrology and weed invasions can impact upon particular forest communities which may be very slow to recover, if at all, from such disturbances.

The construction and operation of road corridors has the potential to create such disturbances.

Best Practice Guidelines:

Planning of road corridors within or adjacent to the Wet Tropics World Heritage Area should be undertaken in consultation with the Wet Tropics Management Authority in order to determine the most appropriate locations and concepts.

Avoid road alignments which pass through known areas of rare or poorly conserved forest types.

Plan to align high level use road corridors in less-sensitive areas of the region.

Reduce the effects of habitat fragmentation by aligning road corridors away from species rich communities and implementing ameliorative measures (eg., fauna culverts).

For road projects within the Wet Tropics World Heritage Area, ensure that world heritage values likely to be affected by the project are recognised and impacts minimised.

If a road corridor is considered likely to threaten the values of the region and the impacts are unknown based on the best available knowledge, a precautionary approach should be adopted until further information is obtained.

Plan to assess the impacts of particular actions which may minimise biodiversity and plan to re-establish and enhance levels of biological diversity.

During planning, develop strip maps for road corridors which convey findings of investigations to design, construction and operation phases.

Average width of corridors should be restricted to the minimum that will permit a properly constructed and maintained road on which traffic can travel efficiently and safely.

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Prepare an assessment of the existing vegetation to determine individual species, structural character, level of disturbance and structural associations. Site investigations should be undertaken by suitably qualified and experienced personnel.

Identify the extent and species composition of weeds within road corridors.

Rare and Endangered Species

The desired outcome is to ensure roads do not contribute to the threatening processes affecting rare and endangered species.

The natural habitats of the wet tropics region contain a large number of plants and animals listed as rare or endangered. The causes of declining populations of critical flora and fauna communities include habitat destruction and fragmentation, which are considered to be the principal threatening processes. The introduction of weed species and feral animals resulting from road corridors can exacerbate this problem.

Where rare and endangered species exist in a proposed road corridor development area, particular action to avoid risk to these species should be given priority over all other management policies. Consultation with the Wet Tropics Management Authority and DoE should be undertaken, where appropriate, to identify communities at risk and possible alternatives available for realignment.

Recovery Plans are often prepared for endangered species, these identify the likely or known threatening processes and mechanisms which can be implemented to assist the species recovery. By far the most common threatening processes are habitat loss or a reduced ecological integrity of habitats. Note that specific State and Commonwealth legislation provides statutory protection mechanisms for conservation of endangered species and their habitats.

Best Practice Guidelines:

Identify any endangered species or threatening processes within the site through information review, liaison with the Wet Tropics Management Authority and Department of Environment and through specialist on the ground investigations.

Plan road alignments to avoid endangered species communities and habitats. Further, ensure roadworks planned will not add to threatening processes for any endangered species.

Where roads do traverse habitat of rare or endangered vertebrate (with a backbone) non-volant (cannot fly) fauna species, plan to develop wildlife crossings. This manual provides some options. It is important to consider others based on experience and advice. When considering the significance of a conservation value the following factors should be addressed:

- for species, the statutory conservation status (eg., rare, endangered, vulnerable etc.);
- known threatening processes for rare or threatened species;
- location of populations of species, considering their genetic "connectivity";

- the known biology and ecology of the species (home range, seasonal movement, food, mobility, breeding requirements etc.); and
- the extent of habitat and/or populations which are within protected areas.

Habitat Integrity

The desired outcome is to ensure natural habitat integrity through minimising disturbance, segregation and fragmentation.

The wet tropics region contains a diversity of habitats which support a variety of flora and fauna species, many having a status of rare or endangered. These habitats include the many rainforest types, melaleuca swamps, sclerophyll forests, eucalypt woodlands, wetlands, mangrove forests, samphire swamps, coastal fringing coral reefs, seagrass beds among many.

These habitat communities which lie within the region are recognised for their abundance, biodiversity and unique biological characteristics. Habitat fragmentation such as habitat loss and habitat isolation is one of the processes threatening the biodiversity of the Wet Tropics World Heritage Area. The planning of road corridors should protect the integrity of flora and fauna communities and consider the long term benefits associated with their conservation.

Within rainforests, the maintenance of canopy connectivity is important in maintaining their ecological integrity. The closed canopy of the rainforest creates a moist, low light environment for the lower storeys of vegetation. There are well developed natural mechanisms to repair breaks in the canopy (such as tree fall and landslides) through vines and creepers and tree saplings which remain relatively dormant under the canopy and then grow rapidly to fill canopy gaps or "seal" the forest edges.

However, a corridor disturbance which breaks the canopy connectivity can result in the "sides" of the rainforest becoming sealed with increased vines, creepers and mid/understorey plant growth, owing to greater light conditions. For wildlife of the rainforest such as possums, gliders and forest floor mammals and flightless birds this "natural" repair creates a major barrier.

Best Practice Guidelines:

Plan to reduce the effects of fragmentation and habitat disturbance, particularly in areas of high biodiversity and natural corridors (creek lines). This can be achieved by aligning road corridors in more common or disturbed habitats or limit corridors between areas as to minimise the fragmentation of species' populations as far as possible.

Identify wildlife habitat corridors along existing roadsides or in proposed road corridors.

Evaluate the habitat status of roadside vegetation communities for native wildlife.

In rainforest maintain canopy closure (or connectivity) as far as possible. Note that along a road corridor, although there may be areas where canopy closure cannot be achieved, as a general rule, the greater the canopy closure along the road the greater the habitat integrity.

For planning projects for existing roads in rainforest, ascertain whether canopy connectivity is practically achievable and in what time frame.

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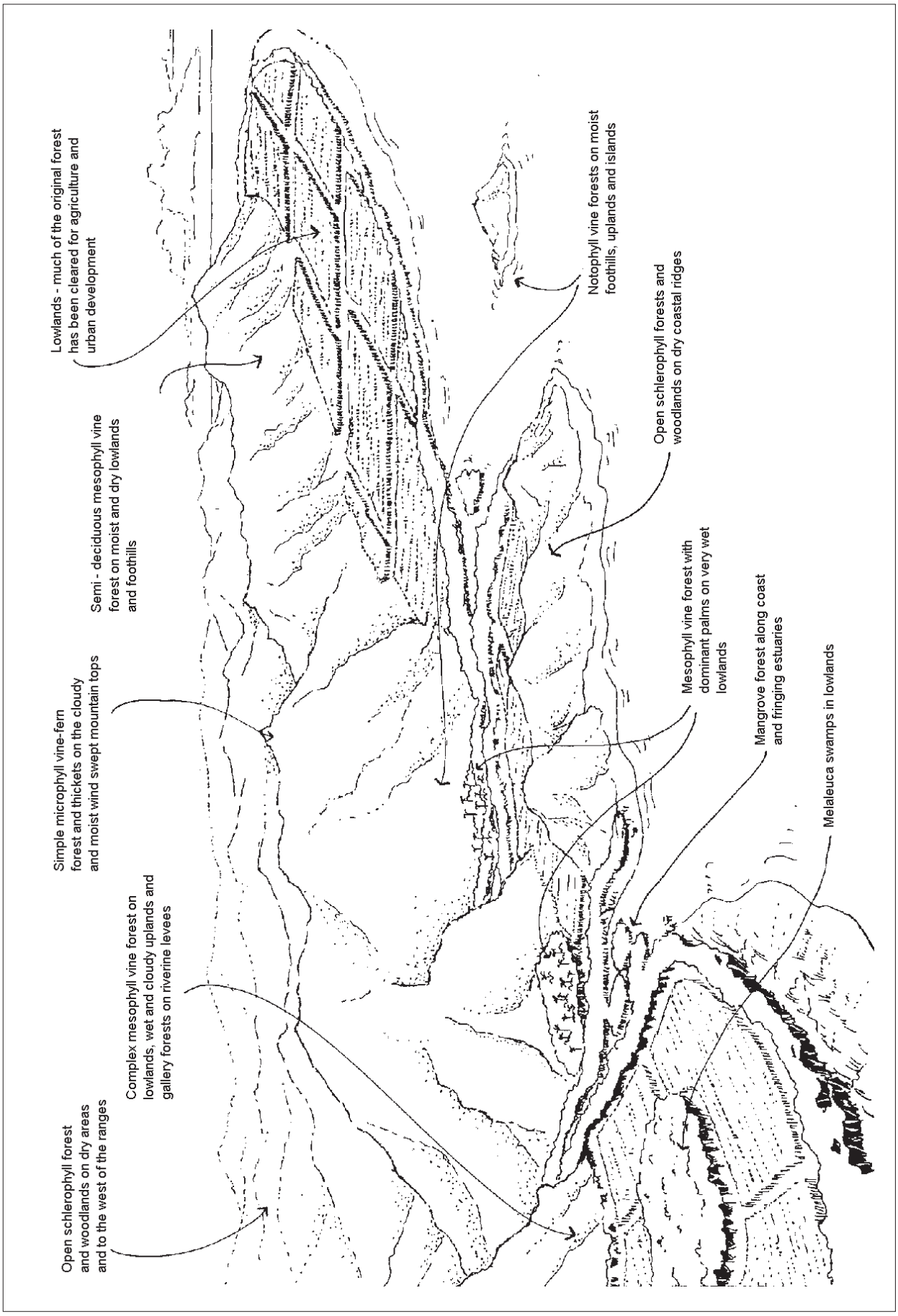


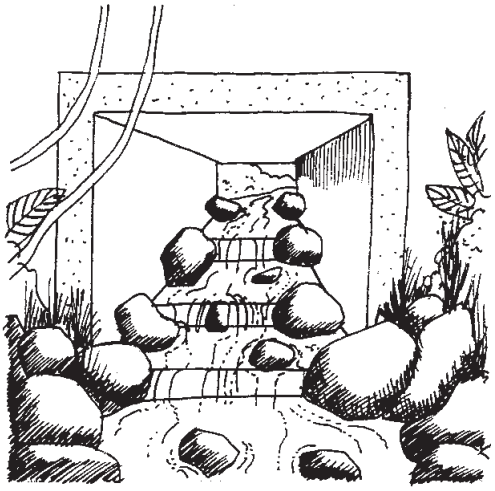
Figure 5 Forest Types of the Bioregion

In rainforest, maintain understorey habitat connectivity as far as possible. It is important to recognise the different understorey habitat types along a route, these are often related to local topography (ie ridges, gullies, etc.). This is vital where the road corridor is traversing natural habitat of endangered species.

As well as recognising major habitat types, undertake an assessment of micro habitat types and communities along the route. Plan to preserve existing riparian vegetation along creek lines, drainage patterns and retain the diversity of vegetation communities and habitats.

Water management approaches need to assess whether fauna are using that corridor and what considerations need to be made for both aquatic and terrestrial fauna using that corridor as a pathway or as access to breeding, hunting, foraging grounds (eg fauna culverts and fish ladders).

Survey to identify any sites along proposed routes which are subject to plant/soil pathogens. Plan to avoid or restrict interference with these areas.



Fish ladders should be installed within culverts to safeguard rare or endangered aquatic faunal habitats

Figure 6 Fish Ladders in Culverts

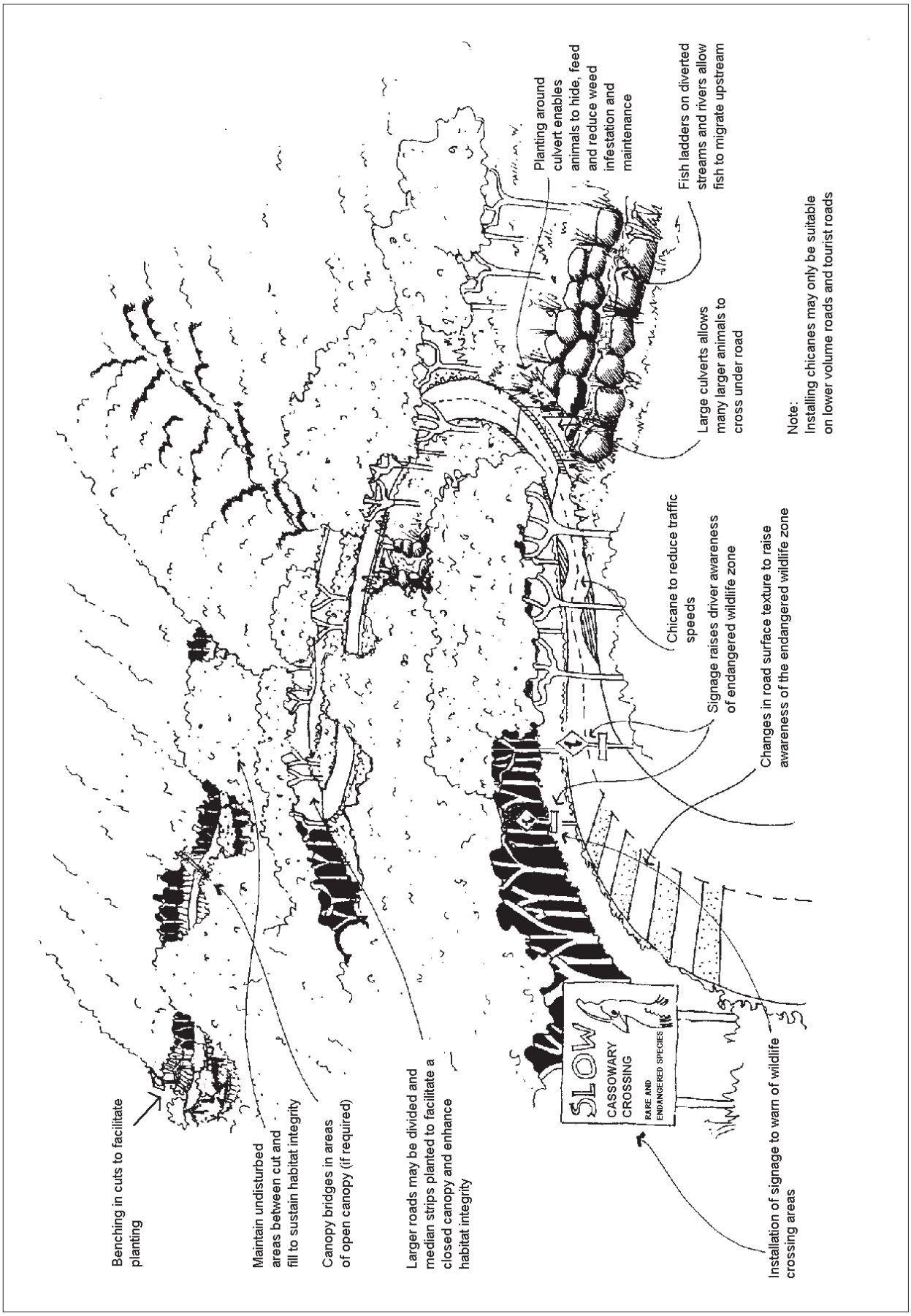


Figure 7 Habitat Integrity

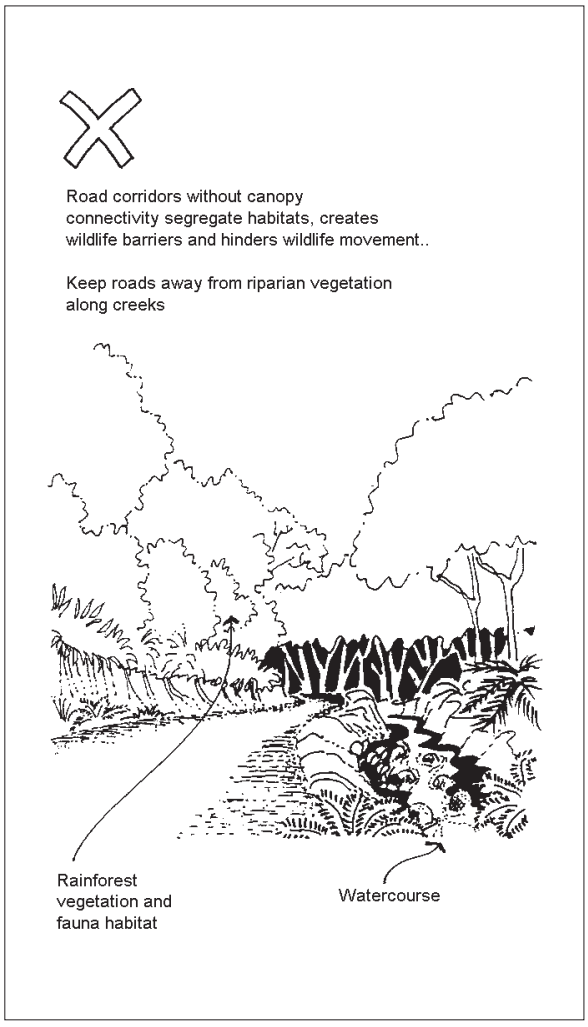


Figure 8 Riparian Habitat

Cultural Heritage

The desired outcome is to ensure planning recognises an area's cultural heritage values and significance.

The region is a living cultural landscape to the Aboriginal people of the Wet Tropics Area. The natural features of the region are incorporated into their cultural and social organisation.

The region also contains many early examples of non-Aboriginal culture such as old settlement sites, mining and logging camps and tracks used by European and Asian settlers (Wet Tropics Management Authority 1995). The planning of road corridors provides the opportunity to promote and present or protect many of these cultural values throughout the region, and the role roads have in accessing and presenting cultural heritage should be recognised.

Some Aboriginal sites are so significant that they cannot be identified to non-Aboriginal peoples. It is important to plan roads to respect these cultural values of the landscape. In some instances, it is important to protect by avoiding the sites, but not identify them (with signs or fences, etc).

Best Practice Guidelines:

Identify cultural heritage resources within and adjoining proposed road corridors during the planning phase.

Ensure anthropological, archaeological, social and cultural impacts are identified during the planning phase by means such as Review of Environmental Factors and Impact Assessment Studies.

For more detailed information on cultural heritage matters, see the Department of Main Roads "Cultural Heritage Manual".

Ensure appropriate protocols are implemented for consultation with relevant interested Aboriginal communities during any cultural heritage assessment. Included in this is to ensure that confidentiality required under Aboriginal tradition is respected whilst still taking into account any impacts.

Seek expert specialist advice in identifying and assessing the likely impacts upon cultural heritage impacts.

Develop a directory of cultural heritage sites which surround road corridors which can be referred to during all phases of road development if required.

Plan for the provision of access and interpretation of cultural heritage resources consistent with the values of the community affected.

Liaise with the appropriate authorities during the planning phase when cultural heritage resources are identified.

Where appropriate, plan for the use of appropriate signage in areas with cultural significance such as access and interpretative signs.

For major projects in cultural landscapes, encourage Aboriginal and non-Aboriginal involvement through extensive consultation during the planning phase of the project.

Undertake conservation measures to protect these sites during road construction and ongoing management operations.

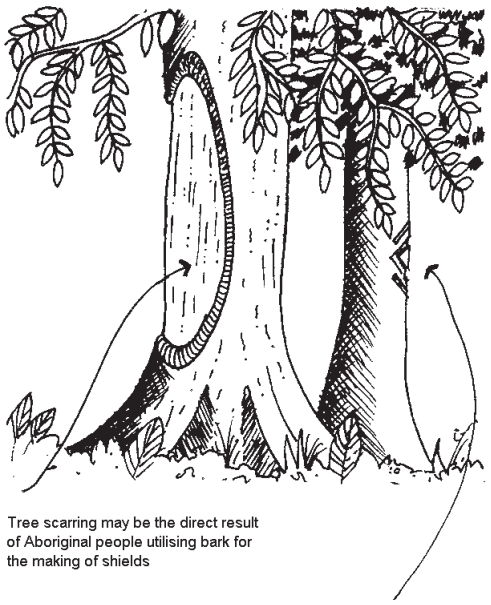


Figure 9 Tree Scars and Carving

Figure 10 Cultural Heritage - Bridges

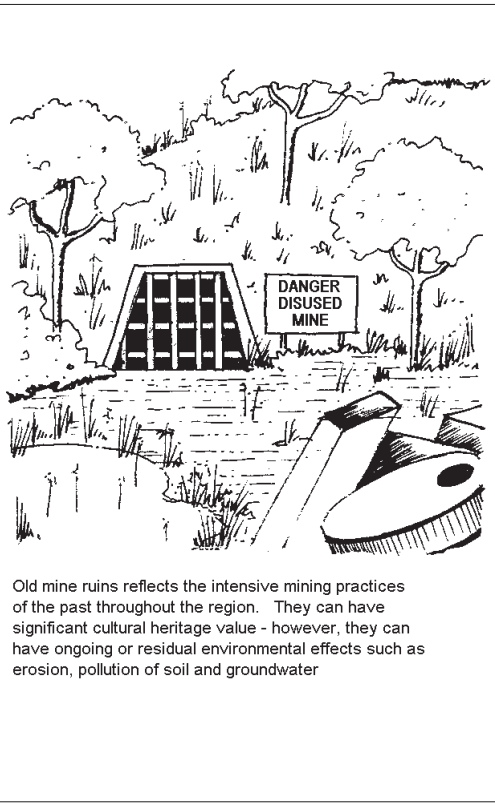


Figure 11 Cultural Heritage - Mine Ruins

Catchment Integrity and Drainage

The desired outcome is maintain catchment integrity and natural drainage lines.

Roads and their associated infrastructure have the potential to change hydrological patterns of both surface and ground waters. Obstructions in flood plains will tend to increase flood height and duration upstream, and reduce their impact downstream.

Design criteria for waterway crossing are usually defined to allow continued usage of the road for a defined storm event rather than for the maintenance of normal flow patterns. This has consequences for alterations to the natural cycles of sediment deposition and erosion, and ground water recharge.

Best Practice Guidelines:

Identify drainage systems, wetlands and riparian lands and determine the ways in which the roadway will interact with and potentially change these environments.

Reinstate natural drainage patterns wherever possible.

In order to minimise the impacts of temporary creek crossings, where possible plan to construct bridges and large culverts before surrounding major earthworks commence.

Drainage from external catchments should be controlled by diversion channels or holding structures such as banks, drains or retention basins.

Plan to retain natural flood ameliorating areas (basins, wetlands etc.) as far as possible.

Bridge and culvert structures are to incorporate designs which minimise adverse effects on channel form, stream flow and bank habitats.

Plan to avoid interference with hydrological patterns of particularly sensitive communities such as remnant palm swamps.

Water Quality

The desired outcome is to maintain the water quality of watercourses.

Long-term impacts from roads on water quality relate mostly to the poor quality of the runoff from the road surface. This can include elevated levels of hydrocarbons, heavy metals (in particular lead), and particulates (from tyres, brakes, exhausts). Unsealed gravel roads have an ongoing loss of material from the surface and drainage channels.

The significance of these will depend upon the relative sensitivity of the receiving environment. Short-term temporary impacts are associated with increased levels of sedimentation and erosion during the construction phase.

Best Practice Guidelines:

Plan to minimise clearing of riparian vegetation. Ensure use of buffer zones between roadways and watercourses.

Try to avoid construction during the wet season. If construction must be undertaken in the wet season, schedule construction disturbance activities to coincide with periods of lowest rainfall (not during the wet season).

Manage stormwater on-site such that pollutants and contaminants (poisons, chemicals, hydrocarbons etc.) are not discharged to the receiving environment. Structures such as sediment retention basins and artificial wetlands should be utilised.

Plan to locate stockpiles, refuelling areas and other potential pollution sources away from watercourses and drainage lines. Bund refuelling and maintenance areas to confine pollutants.

Plan to minimise soil disturbance and earthworks near watercourses.

Install appropriately designed drainage and water quality structures to minimise turbidity and sedimentation impacts on watercourses.

Integrate into the road design mitigative measures to minimise erosion, flow velocities and concentration of runoff resulting from stormwater.

Use point source control of erosion and sediment where possible.

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Minimise the amount of disturbed area, retain natural ground cover (vegetation) as far as possible. Plan during construction to progressively rehabilitate disturbed areas as soon as possible.

Road surface runoff and storm discharge should be detained in water quality structures (eg. sedimentation basins, etc.)

Plan for soil conservation and revegetation treatments to be applied during the construction phase to minimise erosion hazards.

Implement suitable waste management practices to minimise the concentration of nutrients in drainage lines and soil types. This is to include the removal and diversion of all waste material off-site.

Plan to divert water away from areas of soil disturbances to prevent clean water from being directed to disturbed catchments.

Landscape Values

The desired outcome is to maintain the landscape values of area traversed.

The wet tropics region has significant and unique landscape values. The potential effect that road corridors have in altering the appearance of the area should, therefore, be recognised during road corridor planning.

Roads can create contrasting images along landscapes by becoming visually dominant in areas which have high scenic quality. Changes to the landscape can decrease the visual character of an area, however, effective planning of road corridors can minimise this potential. There are three principal areas of consideration when deciding on a road alignment for minimal visual impact. They are:

- horizontal and vertical alignment;
- landform modification; and
- vegetation alteration.

The wet tropics region provides awe-inspiring scenery of natural phenomena, formations and a diversity of features. Of the recreational activities recorded in the area, looking at scenery, photography, scenic touring and walking are the most popular. Road corridors provide access into and through areas which provide opportunities for these activities. Road users experience scenic values both inside and out of vehicles. However, many of the roads throughout the wet tropics region were originally constructed for purposes other than recreational travel and scenic viewing.

The importance of the visual amenity within the road corridor should therefore be recognised and appropriate planning should ensure that the visual values that attract recreational road users are protected.

Best Practice Guidelines:

Plan to align road corridors through areas which have already been disturbed or with minimal to moderate vegetation cover. Although minimising screening opportunities it will remove the potential for a road to cause a linear contrast across the landscape.

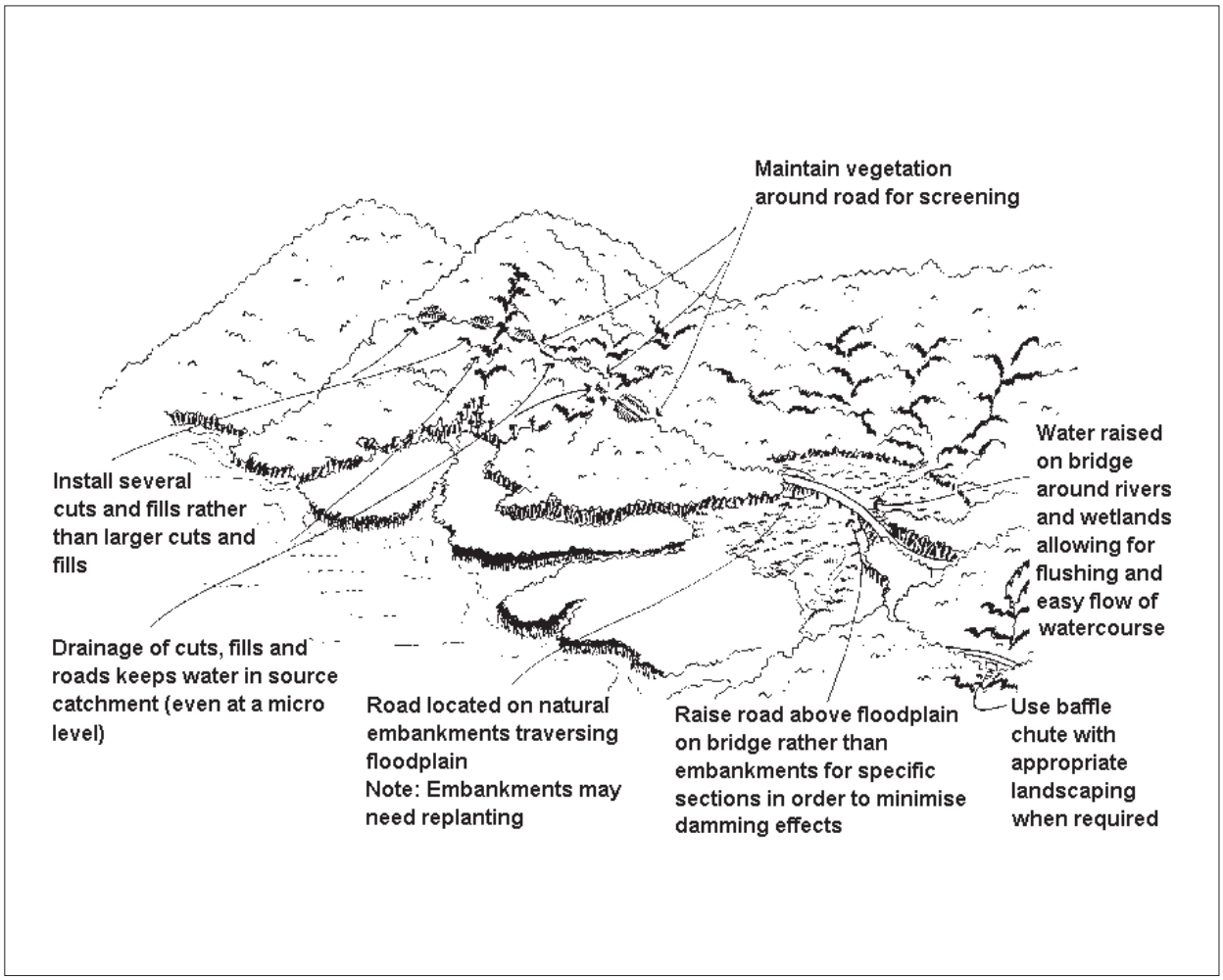

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Figure 12 Catchment Integrity and Drainage

Identify parts of the landscape most sensitive to public viewing where roads may become visually dominant. Plan to avoid these road alignments and/or rehabilitate to enhance visual characteristics.

Undertake landscape analysis and visual impact assessment during the planning phase of the project. Minimise long term visual impacts by creating roadforms which are compatible with the surrounding landscape. This can be achieved by:

- in hilly terrain adopt a curvilinear alignment appropriate to that terrain;
- avoiding road corridor construction along dominant hillsides;
- planning road corridors to complement the form, line, colour and texture of the landscape;
- naturalising cuttings by rounding top edges and warping of faces; and
- ensure prompt revegetation to cover and/or screen disturbed areas.

Plan not to rely entirely on revegetation and rehabilitation treatments to screen visually intrusive road corridors.

Investigate potential of creating scenic lookouts and side roads when realigning roads, constructing new roads or undertaking substantial upgrading of a road.

Rehabilitation

The desired outcome is to plan for (whilst minimising) requirements for rehabilitation.

Rehabilitation is the process used to repair the impacts of road corridors on the environment.

Successful rehabilitation of a low maintenance land use such as a native ecosystem which is sustainable in the long term, requires an understanding of the basic concepts of soil development, plant succession and species diversity. Specialist expertise is usually required to ensure a successful result. Rehabilitation normally comprises two stages:

- landform design and the reconstruction of a stable land surface; and
- revegetation.

Standards for rehabilitation should be developed to include criteria for landform stability and erosion control. In general, the rule of thumb is >60% of the surface area should be protected by some physical cover, either matting or vegetation. However, this depends upon the soil characteristics, slope and likely rainfall intensity.

Standards will also need to be developed that address the issue of directing the flow of existing waters and the direction of new discharges from disturbed soils. The rule of thumb for much of the wet tropics region is that any flow velocity greater than 2 m/sec should be stabilised with some material other than vegetation. However, for any grade greater than 1% and any flow velocity greater than 1m/sec stabilisation requirements should be determined.

Best Practice Guidelines:

Plan to repair and rehabilitate disturbed areas to restore the pre-existing biodiversity as far as possible. Disturbed areas should be revegetated with appropriate native species at staged intervals during construction. Planning should also determine needs for ongoing revegetation after the construction phase is completed.

Prepare a rehabilitation plan prior to road development. A rehabilitation plan should be included in the EMP (Planning) for the road project.

Plan to prevent the establishment of weeds and pests through prompt rehabilitation and

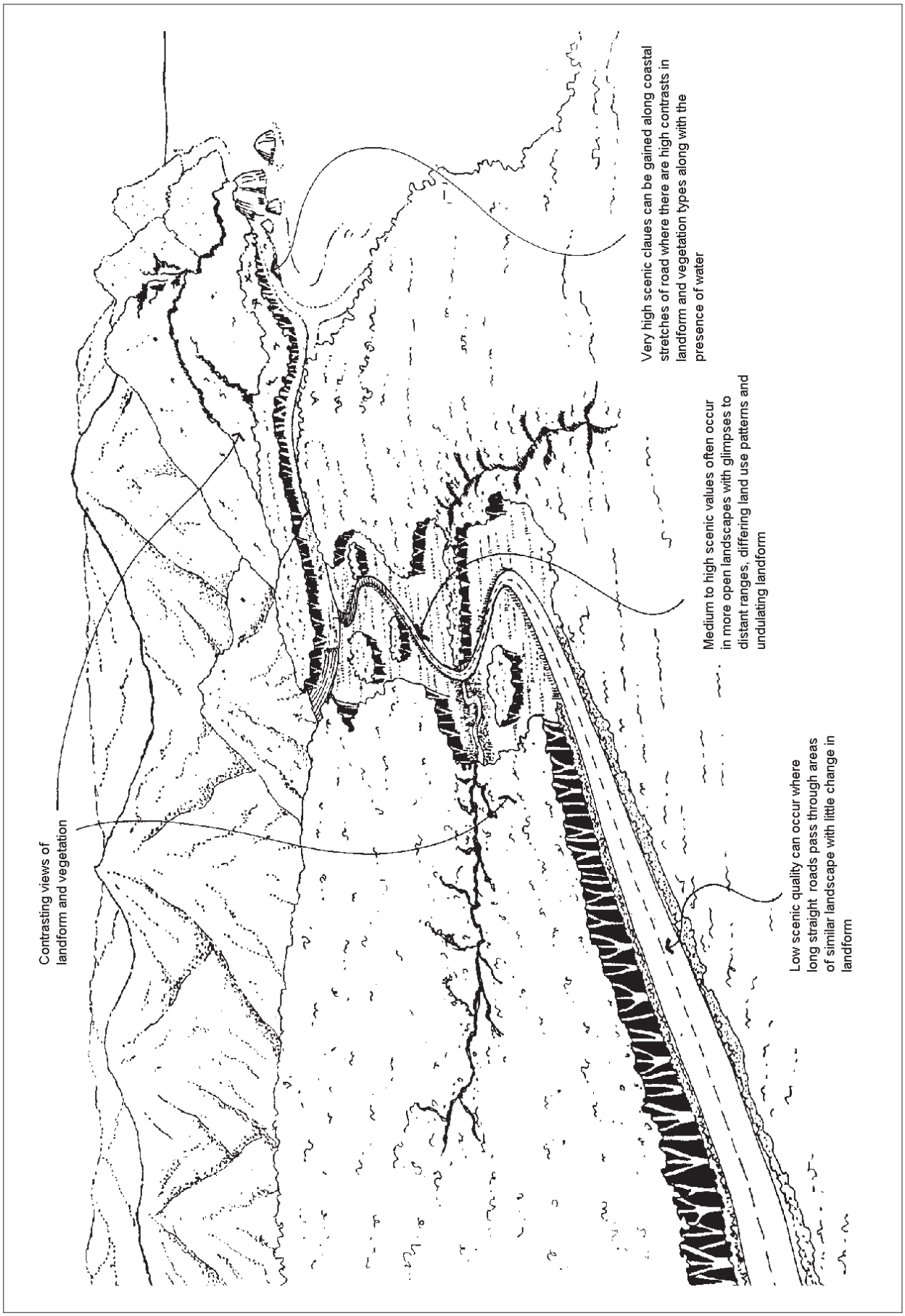


Figure 13 Landscape Values

to progressively rehabilitate as construction proceeds.

Research during landscape design is an important factor in preparing a successful rehabilitation strategy. The more that is understood of the structure and function of the ecosystem the greater the chance of successful rehabilitation.

Plan to rehabilitate to minimise ongoing maintenance requirements using native species.

D3

For major projects in natural forest areas, undertake flora surveys of upper, mid and understorey species to develop species lists for revegetation purposes.

In natural vegetation areas it is vital that locally occurring species (and the local provenance subspecies) are used for rehabilitation. As seed collection times vary for different species, allow for the collection of seeds over a twelve month period prior to construction.

During the planning process, identify and consider rehabilitation strategies which will minimise maintenance requirements and environmental impacts. For example, plant fire retardant species along roadside in drier locations which are prone to roadside fire escaping into nearby forest, or plant shrubs and trees rather than grasses which need ongoing mowing.

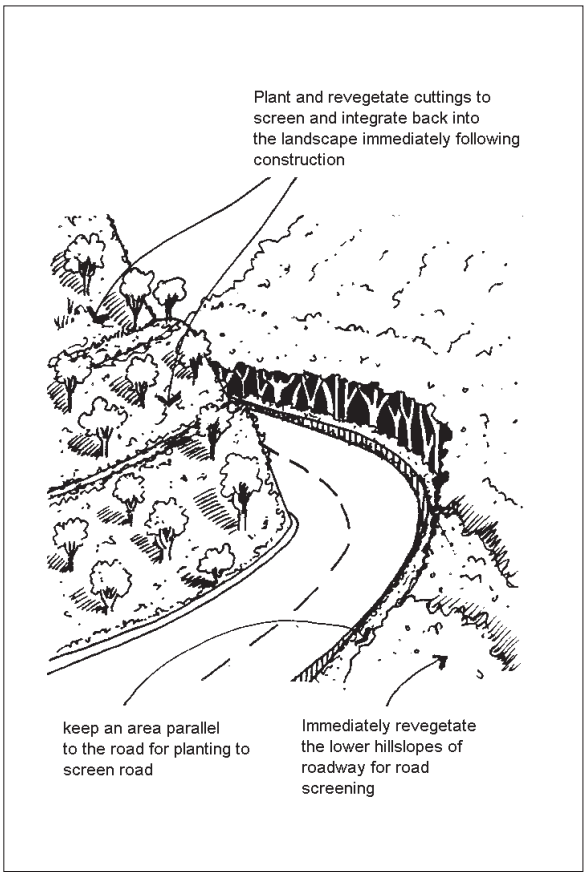


Figure 14 Plan For Rehabilitation

D4 Community Context

Regional Planning Context

The desired outcome is to plan roads within the context of regional planning frameworks.

Within the wet tropics region there are many planning frameworks and documented policies and strategies which are relevant to road planning. As at mid 1997, these include:

- FNQ 2010 Regional Growth Management Framework;
- Wet Tropics Ecotourism Strategy;
- FNQ 2010 Regional Environment Strategy (in preparation);
- FNQ 2010 Integrated Transport Strategy;
- Far North Queensland Strategy;
- FNQ 2010 (regional thematic strategies);
- Wet Tropics Plan;
- Great Barrier Reef Strategic Plan and Zoning Plans;
- Coastal Plans (in preparation); and
- Local government planning schemes.

Best Practice Guidelines:

Ensure all relevant planning documents, policies, strategies and processes are considered during road planning.

Community Need/Value

The desired outcome is to identify and consider community concerns, values and needs when planning roads.

Road corridors can facilitate a range of social functions that relate to the experience, behaviour and enjoyment of people that interact with areas adjoining or accessed by roads. It is recognised that communities, authorities, groups and individuals have interest in the management of road corridors. Given the wide range of values held by different sections of the community, the importance of community involvement during the decision making process is considerable.

Community consultation and public participation in decision making increases community ownership of the outcomes.

Best Practice Guidelines:

Identify relevant stakeholders early in the planning process and recognise that each project has a unique set of stakeholders each of whom may be best approached through different consultative mechanisms.

Determine appropriate levels of community consultation.

Increase community awareness of the range of values within road corridors via community education and liaison.

Provide for early community consultation in road projects.

Encourage community involvement in development of policy, planning and design of road corridors through interactive public consultation meetings aimed at determining the needs of the community and how these needs can be addressed.

Allow flexible and responsive decision making by incorporating the results of community consultation in current planning process.

Recognise other regional and strategic planning processes which have extensive community consultation or public participation processes (eg. FNQ 2010).

Economic Considerations

The desired outcome is to identify and consider the economic functions and values of road corridors, taking into account existing and future transport connectivity, the road network capacity and the needs of existing and future users.

D4

Road corridors provide and influence a range of economic functions that benefit all community members. The benefits of providing transport links for industry and access for tourism and commercial activities are some economic functions of the road corridor.

Roadworks provide employment for people in a range of disciplines and benefit local economies both directly and indirectly.

Efficient and effective transport is recognised in the regional planning process FNQ2010 as being vital to future economic development and maintenance of access to services. For example, the capacity of existing linkages between the coast and tablelands near Cairns is limited and represents a significant threshold to future economic development on the tablelands, which will require efficient access to air, sea and rail terminals on the coast (FNQ 2010, 1995).

The tourism industry is recognised as one of the major economic influences within the wet tropics region (particularly presentation).

Cost benefit analysis has been used to determine the financial costs of various options. It is useful in assessing the economic merits between various alternative road options. The Cost Benefit Analysis Manual by the Queensland Transport sets out the procedures to be adopted in undertaking this process.

Cost benefit analysis only provides a means of assessing projects where the cost can be quantified in monetary terms. For some environmental values, this is not appropriate (although qualitative indicators and ratings can be used).

Best Practice Guidelines:

Ensure that roads continue to provide appropriate links for communities, industry and other transportation modes (eg., seaports and airports).

Encourage public utilities to share infrastructure within easements in order to minimise impacts and overall cost of infrastructure.

Identify and define road corridor management and enhancement opportunities appropriate for funding and sponsorship.

Presentation

The desired outcome is to provide access to presentation opportunities which facilitate understanding and appreciation of the region's natural and cultural values.

The wet tropics region is one of the world's unique and outstanding natural areas. It is a requirement of the World Heritage Convention that the Wet Tropics World Heritage Area be protected, conserved and presented for all. The WTMA recognises its fundamental role in presenting the area. It is for the latter reason that roads within the wet tropics region are of importance. Vehicle touring is the most popular way of enjoying the area and is often combined with walking, picnicking and camping. However, it is not just the World

Heritage Area which provides suitable opportunities, there are many presentation opportunities throughout the region.

It is important to note that road planning, design, construction and maintenance to maximise presentation values incurs additional costs and that it is not solely the road owner's (particularly DMR's) responsibility to fund and provide presentation opportunities. However, it is recognised that if presentation opportunities are not recognised and provided for in the planning stage they can be very hard to construct later.

Best Practice Guidelines:

Identify through landscape analysis the full range of tourism and recreational opportunities along road corridors within the region by assessing which roads offer potential for tourist sites (lookouts, camping areas, picnic areas, walking tracks etc.), tourism drives (which need suitable provision for intersections), scenic areas and natural landscapes.

Integrate the requirements of enhancing the visual experience of the road corridor and adjoining areas with other considerations such as safety and utility issues, environmental values and engineering requirements.

Investigate potential for provision of scenic tourist routes so as to minimise conflict between transport and tourism users on major transport links. These routes are to be clearly designated with appropriate signage.

Plan roads to complement intrinsic landscape characteristics which provide an attractive experience for the road user.

Plan and manage for attractive views along road corridors by framing views and screening unattractive scenes.

Plan for roads to provide access to facilities such as lookouts, walking tracks and picnic areas.

Directly provide information to tourists, tour operators and the general community in the form of road side signage and indirectly by supporting others to orientate and interpret via brochures, audio visual aids etc.

Coordinate the enhancement and management of visitor opportunities by liaising with relevant authorities such as the Department of Environment, Wet Tropics Management Authority, Department of Natural Resources and Local Government. Specifically during planning, consult with the Alliance for Sustainable Tourism (or other representative tourism body) and these agencies in identifying presentation opportunities.

Determine level of Local Government and agency interest in developing scenic drives.

Regional and Long Term Considerations

The desired outcome is to consider the regional context, regional planning objectives, the long term character and function of the network during road planning.

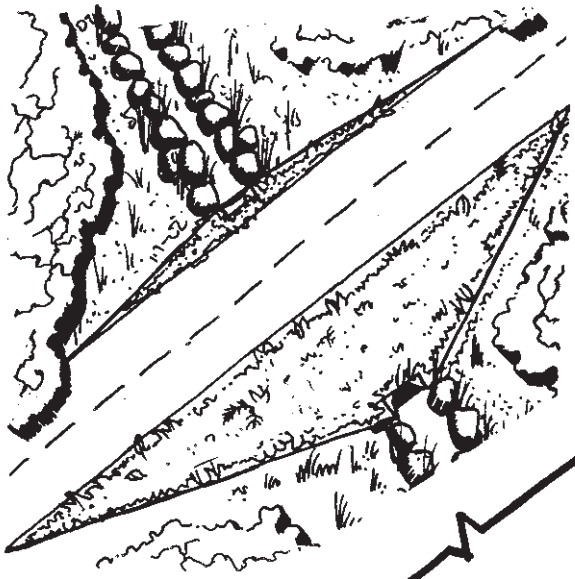
It is recognised that a high proportion of transport services available to the region pass through or are located within the Wet Tropics World Heritage Area. Likely increases in population and thus vehicle use and traffic demand have the ability to impact negatively on the conservation values of the area.

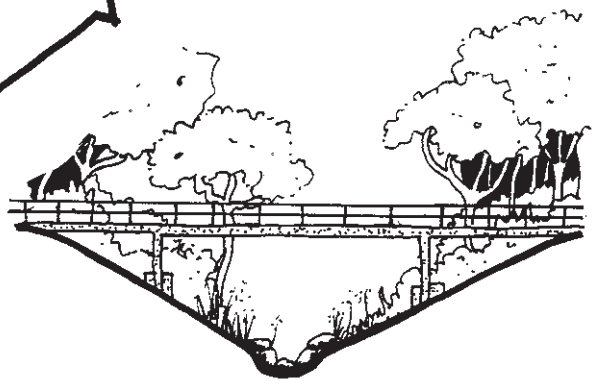
Many of the current roads whose function it is to provide movement of traffic between centres of populations (the highways), will require upgrading (widening or sealing) as populations grow. However, there are also roads which may have a long term role which may allow for or require their construction standard to diminish.

Gully backfilled with small culvert
and revegetated embankments

Note:
This dissects gully habitats, displaces
fauna and flora while discouraging
fauna movement through gully

Introduced or inappropriate vegetation
compounds the problem





Bridging over gullies and creeklines
minimises impacts on water courses
and undisturbed vegetation encouraging
fauna movement

Note:
This may more expensive in the
short - term, but will yield lower
environmental and maintenance costs

Figure 15 Consider Alternative Options

As an example, old forestry roads which provided for relatively fast two-way movement of timber trucks on well formed but unsealed roads, whose function now is as a scenic drive, may be managed as a one way, low speed road. This allows the cleared width to be vastly reduced, with an acceptable consequent reduction in design speed.

The development of the arterial road network is recognised as a key component in the management of regional growth over the next twenty years (FNQ2010, 1995). This is particularly relevant in cases where the threshold capacities of some of the major transport links throughout the north will be met and exceeded during this time.

Best Practice Guidelines:

Minimise the construction of additional transport corridors within the Wet Tropics World Heritage Area and avoid natural habitats with conservation significance outside the area.

Consider the regional context of the road, including the road's future function in the network.

Consider the likely long term character of the road (eg., will the road eventually be dual carriageway?). Consequently, minimise the impacts of progressive upgrading by planning for the ultimate standard. Such planning may include staged construction.

Consider regional planning and regional strategy plans to identify the long term planning objectives for land use and population as it affects the road network.

Consider the long-term configuration of planned road corridors in the context of the particular conservation values of the particular area, eg where an area is important for arboreal mammals, canopy connectivity can be maintained by planning for two separated dual lane carriageways.

Consider the cumulative (such as further fragmentation of habitat) and consequent impacts (such as increased settlement or new industries) of major projects in the regional context.

D5 Transport Context

Road Function and Purpose

The desired outcome is to determine road functions, which are consistent with the social, cultural and environmental contexts and meet the needs of road users and transport requirements.

In planning and designing roads the function and purpose of the road will influence the design speed, widths and other design elements of the road.

Table 2 "Road Types and Function" sets out the types of road which have been adopted for use in this manual. Note that adaptations to the usual standards have been made to take into account the special values and topography of the wet tropics region.

In many instances in the wet tropics region the road will have a mixed function of a major connecting route and a tourist road. This is likely to occur in areas of outstanding natural beauty through which a major road passes such as along coastal areas.

Major roads will have a number of purposes such as:

- freight distribution;
- commercial movements between centres;
- commuter movements between centres;
- tourism movements between centres;
- tourism movements along the route to access adjacent attractions; and
- local access movements.

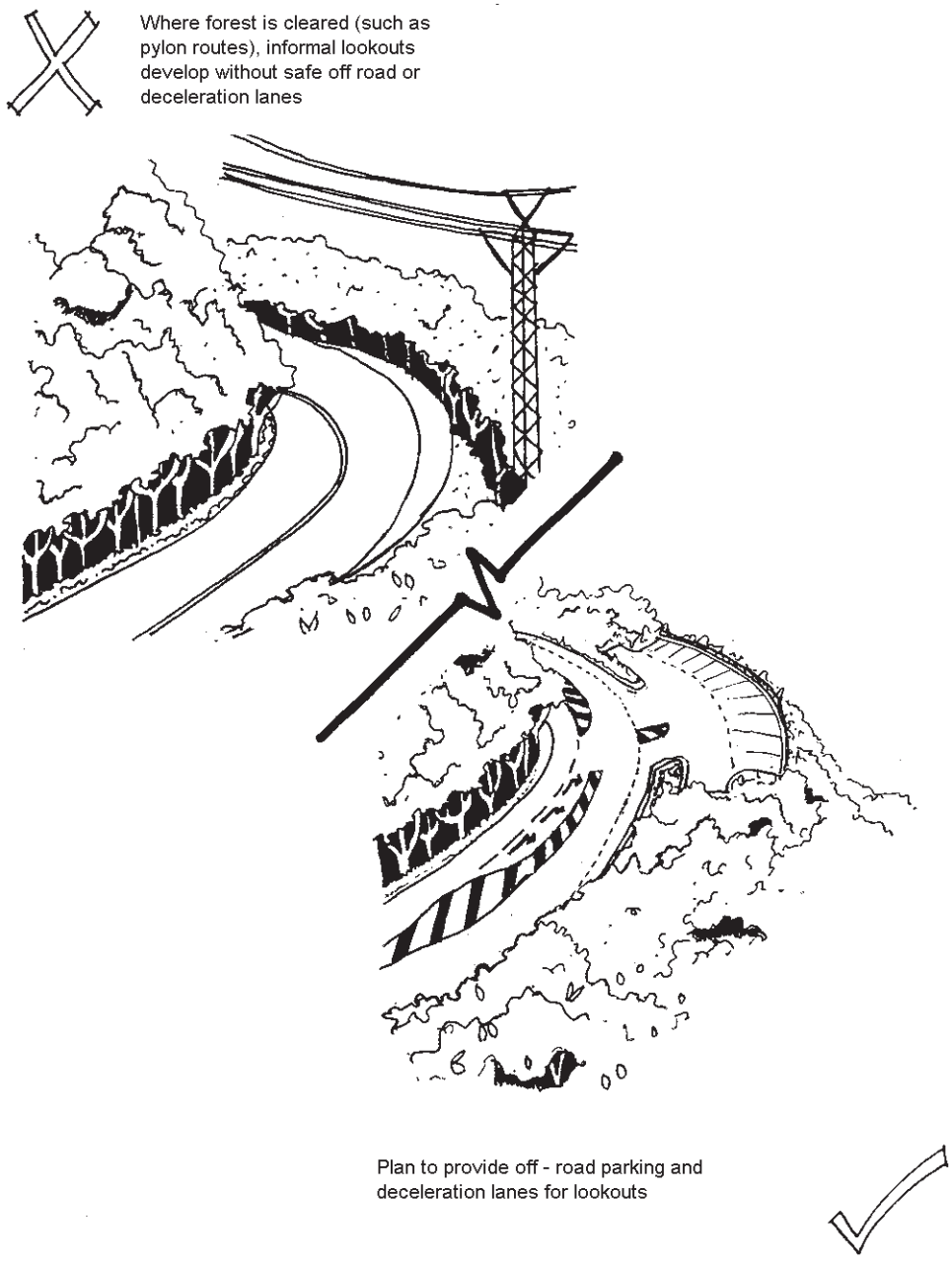


Figure 16 Planning For Presentation

Each of the above movements are for a different purpose and the needs of each of the groups will vary considerably. Some groups such as commuters and freight distributors are best accommodated by high speed, flat roads with overtaking opportunities. Tourists on the other hand are often looking for a lower speed environment that enhances the natural scenic values along the route.

Developing the route for a single purpose will often be inappropriate and the needs of all the groups will have to be taken into account. It would be preferable to provide separate roads for the various purposes and this may be possible on the high value scenic routes by providing a higher speed bypass route and retaining the existing scenic road for tourist use.

In the flatter, less scenic areas the tourism traffic is likely to prefer a higher speed alignment to enable them to get to their next destination. This will be more compatible with the needs of the commuters and freight distributors etc.

The needs of the various road user groups is therefore likely to change along the route depending on the terrain through which the route passes.

Best Practice Guidelines:

Plan and design the road to cater for its main functional use in accordance with Table 2. Identify the purpose of the road and the needs of the various user groups along the route.

Note: In many cases the ideal form of the road to meet a particular function may have significant environmental impacts, there is often a need to compromise in the design and planning of roads to mitigate these impacts particularly in sensitive areas. For instance, whilst a high design speed may be ideal for a particular function, the consequent need for wide cleared verges increases habitat fragmentation and disturbance in natural areas and is environmentally unacceptable/inappropriate.

Consider the needs of other users and ensure that all road user needs are accommodated as far as possible.

It may be possible to redirect demand for a particular road function to an alternative route with reduced costs.

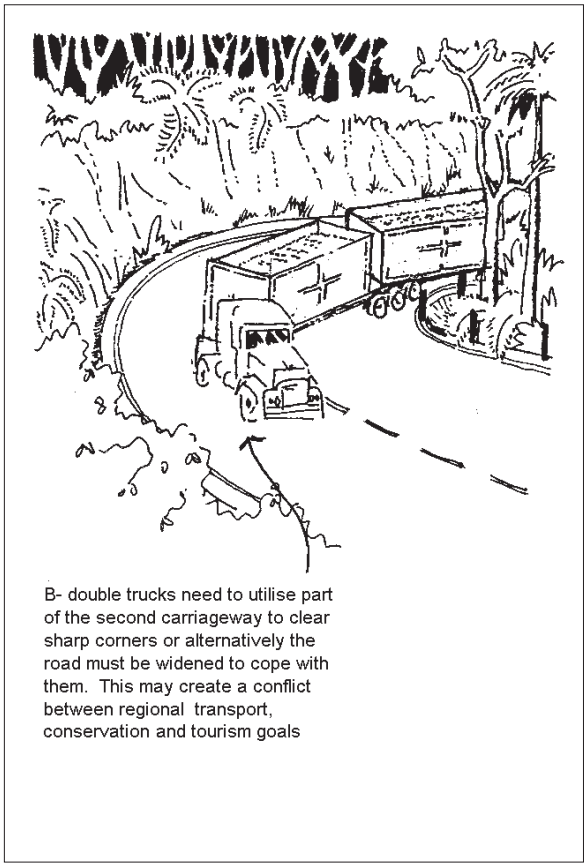


Figure 17 Road Function and Vehicle Type Conflicts

If a major tourist route, ensure that the route is designed to cater for the tourist traffic by providing a lower speed environment through high value scenic areas.

For safety reasons it may be desirable that the faster moving commuter traffic be separated from the slower moving tourist traffic. One option that may be considered would be to retain the existing scenic road as a tourist road and bypass this with a higher standard alignment to cater for the high speed traffic. The net increase in environmental impact would need to be considered.

In some circumstances there may be a net benefit in having two narrower corridors through natural areas, however this is not always the case.

Where cost, terrain or other factors preclude the use of a higher speed alignment then the existing road alignment may need to be adjusted by gradually reducing the design speed as the road approaches a scenic area or an area of significant conservation or cultural value so that the total traffic is slowed to a speed compatible with the tourist section.

In areas of low scenic quality the route should be designed for the major users as a higher speed environment with overtaking opportunities provided.

Planning the Route

The desired outcome is to plan the road alignment to ensure identified environmental impacts are minimised or mitigated.

As a fundamental input to route selection the following elements should be established (where appropriate):

- road function;
- design speed;
- design vehicle;
- cross sectional elements;
- design traffic volumes;
- maximum grades;
- environmentally sensitive areas;
- fauna habitats and crossings;
- high value flora areas;

Table 2 Road Types and Function

Road Type	Function	Traffic Characteristics
Major highways connecting major centres	To provide movements of people and freight between major urban centres and intra and interstate movements and provide the principal avenue of communication between capital cities.	High speed, major freight movements. Large heavy vehicles or B doubles. These roads often have at least 30% of their traffic being tourism related.
Important Regional Roads	Provide the principal communication between regional town or cities.	High/medium speed, may be medium to major freight movements possibly B Doubles (or other freight efficient vehicles) in the traffic stream. Many of these roads also have significant tourism traffic.
Tourist Roads	Primary function is to provide access to tourist/ scenic attractions along or adjacent to the route.	Predominantly slower moving tourist traffic with a mix of some tourist coaches on scheduled runs.
Local Access Roads	Primary function is to provide access to the adjacent landowners.	Slow moving local vehicles.
Special Purpose Roads	These are special purpose roads built primarily to service an industry or particular land use.	May be slow or higher speed depending on the design of the road and the terrain through which it passes.

- opportunities for presentation of cultural and natural values; and
- landscapes of high scenic quality.

Establishing these elements requires input from the Planning REF and IAS (if required).

It is essential that the engineering and environmental issues are investigated as early as possible in the planning process so that planning elements such as fauna habitats, viewing areas etc., can be established and the route planned to avoid any sensitive areas and enhance the presentation and functional aspects of the route.

In various areas some elements will have more significance than others. In some rainforest areas maintaining tree canopy connectivity may be particularly important whilst in less sensitive and rural areas, the opportunity may be taken to provide overtaking opportunities and hence a greater road clearing width may be appropriate.

The development of solutions needs to take into account the various environmental elements along the route, and balance these against the needs of the road users.

Best Practice Guidelines:

Provide a design concept that will carry the anticipated traffic with safety.

Fit the road to the topography to minimise alterations to the natural features.

Plan the road alignment so that environmental elements are identified and where possible the impact is minimised or measures are taken to ameliorate the impacts.

Determine the environmental elements by obtaining specialist reports on:

- flora;
- fauna;
- scenic amenity, archaeological sites and cultural heritage sites; and

Develop design options that reduce the impact on the areas highlighted in the reports.

In the wet tropics region information on the above may be obtained from:

- Department of Environment;
- Wet Tropics Management Authority;
- Department of Natural Resources;
- Great Barrier Reef Marine Park Authority;
- Australian Heritage Commission;
- Cooperative Research Centres (Tropical Rainforest Ecology and Management, Reef and Savannah); and
- specialist researchers and consultants.

Provide safe access to scenic locations. If possible relocate the access to a safe location and provide an access road to the scenic location. Adopt a curvilinear alignment in scenic areas.

Provide adequate opportunities for overtaking in flatter and less environmentally sensitive areas.

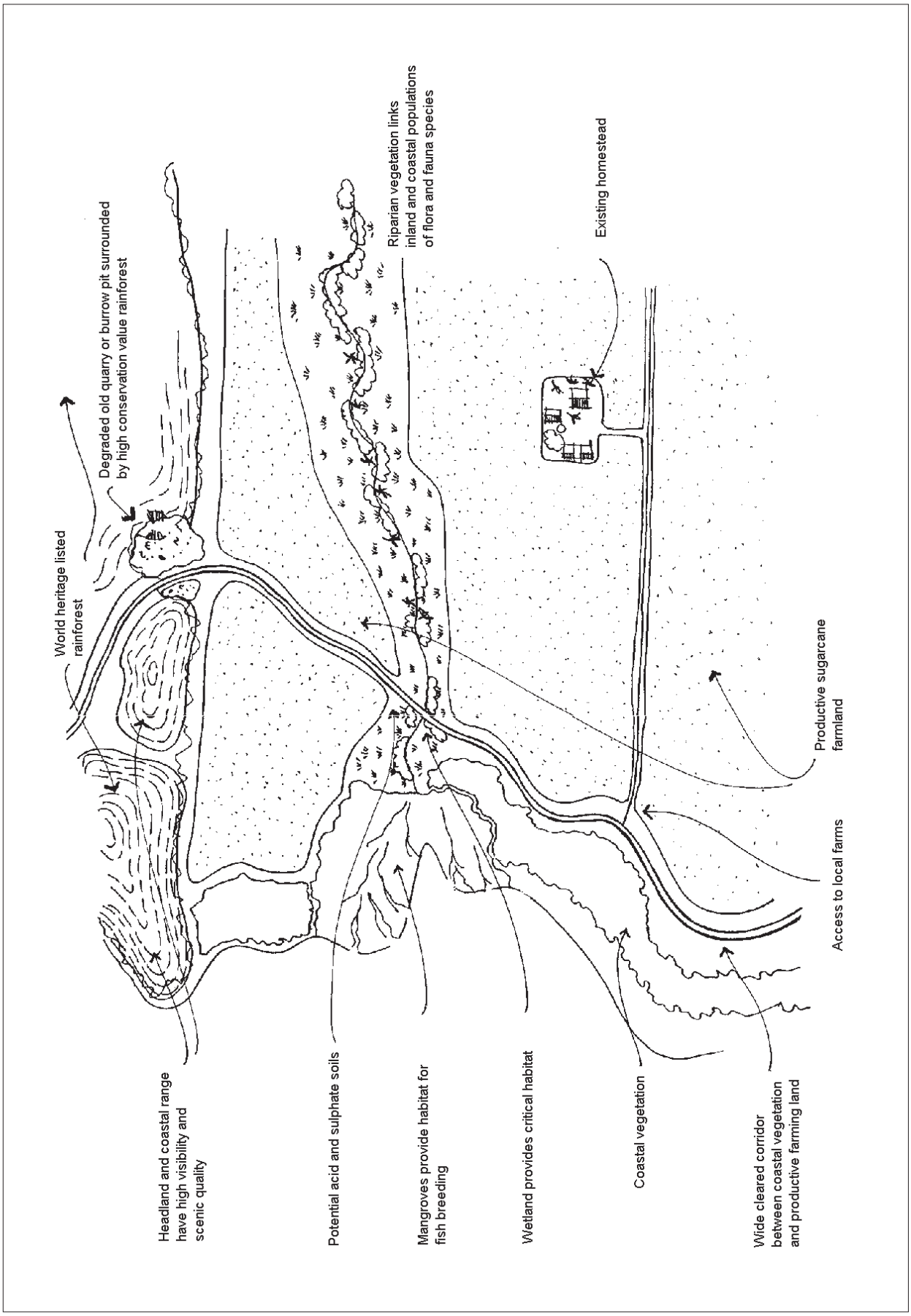


Figure 18 Planning Environmental Elements

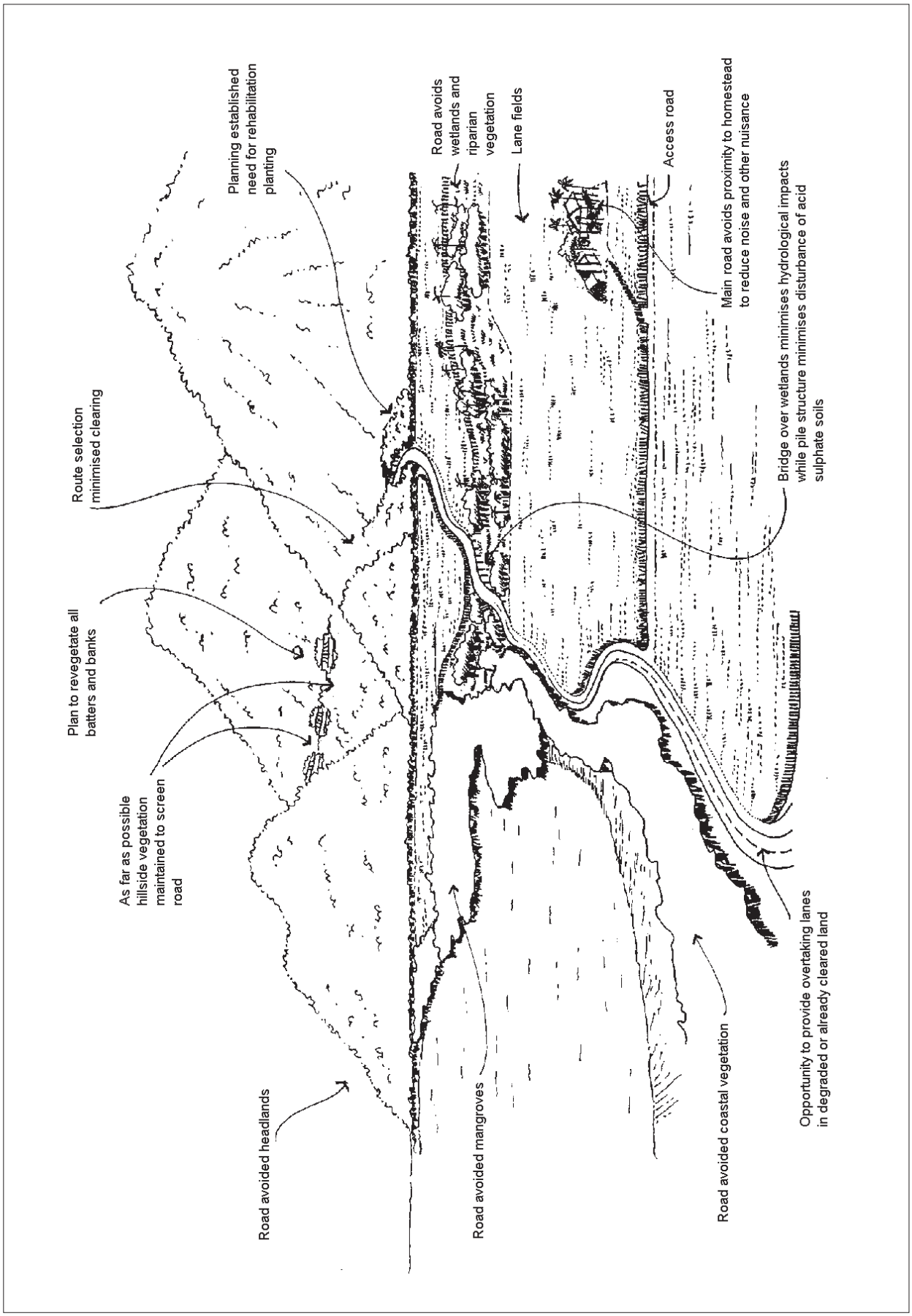


Figure 19 Planning Response to Environmental Elements

Types of Vehicles

The desired outcome is to develop roads to meet the standard required by varying vehicle types whilst also protecting roadside values.

The traffic using a given road will comprise a mix of different vehicles types and each vehicle type has different turning, manoeuvring and performance characteristics. The turning radius of the vehicles should influence intersection designs and curve widening on bends. Slow moving vehicles combined with steep grades may also affect roadway capacity.

D5

Best Practice Guidelines:

From previous studies, strategy reports, traffic counts and local knowledge determine the makeup of vehicles using the existing road. Possible groupings to be considered are:

- tourism and recreational traffic (buses, cars, campervans; and bicycles);
- local traffic;
- commercial traffic (including vehicle types such as B doubles, semi trailers etc.);
- commuter traffic (intercity / interstate);
- forestry or mining or other special use.

The above users will have different needs and expectations for the road and it may not be possible to meet all those expectations. Table 3 “Road Types and Design Vehicles” gives an indication of the types of vehicles which need to be considered for each road type.

Note: Whilst the Table is a guide, planning should ensure that the road design will cater for all vehicles deemed appropriate to use the road. There may be instances where, after considering submissions received during consultation and analysing all factors, some road types catering for certain vehicles are deemed inappropriate. For example, where there are significantly increased environmental impacts in a road meeting the requirements for particular vehicles or where the road is primarily used for one purpose, eg local commuting which is incompatible with other uses (eg. large freight efficient vehicles with wide turning radii).

Speed Environment

The desired outcome is to plan for design speeds which maximise the utility of the road and are consistent with the natural and cultural values of the area.

In assessing the design speed of the road the Austroad Guide to Rural Road Design is generally used. However, in the wet tropics region the roads often traverse steep hilly and winding terrain with large differences in design speed and other design elements along the route.

For Type 1 and 2 roads (see Table 3), the design speed should desirably be as high as possible within the constraints of the environment and allow a consistent speed to be maintained as far as possible.

Best Practice Guidelines:

Ensure that the design speed is appropriate and compatible with the likely speed environment taking into consideration the terrain through which the route passes.

When it is not possible to maintain a high design speed the successive design elements should be gradually reduced to allow drivers to adjust to the new speed environment. Studies on steep grades with

high commercial vehicle numbers indicate that it is desirable to keep changes in design speed between successive elements to less than 7 km/hr. In flatter terrain the curves should have a design speed not more than 10 km/hr to 15 km/hr maximum below the design speed of the straight.

Use Table 4 “Radius of Curves for Design Speed and Terrain” as a guide for determining the appropriate speed environment and horizontal radius of curves. This table includes very tight radii for low design speeds in hilly and mountainous terrain.

Determine design speeds for various road types based on Table 5 “Design Speeds”.

Note: Whilst Tables 4 and 5 are a guide, planning should ensure that the design speed is appropriate for the conditions. Recognising that higher design speeds require larger curve radii and greater clearing of verges, there may be instances in the wet tropics region where there are significantly increased environmental impacts in a road with a higher design speed. The planning process should then reconsider the need to provide for the higher design speed.

Table 3 Road Types and Design Vehicles

Road Type	Vehicle Type							
	Car	Tourist Bus (40 seats)	4 WD Bus (15 seat)	19 m semi trailer	B doubles 25 m	Municipal Garbage Truck	Bicycles	Type 2 Road Trains
1 Major Highway	✓	✓	✓	✓	✓	✓	✓	✓(some areas)
2 Regional Road	✓	✓	✓	✓	✓(If part of B double route)	✓	✓	✓
3 Tourist Road Sealed Unsealed	 ✓ O	 ✓ O	 ✓ ✓	 – –	 – –	 ✓ -	 ✓ O	 – –
4 Local Access Road	✓	O		–	–	✓	✓	–
5 Special Purpose Road	O	O	✓	O	O	O	O	–

✓ Desirable O Optional – Probably not required

Table 4 Radius of Curves for Design Speed and Terrain

Radius	Speed Environment (km/hr) Terrain Type			
	Flat	Undulating	Hilly	Mountain
25-50[1]				25-50
50[1]			60	50
75			75	70
75-300		90	85	80 (Palmerston Highway)
150-500		100	95	
over 300-500	115	110		
over 600-700	120			

* Rural Road Design Guide Austroads 1989
1 Suggested additional curves and speed included for steep mountainous terrain or scenic natural areas.

Table 5 Design Speeds

Road Type	Design Speed (km/hr) Terrain Type		
	Flat	Hilly	Mountain
1 Major highway	100-120	90-100	70-80
2 Regional road	100-110	80-100	40-60
3 Tourist road	80-100	70-90	25-60
4 Local access	80	60-80	25-60
5 Special purpose	To suit user needs		

Safety and Reliability

The desired outcome is to reduce the potential for accidents, injury or death with provision of a safe road environment.

Road safety is a central issue in the planning and design of road corridors. Often road safety issues conflict with other road interests such as the ecological values of areas adjoining road corridors. Ensure all safety values are protected.

Traffic accidents generate major community costs. Road engineering design can help reduce the number of traffic accidents by designing and maintaining roads that:

- provide sight distance appropriate to the speed environment;
- are compatible with the speed environment;
- are designed to discourage drivers from exceeding safe speeds;
- cater for the traffic volumes using the road;
- provide for the various vehicle types using the road;
- provide sufficient widths in terms of providing a clear zone, traffic lanes and clear width to obstructions; and
- provide for safe entrances and exits at intersections and accesses.

Best Practice Guidelines:

Provide clear widths or recovery zones dependent on the volumes and traffic speeds.

Alternatively consideration may be given to providing guard rails to protect drivers from roadside hazards (such as rainforest trees forming a closed canopy or other significant environmental values).

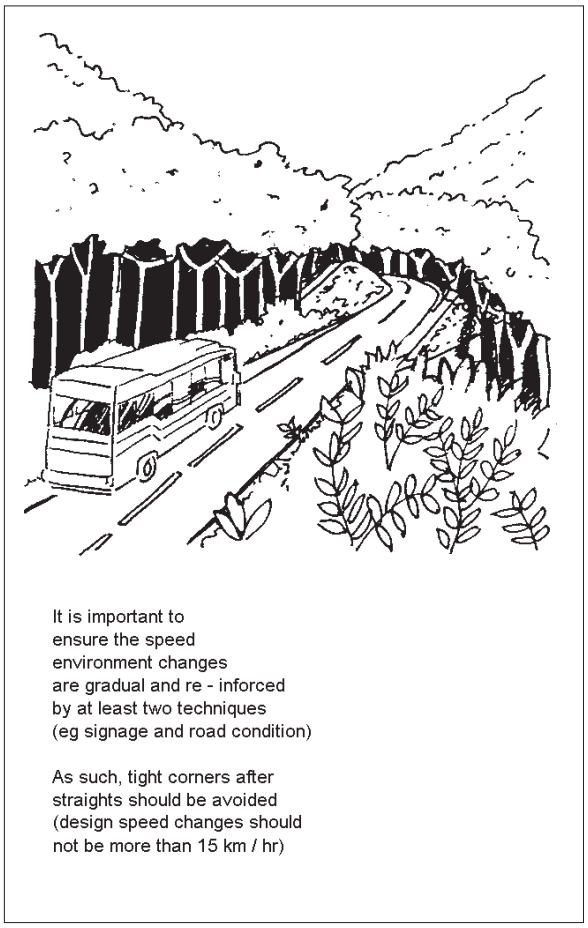


Figure 20 Speed Environment

Alternatively consideration may be given to providing guard rails to protect drivers from roadside hazards (such as rainforest trees forming a closed canopy or other significant environmental values).

Provide safe entrances and exits to presentation sites by developing intersection treatments compatible with the design speed, volume of type of traffic and the scenic qualities of the site.

Increase broad community awareness of the range of safety issues via roadside information and awareness programs and by utilising organisations such as the RACQ and schools to disseminate safety information to the community.

Align roads to maintain safe distances (or sufficient protection such as guardrails, Brifen wire fences or berms) from vegetation with trunk diameter greater than 75 mm.

Where possible separate roads from pedestrian and bicycle paths to improve road safety and enhance the experience for pedestrians and cyclists.

Design road corridors to provide and maintain a high level of driver awareness through use of signage and rest opportunities.

Provide clear and consistent signage (both safety and direction/orientation) on all roads, particularly on scenic routes as visiting drivers are usually unfamiliar with roads. Consider utilising internationally recognised symbols on important tourist routes.

D5

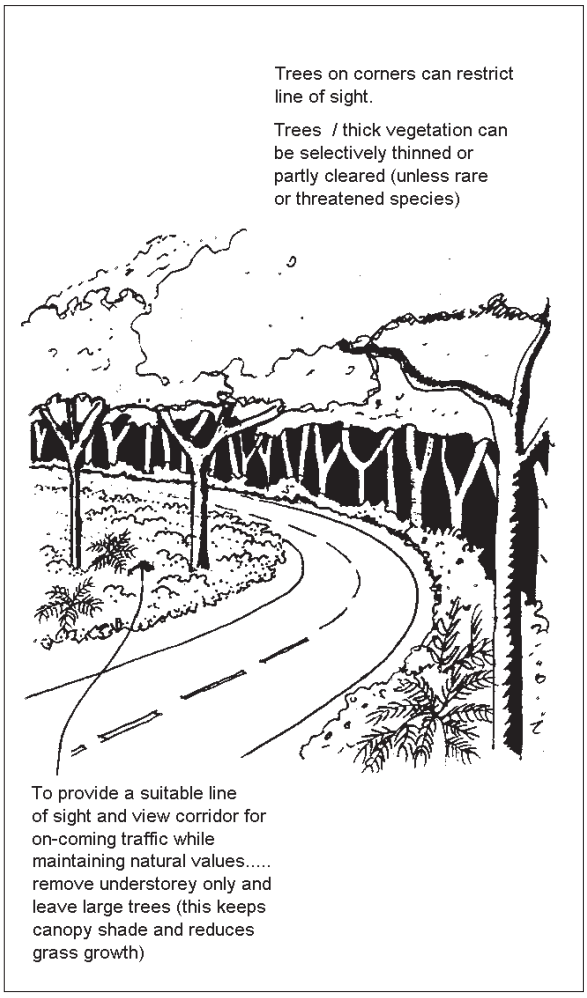


Figure 21 Providing Line of Sight

Design Traffic Volume

The desired outcome is to avoid incremental upgrading by planning for predicted future traffic demands.

The amount of traffic using the road will influence the widths of roads, pavement depths and to some extent the need for capacity improvements such as overtaking lanes and intersection improvements.

Generally, roads are designed for the design (predicted) traffic volume at a point, sometimes 20 years after construction. For some urban roads design periods of 25 years are adopted. Most roads in the wet tropics region are rural roads and a design traffic volume of 20 years hence would be acceptable.

Planning needs to consider the ultimate design standard of the road as incremental upgrading often results in a road which has greater environmental impacts and is poorer in road engineering terms (eg. a road upgraded to three lanes, then four lanes as traffic increases as opposed to split dual carriageways).

With all roadworks planning it is necessary to assess the future traffic volume. Vehicular traffic will often comprise a mixture of freight, inter-regional movements as well as local access movements and tourists. Most road planning addresses the need to upgrade existing roads, as such the existing traffic volume gives a good basis for predicting future requirements. Similarly, for new roads the changed traffic volume on other roads in the regional network, as a result of the new road must be considered.

Best Practice Guidelines:

Avoid incremental upgrading of a road by ensuring planning considers traffic volume 20 years after opening.

Ensure that planning takes into account any major developments that are proposed that may influence future traffic figures such as new tourism development or urban expansion.

Consider redirecting demand for some uses if there will be (are) major conflicts between use types.

Investigate likely future urban growth patterns or alternative transport mechanisms (eg. rail) to ascertain if this will influence volumes.

Horizontal and Vertical Alignment

The desired outcome is to have road alignments which are compatible with the terrain.

The horizontal alignment able to be adopted will be largely dependent on the terrain, the desired design speed and the type of road being designed.

The horizontal radii adopted will be influenced by the design speed and the maximum super-elevation allowable.

The Guide to the Geometric Design of Rural Roads by Austroads provides the design framework.

Best Practice Guidelines:

In the mountains and ranges of the wet tropics region the use of maximum super-elevation for dangerous or steep grades may need to be considered where the radius of the curve is approaching the minimum for the speed environment.

The combination of vertical and horizontal alignment needs to address the following:

- minimise the extent of earthworks; and
- in scenic areas avoid long flat straights which promote high speeds especially between sections of restricted horizontal and vertical alignment.

The maximum super-elevation permitted will depend on the vehicles using the road with large trucks limiting super-elevation to 7% with an absolute maximum of 10%. The vehicles using the road will therefore influence the minimum radius that can be adopted.

The horizontal and vertical alignment should be coordinated where possible to provide a safe and visually appropriate alignment.

For scenic/tourist type roads coordinating the vertical/horizontal curves can produce a curvilinear alignment which is well suited to providing an interesting route compatible with the landscape. However, providing a curvilinear alignment may restrict overtaking opportunities.

If a curvilinear alignment is adopted for the major routes, then consideration may need to be given to providing:

- overtaking lanes; or
- providing split carriageways;

in areas of lesser natural and scenic quality.

Road Widths

The desired outcome is road widths which meet minimum road engineering requirements whilst minimising the impacts of the clearing through natural areas.

Provision needs to be made for carriageway widening on curves for larger vehicles. Adopting the minimum radius curves in a steep terrain may result in the need to provide extensive widening for B doubles and for sight distance. For instance on a 50 m

radius curve a B double would require the traffic lane to be widened to 6 m.

A verge width may also need to be allowed to provide for guard rail, verge drains and verge berms on fill.

Providing separate dual carriageways will spread the traffic and increase the gaps in the traffic stream increasing the chances of animals being able to safely cross. Separating carriageways with forested medians also permits faunal refuge.

For other roads the minimum widths should generally be adopted consistent with the type and volume of traffic.

D5

Best Practice Guidelines:

The width of the road should generally be based on the traffic volume, the type of road being designed, the speed of the traffic and the likely environmental impacts.

Typical design widths are outlined in Table 6. The single most important way to minimise impacts of roads through the tropical rainforest in the wet tropics region is the reduction of clearing width and the achievement of canopy closure for as much of the road length as possible. Planning should therefore identify mechanisms to reduce clearing width as far as possible (such as use of barriers rather than relying on clearing for the necessary recovery width).

On scenic (tourist) 4WD roads or in World Heritage Areas where one lane is desirable (taking into account safety considerations), width can be reduced by providing drainage on one side only (crown shape with drainage each side).

For higher traffic volume roads an assessment should be made of the impacts of providing two separated carriageways where key fauna species cross the road. Consider split carriageways for higher traffic volumes in preference to four lanes undivided.

Grades

The desired outcome is for grades to match the function of the road, the terrain and to minimise earthworks and the total area of natural habitats disturbed.

The grades that can be adopted will vary with the design speed, type of vehicles and traffic volumes.

Adopting maximum grades will affect the performance of large heavy vehicles. For moderate to heavy traffic volumes the slow vehicles will significantly reduce road capacity and require the provision of overtaking lanes or possible duplication. On lower volume roads combined with low volumes of heavy vehicles the adoption of maximum grades is less of a concern.

Generally, the grades used should be in accordance with the "Guide to the Geometric Design of Rural Roads" - Austroads 1989. Table 7 provides some typical maximum grades (as percent slope) for various design speeds.

Best Practice Guidelines:

The maximum grades should be avoided if possible.

For unsealed roads avoid grades steeper than 10% or seal the road to reduce erosion.

Road Cross Section

The desired outcome is to provide a road cross section which meets traffic engineering requirements and minimises disturbance and clearing of natural vegetation.

The typical cross-section adopted for the road corridor will impact on the environment

Table 6 Generalised Design Widths

Design Traffic Volume Vehicles Per Day (VPD)	Traffic Lane Width (m)	No. of Lanes (m)	Shoulder[2] (m)	Formation (m)
0-50	4.0	1	1.5	7
0+150	3.01	1 or 2	0.6	7.2
150-500	3.0	2	0.6-1.5	7.2-9
500-100	3.0-3.5	2	1.0-2.0	8-11
over 1000	3.5	2	1.0-3.0	9-13

[1] Could consider a single lane of 4.0 m with shoulders of 1.5-2.5 m.
[2] If shoulders are to cater for bike riders then a minimum of 2 m is required.

Table 7 Grades

Design Speed	Terrain Flat	Mountainous
60	4-7%	9-10%
80	4-6%	7-9%
100	3-5%	6-8%

From Table 8 - Guide in Geometric Design of Rural Roads - Austroads 1989

in a variety of ways. The typical cross-section may need to be varied along a route to minimise a particular impact. Generally, for two lane roads the minimal clearing widths will produce the least impact.

A four lane undivided facility produces a wide expanse of bitumen that makes canopy connectivity impossible.

Where the capacity requirements require additional lanes consideration should be given to providing a split dual carriageway. A split dual carriageway which enables retention of natural vegetation in a relatively wide median may provide greater opportunity for canopy connectivity. In addition fauna crossing the road only has to contend with traffic from one direction over a shorter distance (although two crossings will be required).

Whilst the split dual carriageway may have the above advantages the cross section of roads through natural habitat will need to be determined based on the conservation values requiring protection.

On local access tourist roads two single lanes separated by a wider median may also have less impact than the two lane road.

Importantly, the overall width of the disturbed road corridor is an issue requiring consideration, generally minimising the overall width from cleared forest edge to cleared forest edge will have a consequent reduction in impact.

In addition to clearing width, selection of cross sections should consider the potential impacts of side cuts and batters, as in some circumstance they become fauna barriers, in effect impassable cliffs.

Best Practice Guidelines:

Table 8 provides some of the advantages and disadvantages of the different cross section types and suggests areas where they may be used.

It is important to note that best practice will involve the consideration of these different cross sections over relatively short sections. As an example, for environmental reasons divided carriageway may only need to be over a short distance to maintain connectivity of a particular habitat (eg. a riparian gallery rainforest, or a steeper gully).

Table 8 Cross Section Suitability

Cross Section Type and Suitability	Advantages	Disadvantages
Unsealed road	Cheaper construction costs. Suitable for low volume roads with moderate grades. In some circumstances provides presentation opportunity and "character".	As traffic volumes increase, maintenance costs increase significantly along with erosion and sedimentation. Steep grades more readily eroded and may require sealing. May need to close to traffic during the wet season.
Single lane sealed road two way Suitable for low volume roads.	Requires minimum width of disturbance. Cheaper solution than a 2 lane sealed road. If in closed forest and narrow clearing, may enable canopy connectivity to be maintained.	Requires widening at crests and curves for safety. Unsuitable for high volume roads. Unsealed verges may erode.
Two lane carriageway, each way separated by a wide median Suitable for low volume roads especially access roads and tourist roads. Note: this option has not been used in the wet tropics region, most likely application is for short distances to meet specific environmental requirements.	Requires minimum width for clearing. Enables canopy connectivity to be maintained. Enables refuge area within the median for animals (whilst crossing). In steep sidelong country this design will better match the terrain with less height to cuts and fills.	May be a safety concern with wrong way movements. Need to provide areas for passing disabled/parked cars (only on uphill side). With long lengths and medium traffic volumes overtaking opportunities may need to be provided.
Two lane, two way road This is the normal road cross section for rural roads and is likely to be the usual solution in most cases.	Provide for some canopy connectivity if minimum widths adopted. Generally less total width of disturbance than two single carriageways. Cheaper to construct than two single lane carriageways.	For higher volume roads may require passing lanes. As widths increase with traffic volumes canopy connectivity will be more difficult to maintain. Less gaps in the traffic stream than a divided carriageway.
Four lane undivided Suitable in less sensitive environmental/scenic areas and where fauna crossings are not an issue.	Provides a cheap alternative to increasing traffic capacity and level of service on medium to high volume roads. Provides opportunities to overtake slower moving vehicles safely. Whilst not necessarily the key aspect to minimising environmental impact, the total width of clearing is less than divided and there are only two forest edges (with edge effect impacts)	As traffic volumes increase head on collisions may become an issue. Requires a wide construction width making canopy connectivity impossible. On tourism routes concerns have been expressed that the widths are not compatible with providing a scenic drive. The large widths tend to dominate the landscape.

Table 8 Cross Section Suitability

Cross Section Type and Suitability	Advantages	Disadvantages
Four lane divided narrow median (New Jersey barrier) May be an option where increased capacity and safety is required on steep hilly sections and the terrain precludes construction of a second carriageway.	Provides high capacity and overtaking opportunities. Provides increased safety and eliminates head on collisions.	Likely to be more expensive than a four lane undivided facility. New Jersey barrier will prevent fauna crossings across the road although if traffic volumes require a four lane facility it is unlikely that sufficient gaps in the traffic stream will occur to enable animals to cross safely.
Four lane divided wide median May be the preferred solution in environmentally sensitive areas where the median is forested.	Breaks the total width into two parts enabling some canopy connectivity to be maintained. Breaks the traffic stream into two streams producing larger gaps for fauna to cross, however grade separated fauna crossings are the preferred solution. In steep sidelong country this will better match the terrain. Provides safer overtaking opportunities. Prevents head on collisions.	May have a higher construction cost than a four lane undivided facility. Total width of disturbance likely to be greater.

Level of Service

The desired outcome is for the level of service provided by roads to meet traffic engineering requirements and be consistent with the conservation significance of natural areas traversed.

The level of service of a road is an indication of whether a road is reaching capacity. Under heavy traffic volumes resulting in slow driving conditions with numerous delays a road would be providing a poor or low level of service. In rural areas level of service often suffers as a road enters a winding hilly section with limited overtaking opportunities especially combined with slow moving vehicles (eg., loaded trucks). However, short bottlenecks are not as major a consideration as a road with a low category of service along its length.

Again if the vehicles are being slowed through a scenic area the tourist component of the traffic stream may enjoy the slower pace. However, regional freight transport drivers are often on tight daily schedules and may be frustrated by delays.

One way of increasing the level of service is to provide overtaking opportunities.

Table 9 shows the recommended traffic volumes to be used as a guide for the consideration of overtaking lanes.

The above table shows that with restricted overtaking opportunities traffic volumes over 1 000 vehicles per day (VPD) may require overtaking lanes.

For traffic volumes less than 1 000 VPD and in flat, straight areas the volumes could be as

high as 5 000 before level of service becomes an issue.

Best Practice Guidelines:

Provide a consistent level of service appropriate to the road users. In hilly terrain at volumes above 1 000 VPD consider overtaking lanes.

In flatter areas consideration may not need to be given to providing overtaking lanes after traffic volumes reach 4 000 to 5 000 VPD.

D5

Design Life

The desired outcome is for roads to be developed in order to minimise the need for additional construction disturbance in the short and medium term.

The design of roads typically involves predicting traffic flows 20 years into the future. It is desirable that any earthworks within the wet tropics region are undertaken to cater for the traffic volume over the next 20 years so that disturbance of the vegetation along the road corridor is only undertaken once within a 20 year time frame.

Most roads are designed with a pavement life of 20 to 25 years. The road surfacing treatment is, however, undertaken on a more frequent basis with sealing or asphalt surfacing every 7 to 15 years. As these surfacing operations will not involve earthworks or widening but simple surface treatments that can be undertaken with minimal impact.

For gravel roads the pavement surfacing is designed for a shorter timeframe. The actual period that a gravel pavement will last before re-sheeting depends on a number of factors including the type of material, traffic volumes, gradient, climate etc. These resheeting operations involve significant earthworks, including disturbance of road shoulders and table drains.

Best Practice Guidelines:

Undertake earthworks to cater for the ultimate development of the road and for a design life of 20 years minimum (sealed roads).

Table 9 Overtaking Lane Requirements

Overtaking Opportunities Over Preceding 5 km		Current Year and Design Volume Average Annual Daily Traffic (AADT)		
Description	Percent Length Providing Overtaking	Percent of Slow Vehicles 5	10	20
Excellent	70-100	5 670	5 000	4 330
Good	30-70	4 330	3 670	3 330
Very Restricted	0-30	930	800	670

From Table 9.1 Guide to Rural Road Design Austroads.